Our Affiliates

EBS PILOT SHOP
Pilot/ Aeronautical Engineering Books, Gifts & Music
17-L, Connaught Circus,
New Delhi - 110 001
Tel.: 011-2341-7126, 2341-7936, 2341-5031 Fax: 2341-7731
Email : ebspilotshop@gmail.com

EBS AVIATION TRAINING CENTRE
Pilot & Aeronautical Maintenance Engineering Training
D-16, Ist Floor, (near Odeon, above Bata)
Connaught Place, New Delhi - 110 001 (INDIA)
Tel.: (011) 4151-7617, 4151-7618, 4151-7619 Fax: 4151-7620
Email : ebsatc@airtelmail.in
Website : www.ebsaviationt rainingcentre.com

Distributed by
THE ENGLISH BOOK STORE
17-L, Connaught Circus,
New Delhi - 110 001
Tel.: 011-2341-7126, 2341-7936, 2341-5031 Fax: 2341-7731
Email : info@englishbookstore.net
Website : www.englishbookstore.net

ISBN [illegible]

Rs. 950

1000 QUESTIONS

ANSWERS AND EXPLANATIONS FOR

JAR ATPL(A) AND CPL(A)

GENERAL NAVIGATION

KEITH WILLIAMS

© Keith williams, 2005
Reprint, 2010
All rights reserved. No part of this publication may be reproduced, stored in any form of retrieval system, nor transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the author. This publication shall not, by way of trade or otherwise, be lent, resold, hired out or otherwise circulated without the prior permission of the author.
The information contained in this publication is for private study purposes only. Whilst every effort has been made to ensure its accuracy and validity, no responsibility is accepted for errors or discrepancies.

Printed at
Thakur Enterprises

ISBN 81-7002-092-1

A Himalayan Books Presentation
First Published in 2005 by Himalayan Books, New Delhi 110013

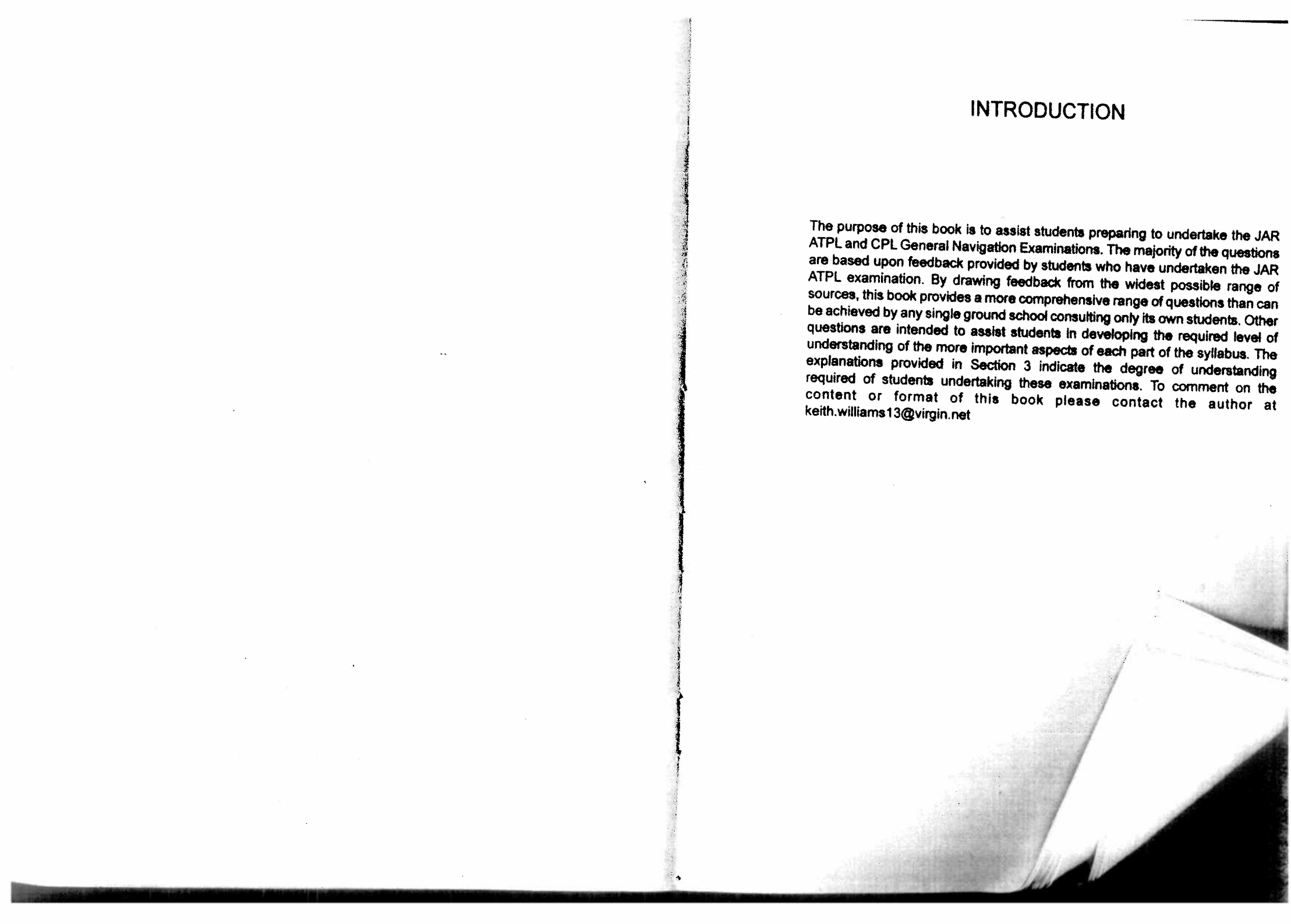
Distributed by
The English Book Store
17-L, Connaught Circus, New Delhi - 110001
Tel.: (011) 2341-7126, 2341-7936, 2341-5031
Fax: 091-11-2341-7731
E-mail : info@englishbookstore.net
Website : www.englishbookstore.net

CONTENTS

Section 1	Key facts and commonly used equations.	5 - 29
Section 2	Questions.	31 - 242
Section 3	Answers and explanations.	243 - 695

INTRODUCTION

The purpose of this book is to assist students preparing to undertake the JAR ATPL and CPL General Navigation Examinations. The majority of the questions are based upon feedback provided by students who have undertaken the JAR ATPL examination. By drawing feedback from the widest possible range of sources, this book provides a more comprehensive range of questions than can be achieved by any single ground school consulting only its own students. Other questions are intended to assist students in developing the required level of understanding of the more important aspects of each part of the syllabus. The explanations provided in Section 3 indicate the degree of understanding required of students undertaking these examinations. To comment on the content or format of this book please contact the author at keith.williams13@virgin.net



SECTION 1

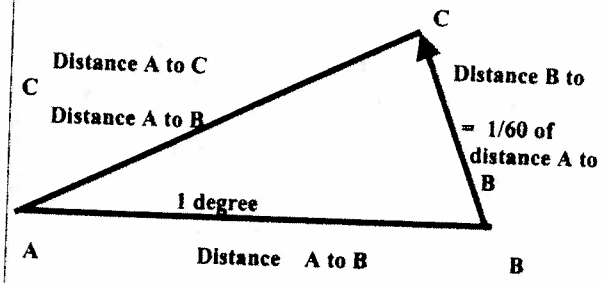
KEY FACTS AND COMMONLY USED EQUATIONS

Subject	Pages		
Departure, Convergency, Conversion Angle.	7	to	7
Scale, Distance & Velocity.	8	to	8
One in Sixty Rule.	9	to	9
Climb Gradient, PNR, PSR, Critical Point.	10	to	11
Speed Time Distance, LSS, Mach Number.	11	to	11
Density altitude, ISA, Time.	12	to	13
Gyroscopes.	13	to	14
Ring Laser Gyros, INS, IRS, FMS.	14	to	15
The Erath's Magnetic Field.	15	to	16
Magnetic Compasses.	16	to	17
Mercator Projections.	18	to	18
Lambert's Conical Projections.	19	to	19
Polar Stereographic Projections.	20	to	20
Transvers Mercator Projections.	21	to	21
Oblique Or Skew Mercator Projections.	22	to	22
Standard Chart Symbols.	23	to	23
Extracts From The Air Almanac.	24	to	29

KEY FACTS

Departure	**The term "Departure" refers to the distance between two meridians along a specified parallel of latitude. It is usually expressed in nautical miles.** **Departure is greatest at the equator and decreases as the parallels converge with increasing latitude. This means that the earth distance equating to any given change in longitude depends upon the latitude at which the distance is measured.** **1 degree of longitude = 60 nm at the equator only.** **1 minute of longitude = 1 nm at the equator only.** **At all other latitudes the distance between any two parallels of longitude can be calculated using the departure equation:** **Departure in nm = Change in longitude in minutes x cosine of latitude.**
Earth Convergence	**The term "earth convergence" refers to the fact that the distance between any two lines of longitude is a maximum at the equator and decreases with increasing latitude.** **Earth convergence = Change in Longitude x sin of mean latitude**
Earth Conversion Angle	**The Earth conversion angle is the difference between the great circle direction and the rhumb line track between two points.** **Earth conversion angle = ½ earth convergence** **Earth conversion angle = ½ change in longitude x sin of mean latitude**
Lambert's Convergency	**The convergency on a Lambert's chart can be calculated using the following formulae:** **Lambert's Convergency = change in longitude = sin of parallel of origin** **Lambert's Convergency = change in longitude = constant of the cone of the chart** **Lambert's Convergency = change in longitude = convergence factor**

Chart Scale	The term "chart scale" refers to the ratio of the distance on a chart compared with that on the earth. Chart scale = Chart Distance / Earth distance
Distance Conversion Factors	1 nautical mile or nm = 1.852 km. So the distance in nm x 1.852 = distance in km. 1 nautical mile or nm = 1852 metres. So the distance in nm x 1852 = distance in metres. 1 nautical mile or nm = 6080 feet. So the distance in nm x 6080 = distance in feet 1 statute mile or sm = 5280 feet. So the distance in nm x 5280 = distance in feet The distance between any two parallels of latitude is constant at all points on the earth. 1 degree of latitude = 60 nm. 1 minute of latitude = 1 nm. The distance between any two parallels of longitude varies with latitude. This distance can be calculated using the departure equation above.
Velocity Conversion Factors	1 knot or kt = 1 nautical mile per hour. 1 kt = approximately 101.333 feet per minute. Speed in kt x 101.333 = speed in ft/min. 1 kt = approximately 1.689 metres per second. Speed in kt x 1.689 = speed in ft/sec. 1 kt = 30.867 metres per minute. Speed in kt x 30.867 = speed in m/min 1 kt = approximately 0.514 metres per second. Speed in kt x 0.514 = speed in m/sec.

	1 statute mile per hour or mph = 5280 feet per hour. Speed in mph x 5280 = speed in ft/h. 1 mph = 88 feet per minute. Speed in mph x 88 = speed in ft/min. 1 mph = 1.467 ft/sec. Speed in mph x 1.467 = speed in ft/sec.
One in sixty Rule	The one in 60 rule is derived from the fact that one radian is the angle produced when a point on a circle moves a distance of 1 radius around the circle. The total circumference of a circle is 2π x the radius. Each radius is equal to one radian, so the total angle is 2π radians. A complete circle is 360 degrees, so dividing this by 2π gives: 1 radian = 360 / 2π = 57.3 or approximately 60 degrees. This means that an angle of 1 degree is approximately 1/60 of a radian, so the distance between two points that are 1 degree apart is approximately 1/60th of the range to those points as illustrated below.  To calculate the distance that an aircraft moves off the desired track use: Off track distance = range flown x drift angle / 60. To calculate the height that an aircraft gains or loses over a given ground distance use: Height change = ground distance x climb/descent angle x 1/60

	To calculate the vertical speed of an aircraft given the ground speed and climb or descent angle use: Vertical speed = ground speed x climb/descent angle / 60. in kts in kts in degrees
Climb Angles, % Gradients, Vertical Speeds, Distance & Time to Climb.	Time to climb in sec = $\frac{\text{height difference x 60}}{\text{Rate of climb}}$ Distance Taken to Climb in nm = $\frac{\text{Height difference (ft) x Groundspeed (kt)}}{\text{Rate of climb} \quad 60}$ Still air % Gradient = $\frac{\text{ROC (ft/min) x 6000}}{\text{TAS (kts) x 6080}}$
Point Of No Return (PNR) & Point Of Safe Return (PSR).	PNR and PSR mean the same thing. The time to the PNR or PSR can be calculated using the formula: Time to PNR or PSR = $\frac{E \times H}{O + H}$ Where: E = Endurance. H = Homebound groundspeed. O = Outbound groundspeed. To calculate the distance to the PNR or PSR use the above formula to calculate the time to the PNR or PSR, then multiply this by the outbound groundspeed. Distance to PNR or PSR = $\frac{E \times H \times O}{O + H}$ To calculate the distance to PNR or PSR for any given fuel flow rate, use the following formula: Distance PNR or PSR = $\frac{\text{Total fuel quantity available}}{\frac{\text{Outbound fuel flow}}{O} + \frac{\text{Homebound fuel flow}}{H}}$
Critical Point	The Critical Point between the place of departure and destination, is the point at which the time taken to return to the place of departure is equal to the time taken to continue to the destination. The distance to the critical point can be calculated using the formula: Distance to critical point = (D x H) / (O + H)

	Where: D = Distance between departure and destination. O = Onbound groundspeed, beyond the critical point. H = Homebound groundspeed used when returning from the critical point back to the departure point. The groundspeed used must take into account the effects of an engine failure either on the onward or return leg of the flight. The time to the critical point can be calculated using the formula: Time to CP = Distance to CP / Outbound groundspeed
Speed Time & Distance.	Distance = Speed x Time. Time = Distance / speed. Speed = Distance / Time.
Local Speed Of Sound LSS.	The Local Speed Of Sound is the speed at which pressure waves move through the air. It is determined by the absolute temperature of the air and can be calculated using the formula: LSS (in kts) = 38.94 $\sqrt{}$AbsoluteTemperature. Where the absolute temperature = temperature in degrees Centigrade + 273. At mean sea level in the ISA for example where the outside air temperature is approximately 15°C, the LSS is: LSS at ISA msl = 38.94$\sqrt{}$(15 + 273) = 660.8 kts As altitude increases up to the tropopause in the ISA, the temperature and LSS gradually decrease. Above the tropopause up to 54000 ft pressure altitude, both temperature and LSS remain constant.
Mach Number.	Mach number is the TAS of an aircraft expressed as a fraction of the local speed of sound. So Mach 1 means that the TAS is equal to the Local Speed of Sound. Mach number = TAS / LSS

Calculating Density Altitude.	**The Density altitude is the pressure altitude corrected for deviation from ISA temperature. It can be calculated using the formula:** **Density altitude = Pressure Altitude + (120 x ISA deviation)** **Always use the above formulae to calculate Density Altitude in JAR examinations because it is more accurate than any analogue navigation calculator.**
Calculating ISA Temperature & ISA Deviation.	**To calculate the ISA temperature in the troposphere (below the tropopause) use the formula:** **ISA temperature = 15°C – (pressure altitude / 500)** **Or** **ISA temperature = 15°C – 2 degrees per 1000 ft above msl.** **For example at 10000 ft amsl:** **ISA temperature = 15°C – (2 x 10) = -5°C.** **ISA Deviation = Actual Temperature – ISA Temperature** **For example if temperature is $+10^{\circ}$C at 1000 ft amsl:** **ISA deviation = $+10^{\circ}$C – (-5°C) = $+15^{\circ}$C.**
Time.	**When the Sun crosses a particular meridian the Local Mean Time or LMT at all points on that meridian is noon. Local mean time at any point on the Earth, is therefore the time as indicated by the position of the Sun relative to the meridian on which the point is located.** **LMT changes by 1 hour for each 15° change in longitude.** **So the difference between LMT at any point and LMT at Greenwich (Greenwich mean time or GMT) is equal to:** **LMT change in hours = $\frac{\text{Change in longitude (via Greenwich)}}{15^{\circ}}$** **Moving East the clocks move forwards (time increases). Moving West the clocks move backwards (time decreases).** **This is sometimes stated as:** **Longitude East, LMT is least (less advanced).** **Longitude West, LMT is best (more advanced).**

	If change is LMT is more than 24 hours, subtract 24 hours and increase date by one day to the date. **If change in LMT is less than zero, add 24 hours and subtract one day from the date.**
Gyroscopes.	**Employ a spinning mass to create properties of rigidity and precession.** **RIGIDITY The tendency of the spin axis to remain aligned with one point in space.** **PRECESSION Any externally applied force tending to change the alignment of the spin axis, acts not at its point of application but at a point 90 degrees later in the direction of rotation.** **Degrees of freedom do not include spin, and are equal to the number of gimbals.** **RATE GYRO Has only one gimbal and one degree of freedom. Senses rate of change of orientation of its spin axis, rather than the degree of change. Used in a turn and slip indicator.** **RATE INTEGRATING GYRO A special form of rate gyro used in INS and IRS systems. Integrates accelerations once to calculate velocities and a second time to calculate displacements.** **DRIFT is when spin axis shifts in the horizontal plane.** **TOPPLE is when the spin axis shifts in the vertical plane.** **WANDER is any change vertical or horizontal in the direction of the spin axis. Wander is the vector sum of drift and topple.** **REAL WANDER When the spin axis shifts relative to space. It is caused by mechanical imperfections, including imbalances and friction.** **APPARENT WANDER When the spin axis appears to shift relative to any given point on the earth but does not shift relative to space. Made up of earth rate drift and transport wander.** **EARTH RATE DRIFT It is caused by rotation of the earth.**

	Earth rate drift in degrees per hour = 15^0 x the sine of the latitude. **EARTH RATE TOPPLE It is caused by rotation of the earth.** **Earth rate topple in degrees per hour = 15^0 x the cosine of the latitude.** **DRIFT DUE TO DGI TRANSPORT WANDER** **TW drift rate in degrees per hour = (East West component of groundspeed (in Kts) x Tan of latitude) / 60** **Where westerly ground speeds are negative.** **LATITUDE NUT is fitted to DGIs to compensate for earth rate drift.**
Ring Laser Gyroscopes.	**Sense angular accelerations and velocities by measuring changes in the resonant frequency of two beams of laser light.** **Do not have any rotating parts, so they do not require any spin-up time and have longer service lives than conventional gyros.** **They suffer from laser lock, which reduces their ability to sense small movements.** **Laser lock is prevented or overcome by a dither motor, which vibrates the entire gyro unit.** **Laser gyros are used in modern strapped down IRS platforms.**
INS, IRS & FMS.	**Inertial systems use three accelerometers set at 90 degrees to each other to form a trihedron to sense vertical lateral and longitudinal accelerations.** **Three gyros arranged in a similar manner detect angular accelerations.** **FMS systems coupled to autopilots fly great circle routes.** **INS systems use conventional gyros and stabilised platforms, which must be physically aligned with true north and earth horizontal before flight.** **IRS systems use ring laser gyros and strapped down system, which do not need to be physically aligned with true north or earth horizontal before flight. The**

	alignment process in IRS is done mathematically instead of physically aligning the platform **The IRS alignment process involves the computer calculation the orientation of the trihedron or platform relative to true north and earth horizontal.** **IRS and INS cannot be realigned in the air following a shut down or power loss. But IRS can still give attitude information for the remainder of the flight.** **Both IRS and INS suffer from Schuler errors due to their pendulum effect, and corriolis effects because of earth rotation.** **The schuler period is 84.4 minutes and the greatest errors occur at 21.1 and 63.3 minutes. The errors are zero at 42.2 and 84.4 minutes.**
The Earth's Magnetic Field.	**Is produced by the magnetic materials in the core of the Earth.** **The North pole of the Earth is the equivalent of the South (Blue) Pole of a magnet.** **Lines of magnetic force or flux flow out of the Magnetic south pole and into the Magnetic North Pole.** **The magnetic and geographic poles are not exactly aligned.** **The difference between magnetic north and geographic north is called the Magnetic Variation and changes gradually with the passing of time.** **VARIATION is the angle between True North and Magnetic North.** **Variation East means that Magnetic North is to the east of True North.** **Variation West means that Magnetic North is to the west of True North.** **When converting from magnetic to true use the reminders below:** **VARIATION WEST MAGNETIC IS BEST This means that if the variation is west then the magnetic heading is greater than the true heading.**

	VARIATION EAST MAGNETIC IS LEAST This means that if the variation is east then the magnetic heading is less than the true heading. **ISOGONAL LINES are lines of constant variation on charts and are marked as pecked (or dashed) lines.** **AGONIC LINES are lines on charts joining points of zero variation.** **The positions of the Magnetic North and South Poles varies gradually with the passing of time.** **The lines of magnetic force are horizontal at the magnetic equator and dip downwards as the approach the poles.** **This dipping of the lines of magnetic force is called dip and is 90° at the Magnetic Poles and zero at the Magnetic Equator.** **ISOCLINALS are lines on charts joining point of equal magnetic dip.** **ACLINIC LINES are lines on charts joining points of zero dip.** **The dipping of the lines of magnetic force reduces the accuracy of magnetic compasses. So such compasses are most accurate at the Magnetic equator and least accurate at the magnetic Poles.**
Magnetic Compasses.	**Use a magnetic needle, which aligns itself with the lines of force of the Earth's magnetic field.** **Are most accurate at the equator where the lines of force are horizontal and least accurate at the magnetic poles where the lines of force dip vertically into the Earth.** **DEVIATION is the angle between the local magnetic meridian and the direction in which the compass magnets are aligned.** **Deviation is East or + when the red end of the compass magnet points to the East of magnetic north.** **Deviation is West or - when the red end of the compass magnet points to the West of magnetic north.**

	When applying deviation use the following reminders: **DEVIATION WEST COMPASS IS BEST This means that if the deviation is west then the compass heading is greater than the true heading.** **DEVIATION EAST COMPASS IS LEAST This means that if the deviation is east then the compass heading is less than the true heading.** **Damping wires and short magnets to damp out oscillations making the compass aperiodic or dead-beat.** **Pendulous suspension systems are used to minimise the effect of the dipping of the lines of magnetic force.** **Suffer from errors when accelerating on East-West headings, except at the magnetic equator.** **Suffer from turning errors when turning through North-South headings.**

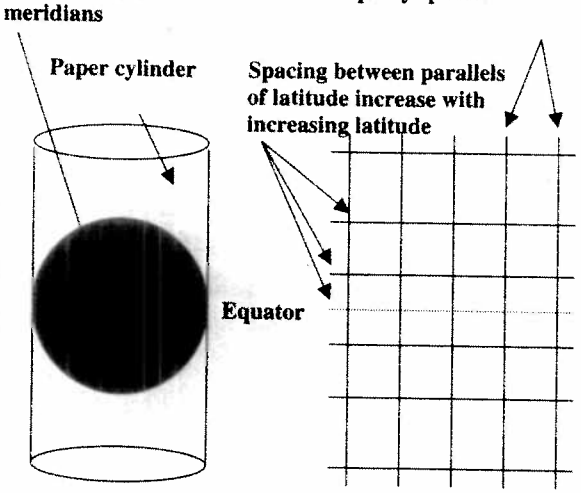
A summary of turning errors is provided below.

Hemisphere	Turning	Aircraft turns	Magnets turn	Reading at end of turn	Turn must be stopped	Effect of liquid swirl	Compass condition
North	45 to 315	Anti-clockwise	Anti-clockwise	More than 315	Early	Increases error	Sluggish
North	315 to 45	Clockwise	Clockwise	Less than 045	Early	Increases error	Sluggish
North	135 to 225	Clockwise	Anti-clockwise	More than 225	Late	Decreases error	Lively
North	225 to 135	Anti-clockwise	Clockwise	Less than 135	Late	Decreases error	Lively
South	45 to 315	Anti-clockwise	Clockwise	Less than 135	Late	Decreases error	Lively
South	315 to 45	Clockwise	Anti-clockwise	More than 045	Late	Decreases error	Lively
South	135 to 225	Clockwise	Clockwise	Less than 225	Early	Increases error	Sluggish
South	225 to 135	Anti-clockwise	Anti-clockwise	More than 135	Early	Increases error	Sluggish

SLUGGISH means that the compass heading is lagging behind the aircraft heading.

LIVELY means that the compass heading is leading the aircraft heading.

MERCATOR PROJECTION



PROJECTION METHOD **GRATICULE**

Chart convergence is zero.

Chart convergence is equal to Earth convergence only at the Equator.

Scale is correct only along the Equator.

Scale varies least at the point of tangency at the Equator, then expands with the Secant of latitude.

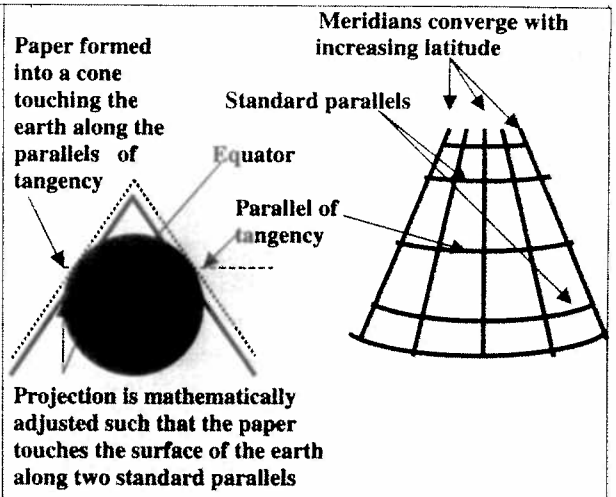
Great Circles are concave to the Equator.

Rhumb lines are straight lines.

This type of projection is used for plotting charts and some topographical charts for areas close to the equator.

Cannot be used for latitudes greater than 70^0 N and 70^0S.

LAMBERTS CONICAL PROJECTION



Projection is mathematically adjusted such that the paper touches the surface of the earth along two standard parallels

PROJECTION METHOD **GRATICULE**

Chart convergency = Ch.Long x Sin of Parallel of Origin.

Chart convergency is equal to Earth convergency at the Equator.

Scale is correct at the Standard Parallels only.

Scale varies least at the Parallel of Origin, then expands with increases distance from that parallel.

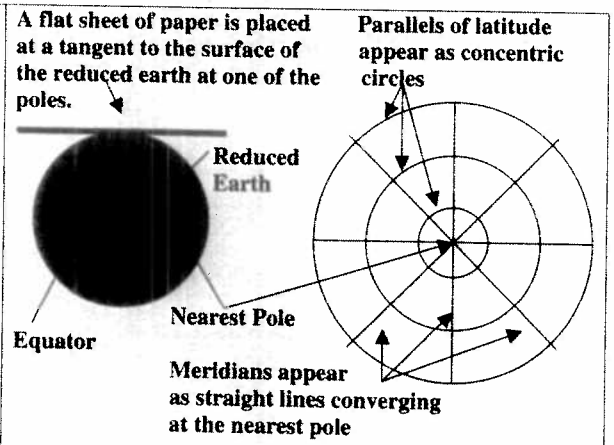
Great Circles appear as straight lines between 2 places on the parallel of Origin.

Great Circles at all other points appear as curves parallel to the parallel of Origin.

Rhumb Lines appear as straight lines.

Used for plotting and topographical charts.

POLAR STEREOGRAPHIC PROJECTION



PROJECTION METHOD **GRATICULE**

Cart convergency is equal to the change in longitude.

Chart convergency is equal to Earth convergency only at the nearest pole.

It is possible to project only areas of the earth that are close to the nearest pole. It is impossible to project the equator.

Scale is correct only at the nearest pole.

Scale varies least at the point of tangency (nearest pole) then expands as the secant^2 of ½ the colatitude.

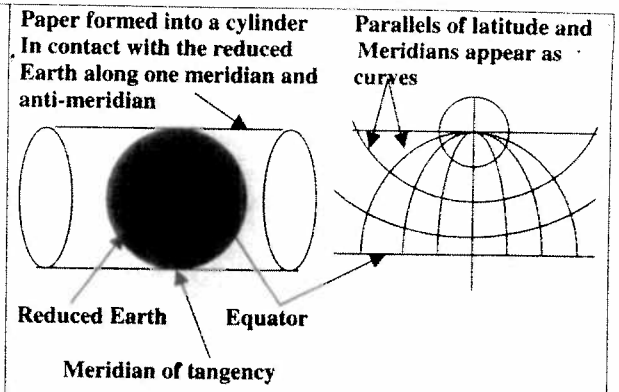
Rhumb lines appear as curves concave to the pole of projection.

Great Circles appear as curves concave to the pole of projection.

Used for Polar plotting charts.

Can be used for areas from the pole of tangency down to about 60^0 latitude.

TRANSVERSE MERCATOR PROJECTION



PROJECTION METHOD **GRATICULE**

Chart convergency is correct at the equator and the poles.

Scale is correct at the contact meridian and its anti-meridian.

Scale expands as the secant of the Great Circle distance from the contact meridian.

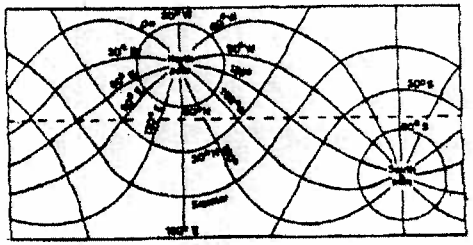
Great Circles appear as straight lines where they cut the contact meridian at 90^0 and when they are very close to the contact meridian.

Rhumb lines appear as curves concave to the nearest pole.

Used for Polar plotting and also for topographical charts of countries with a large change in latitude, but only a small change in longitude.

Best accuracy is achieved within 5^0 of the datum meridian.

OBLIQUE OR SKEW MERCATOR PROJECTIONS	**The projection method is as for the Mercator, but the line of contact is not along a meridian or parallel of latitude. The line of contact is selected to best suit the intended purpose of the chart.**



GRATICULE

The circle along which the paper cylinder touches the reduced earth is called the datum great circle. This is shown as the dotted line on the diagram above.

Chart convergence is correct when close to the datum great circle.

Scale is correct along the datum great circle.

Most other great circles appear as curves concave to the datum great circle.

Those great circles that cut the datum great circle at right angles appear as straight lines.

Rhumb lines appear as complex curves.

Used for great circle routes.

Best accuracy is within 5 degrees of the datum great circle.

Non-directional Beacon (NDB)

1

Basic Radio Navigation Aid

2

3

Aeronautical Ground Light

4

DME

5

TACAN

6

Exceptionally High Obstacle

7

VOR/DME

8

Lightship

9

Lighted Obstacle

Group Of Obstacles

10

11

12

Exceptionally High Lighted Obstacle

Lighted Group Of Obstacle

13

VOR

14

VOR TAC

15

Unlighted Obstacle

STANDARD CHART SYMBOLS

STANDARD TIMES (Corrected to June 1988)

PLACES EAST ON UTC (mainly those EAST OF GREENWICH)

The times given below should be added to UTC to give Standard Time.
subtracted from Standard Time to give UTC

Admiralty Islands	10	
Afghanistan	04	30
Albania*	01	
Algeria	01	
Amirante Islands	04	
Andaman Islands	05	30
Angola	01	
Australia		
Australian Capital Territory*	10	
New South Wales*	10	
Northern Territory	09	30
Queensland	10	
South Australia*	09	30
Tasmania*	10	
Victoria*	10	
Western Australia*	08	
Austria*	01	
Bahrain	03	
Balearic Islands*	01	
Banaba	11	30
Bangladesh	06	
Belgium*	01	
Benin (Dahomey)	01	
Bhutan	06	
Botswana, Republic of	02	
Brunei	08	
Bulgaria*	02	
Burma	06	30
Burundi	02	
Cameroon Republic	01	
Caroline Islands, Palau Islands	10	
Yap Islands, Truk Islands	10	
Ponnapel	11	
Pingelap Islands, Kusaie	12	
Central African Republic	01	
Chad	01	
Chagos Archipelago	05	
Chatham Islands*	12	45
China*	08	
Christmas Island, Indian Ocean	07	
Cocos Keeling Islands	06	30
Comro Islands (Comoros)	03	
Congo Republic	01	
Corsica*	01	
Crete*	02	
Cyprus, Ercan*	02	
Larnaca*	02	
Czechoslovakia*	01	
Denmark*	01	
Djibouti	03	
Egypt, Arab Republic of*	02	
Equatorial Guinea, Republic of	01	
Ethiopia	03	
Fiji	12	
Finland*	02	
France	01	
Gabon	01	
Germany, East*	01	
West *	01	
Gibraltar*	01	
Greece*	02	
Guam	10	
Holland (The Netherlands)*	01	
Hong Kong	08	
Hungary*	01	
India	05	30
Indonesia, Republic of	07	
Bangka, Billiton, Java, West and Middle Kalimantan, Madura, Sumatra		
Bali, Flores, South and East Kalimantan, Lombok, Sulawesi, Sumba, Sumbawa, Timor	08	
Aru, Irian Jaya, Kai, Moluccas, Tanimbar	09	
Iran	03	30
Iraq*	03	
Israel*	02	
Italy*	01	
Japan	09	
Jordan*	02	
Kampuchea, Democratic	07	
Kenya	03	
Kiribati Republic[1]	12	
Korea, North	09	
Republic of (South)*	09	
Kuril Islands	11	
Kuwait	03	
Laccadive Islands	05	30
Laos	07	
Lebanon*	02	
Lesotho	02	
Libya*	01	
Liechtenstein*	01	
Lord Howe Island*	10	30
Luxembourg*	01	

Leeward Islands	04	
Marquesas Islands	09	30
Martinique	04	
Mexico[1]	06	
Midway Islands	11	
Nicaragua	06	
Niue	11	
Panama, Republic of	05	
Paraguay*	04	
Peru	05	
Pitcairn Island	08	30
Puerto Rico	04	
St. Pierre and Miquelon	03	
Salvador, El	06	
Samoa	11	
Society Islands	10	
South Georgia	02	
Surinam	03	
Tobago	04	
Trinidade Island*, South Atlantic	02	
Trinidad	04	
Tuamotu Archipelago	10	
Tubuai Islands	10	
Turks and Caicos Islands*	05	
United States of America		
Alabama[2]	06	
Alaska[2], east of long. W.169°30'	09	
Aleutian Is., west of W.169°30'	10	
Arizona	07	
Arkansas[2]	06	
California[2]	08	
Colorado[2]	07	
Connecticut[2]	05	
Delaware[2]	05	
District of Columbia[2]	05	
Florida[2,3]	05	
Georgia[2]	05	
Hawaii[2]	10	
Idaho[2,3]	07	
Illinois[2]	06	
Indiana[2]	05	
Iowa[2]	06	
Kansas[2,3]	06	
Kentucky[2], eastern part	05	
western part	06	
Louisana[2]	06	
Maine[2]	05	
Maryland[2]	05	
Massachusetts[2]	05	
Michigan[2,3]	05	
Minnesota[2]	06	
Mississippi[2]	06	
Missouri[2]	06	
Montana[2]	07	
Nebraska[2,3]	06	
Nevada[2]	08	
New Hampshire[2]	05	
New Jersey[2]	05	
New Mexico[2]	07	
New York[2]	05	
North Carolina[2]	05	
North Dakota[2,3]	06	
Ohio[2]	05	
Oklahoma[2]	06	
Oregon[2,3]	08	
Pennsylvania[2]	05	
Rhode Island[2]	05	
South Carolina[2]	05	
South Dakota[2], eastern part	06	
western part	07	
Tennessee[2,3]	06	
Texas[2,3]	06	
Utah[2]	07	
Vermont[2]	05	
Virginia[2]	05	
Washington[2]	08	
Washington, D.C.[2]	05	
West Virginia[2]	05	
Wisconsin[2]	06	
Wyoming[2]	07	
Uruguay*	03	
Venezuela	04	
Virgin Islands	04	
Windward Islands	04	

Summer time may be kept in these countries.

[1] Except the states of Sonora, Sinaloa, Nayarit and the Southern District of Lower California, which keep 07 h, and the Northern District of lower California, which keeps 08 h.

[2] Summer (daylight-saving) time, one hour fast on the time given, is kept in these states from the first Sunday in April to the last Sunday in October, changing at 02 h 00 m local clock time.

[3] This applies to the greater portion of the state.

SUNRISE

Lat	Dec. 30	January 2	5	8	11	14	17	20	23	26	29	February 1	4	7	10	13	16
°	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
N72	▬	▬	▬	▬	▬	▬	▬	▬	▬	11 51	11 00	10 31	10 07	09 46	09 27	09 08	08 51
70	▬	▬	▬	▬	▬	▬	11 53	11 09	10 44	10 23	10 05	09 48	09 32	09 16	09 01	08 46	31
68	▬	▬	11 32	11 11	10 55	10 40	10 25	10 12	09 58	09 45	09 32	09 19	09 07	08 54	08 41	28	16
66	10 31	10 26	10 20	10 13	10 05	09 57	09 48	09 38	29	09 19	09 08	08 58	08 50	41	32	22	13
64	09 51	09 49	09 45	09 40	09 35	29	22	09 14	09 06	08 58	08 50	41	32	22	13	08 03	07 53
62	24	22	19	09 16	09 12	09 07	09 01	08 55	08 49	42	34	27	19	10	08 02	07 53	44
N60	09 03	09 02	09 00	08 57	08 54	08 50	08 45	08 40	08 34	08 28	08 22	08 15	08 08	08 00	07 53	07 45	07 37
58	08 46	08 45	08 44	42	39	35	31	27	22	17	11	08 05	07 58	07 52	45	37	30
56	32	31	30	28	26	23	19	15	11	08 06	08 01	07 56	50	44	38	31	24
54	19	19	18	16	14	12	09	08 06	08 02	07 57	07 53	48	42	37	31	25	19
52	08 08	08 08	08 07	08 06	08 04	08 02	08 00	07 57	07 53	49	45	41	36	31	25	20	14
N50	07 58	07 58	07 58	07 57	07 56	07 54	07 51	07 49	07 46	07 42	07 38	07 34	07 30	07 25	07 20	07 15	07 10
45	38	38	38	38	37	35	34	32	29	27	24	22	17	13	09	07 05	07 00
40	22	22	22	22	21	21	19	18	16	14	12	07 09	07 06	07 03	07 00	06 56	06 52
35	07 08	07 08	07 08	07 08	07 08	07 07	07 07	07 06	07 05	07 03	07 01	06 59	06 57	06 54	06 52	49	46
30	06 55	06 56	06 57	06 57	06 57	06 57	06 56	06 56	06 55	06 54	06 52	51	49	47	45	42	40
N20	06 34	06 35	06 36	06 37	06 37	06 38	06 38	06 38	06 38	06 37	06 36	06 36	06 35	06 33	06 32	06 31	06 29
N10	06 16	17	18	19	20	21	22	22	23	23	23	22	22	22	21	20	20
0	05 59	06 00	06 02	06 03	06 04	06 05	06 06	06 07	06 08	06 09	06 10	06 10	06 10	06 11	11	11	11
S10	41	05 43	05 45	05 46	05 48	05 49	05 51	05 52	05 54	05 55	05 56	05 57	05 59	05 59	06 00	06 01	06 02
20	23	24	26	28	30	32	34	36	38	40	42	44	45	47	05 49	05 50	05 52
S30	05 01	05 03	05 05	05 07	05 10	05 12	05 15	05 18	05 20	05 23	05 26	05 28	05 31	05 33	05 36	05 38	05 41
35	04 48	04 50	04 52	04 55	04 58	05 01	05 03	05 07	05 10	13	16	19	22	25	28	31	34
40	33	35	38	41	44	04 47	04 50	04 54	04 57	05 01	05 05	05 08	12	16	20	23	27
45	04 15	04 18	04 21	24	27	31	35	39	43	04 47	04 52	04 56	05 00	05 05	05 09	14	18
50	03 53	03 56	03 59	04 03	04 07	11	16	20	25	30	36	41	04 46	04 51	04 57	05 02	07
S52	03 42	03 45	03 49	03 53	03 57	04 02	04 07	04 12	04 17	04 22	04 28	04 34	04 39	04 45	04 51	04 57	05 02
54	30	33	37	41	46	03 51	03 56	04 02	04 08	14	20	26	32	38	45	51	04 57
56	16	20	24	28	33	39	45	03 51	03 57	04 04	04 10	17	24	30	37	44	51
58	03 00	03 04	03 08	03 13	19	25	31	38	45	03 52	03 59	04 07	14	22	29	37	44
S60	02 40	02 44	02 49	02 55	03 01	03 08	03 15	03 23	03 31	03 39	03 47	03 55	04 03	04 12	04 20	04 28	04 36

SUNSET

Lat	Dec. 30	January 2	5	8	11	14	17	20	23	26	29	February 1	4	7	10	13	16
°	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
72	▬	▬	▬	▬	▬	▬	▬	▬	▬	12 36	13 27	13 57	14 22	14 44	15 03	15 22	15 39
70	▬	▬	▬	▬	▬	▬	12 30	13 14	13 41	14 03	14 22	14 40	14 58	15 14	29	15 44	15 59
68	▬	12 38	13 02	13 21	13 38	13 55	14 11	14 26	14 41	14 55	15 09	15 22	36	15 49	16 01	16 14	16 26
66	13 34	13 41	13 50	14 00	14 10	14 21	14 32	14 44	14 56	15 07	15 19	30	42	15 53	16 04	15	26
64	14 14	14 19	14 25	33	14 41	14 49	14 59	15 08	15 18	27	37	15 47	15 57	16 07	17	27	36
62	14 41	14 45	14 51	14 57	15 04	15 11	15 19	27	35	44	15 52	16 01	16 10	19	28	36	45
60	15 02	15 06	15 11	15 16	15 22	15 29	15 36	15 43	15 50	15 58	16 05	16 13	16 21	16 29	16 37	16 45	16 52
58	19	23	27	32	37	43	15 49	15 56	16 02	16 09	16	23	30	38	45	52	16 59
56	34	37	41	45	15 50	15 55	16 01	16 07	13	19	26	32	39	45	52	16 58	17 05
54	46	15 49	15 53	15 57	16 02	16 06	12	17	22	28	34	40	46	52	16 58	17 04	10
52	15 57	16 00	16 03	16 07	11	16	21	26	31	36	42	47	53	16 58	17 04	09	15
50	16 07	16 09	16 13	16 16	16 20	16 25	16 29	16 34	16 38	16 43	16 48	16 53	16 59	17 04	09	14	19
45	27	30	33	36	39	43	16 47	16 50	16 55	16 59	17 03	17 07	17 12	16	20	24	29
40	44	16 46	16 49	16 51	16 54	16 58	17 01	17 04	17 08	17 11	15	19	22	26	29	33	36
35	16 58	17 00	17 02	17 05	17 07	17 10	13	16	19	22	25	28	31	35	37	40	43
30	17 10	12	14	16	19	21	24	27	29	32	34	37	39	42	44	47	17 49
20	17 31	17 32	17 34	17 36	17 38	17 40	17 42	17 44	17 46	17 48	17 50	17 52	17 54	17 55	17 57	17 58	18 00
10	17 49	17 51	17 52	17 54	17 55	17 57	17 58	18 00	18 01	18 03	18 04	18 05	18 06	18 07	18 08	08	09
0	18 06	18 08	18 09	18 10	18 11	18 13	18 14	15	15	16	17	17	17	18	18	18	18
10	24	25	26	27	28	29	29	29	30	30	30	30	29	29	28	27	26
20	18 42	18 43	18 44	18 45	18 45	18 46	18 46	18 46	18 45	18 45	18 44	43	42	41	39	38	36
30	19 04	19 05	19 05	19 06	19 06	19 05	19 05	19 04	19 03	19 02	19 00	18 59	18 57	18 55	18 52	18 50	18 47
35	17	17	18	18	17	17	16	15	13	12	10	19 08	19 05	19 03	19 00	18 57	18 53
40	32	32	32	32	31	30	29	27	26	23	21	18	15	12	08	19 05	19 01
45	19 50	19 50	19 49	19 49	19 48	19 46	19 44	19 42	40	37	34	30	27	23	18	14	09
50	20 12	20 12	20 11	20 10	20 08	20 06	20 03	20 01	19 57	19 54	50	45	41	36	31	25	20
52	20 22	20 22	20 21	20 20	20 18	20 15	20 12	20 09	20 06	20 01	19 57	19 52	19 47	19 42	19 36	19 31	19 25
54	34	34	33	31	29	26	23	19	15	10	20 05	20 00	19 55	49	43	36	30
56	20 48	20 48	20 46	44	41	38	34	30	25	20	15	09	20 03	19 56	50	43	36
58	21 05	21 04	21 02	20 59	20 56	20 52	20 47	43	37	31	25	19	12	20 05	19 58	50	43
60	21 25	21 23	21 20	21 17	21 13	21 08	21 03	20 58	20 51	20 45	29 38	20 30	20 23	20 15	20 07	19 59	19 50

MORNING CIVIL TWILIGHT

Lat	June 28	July 1	4	7	10	13	16	19	22	25	28	31	August 3	6	9	12	15
°	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
N 72	□	□	□	□	□	□	□	□	□	□	□	□	□	// //	// //	// //	// //
70	□	□	□	□	□	□	□	□	□	□	□	// //	// //	// //	// //	// //	// //
68	□	□	□	□	□	□	// //	// //	// //	// //	// //	// //	// //	// //	// //	01 10	01 39
66	□	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	00 45	01 19	01 24	02 01	02 18
64	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	00 36	01 08	01 30	01 48	02 04	02 18
62	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	00 24	00 53	01 12	01 28	01 43	01 56	02 09
N 60	00 55	01 02	01 09	01 18	01 27	01 36	01 46	01 56	02 06	02 16	02 25	02 35	02 45	02 54	03 03	03 12	03 21
58	01 44	01 48	01 52	01 57	02 03	02 10	02 17	02 24	32	39	02 47	02 55	03 03	03 11	19	27	35
56	02 14	02 16	02 20	02 24	29	34	39	02 45	02 52	02 58	03 05	03 12	19	25	32	39	46
54	36	38	41	02 44	02 48	02 53	02 58	03 03	03 08	03 14	20	26	32	38	44	50	03 56
52	02 53	02 56	02 58	03 01	03 05	03 09	03 13	17	22	27	32	37	43	48	03 54	03 59	04 05
N 50	03 08	03 10	03 13	03 15	03 19	03 22	03 26	03 30	03 34	03 39	03 43	03 48	03 53	03 58	04 03	04 08	04 13
45	03 38	03 39	03 41	03 44	03 46	03 49	03 52	03 55	03 59	04 02	04 06	04 09	04 13	04 17	21	25	29
40	04 00	04 02	04 03	04 05	04 07	04 10	04 12	04 15	04 17	20	23	26	29	32	36	39	42
35	18	20	21	23	25	26	29	31	33	35	38	40	43	45	48	04 50	04 53
30	34	35	04 36	04 37	04 39	04 41	04 42	04 44	04 46	04 48	04 50	04 52	04 54	04 56	04 58	05 00	05 02
N 20	04 59	04 59	05 00	05 01	05 03	05 04	05 05	05 06	05 08	05 09	05 10	05 11	05 12	05 14	05 15	05 16	05 17
N 10	05 19	05 20	20	21	22	23	24	24	25	26	27	27	28	28	28	29	29
0	37	38	38	39	39	40	40	40	41	41	41	41	41	41	41	40	40
S 10	05 54	05 54	05 55	05 55	05 55	05 56	05 56	05 56	05 55	05 55	05 55	05 54	05 53	05 53	05 52	05 51	05 50
20	06 11	06 11	06 12	06 12	06 12	06 12	06 11	06 11	06 10	06 09	06 08	06 07	06 06	06 04	06 03	06 01	05 59
S 30	06 30	06 30	06 30	06 30	06 30	06 29	06 28	06 27	06 26	06 25	06 23	06 21	06 19	06 17	06 15	06 12	06 09
35	40	41	40	40	39	39	38	38	36	35	33	31	29	26	24	21	18
40	06 52	06 52	06 52	06 51	06 50	06 49	06 48	46	45	42	40	37	34	31	28	25	21
45	07 06	07 05	07 05	07 04	07 03	07 02	07 00	06 58	06 56	06 53	06 50	47	43	40	36	32	28
50	21	21	21	19	18	16	14	07 12	07 09	07 05	07 02	06 58	54	50	45	40	35
S 52	07 29	07 29	07 28	07 27	07 25	07 23	07 21	07 18	07 15	07 11	07 07	07 03	06 59	06 54	06 49	06 44	06 39
54	37	37	36	34	32	30	28	25	21	17	13	09	07 04	06 59	54	48	42
56	46	46	44	43	41	38	36	32	28	24	20	15	10	07 04	06 59	53	47
58	07 56	07 56	07 54	07 53	07 50	48	44	41	36	32	27	22	16	10	07 04	06 58	51
S 60	08 08	08 07	08 06	08 04	08 01	07 58	07 54	07 50	07 45	07 41	07 35	07 29	07 23	07 17	07 10	07 03	06 56

EVENING CIVIL TWILIGHT

Lat	June 28	July 1	4	7	10	13	16	19	22	25	28	31	August 3	6	9	12	15
°	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
N 72	□	□	□	□	□	□	□	□	□	□	□	□	□	// //	// //	// //	// //
70	□	□	□	□	□	□	□	□	□	□	□	// //	// //	// //	// //	// //	// //
68	□	□	□	□	□	□	□	□	□	□	// //	// //	// //	// //	// //	// //	23 51
66	□	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	23 15	22 46	22 23	22 04	21 47
64	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	23 24	22 57	22 37	22 20	22 04	21 49
62	// //	// //	// //	// //	// //	// //	// //	// //	// //	// //	23 36	23 12	22 55	22 40	22 26	22 13	22 01
N 60	23 09	23 03	22 57	22 49	22 41	22 32	22 23	22 14	22 04	21 55	21 45	21 35	21 25	21 16	21 06	20 56	20 46
58	22 21	22 19	22 15	22 11	22 05	22 00	21 53	21 46	21 39	31	23	21 15	21 07	20 59	20 50	42	33
56	21 52	21 50	21 48	21 44	21 41	21 36	31	25	19	21 13	21 06	20 59	20 52	45	37	29	21
54	30	29	27	24	21	17	21 13	21 08	21 03	20 58	20 52	46	39	33	26	19	11
52	21 12	21 11	21 10	21 08	21 05	21 02	20 58	20 54	20 49	45	39	34	28	22	16	10	20 03
N 50	20 57	20 57	20 55	20 53	20 51	20 48	20 45	20 42	20 38	20 33	20 29	20 24	20 18	20 13	20 07	20 01	19 55
45	28	28	27	25	24	22	20 19	20 17	20 13	20 10	20 06	20 02	19 58	19 54	19 49	19 44	39
40	20 06	20 05	20 05	20 04	20 03	20 01	19 59	19 57	19 55	19 52	19 49	19 46	42	39	35	31	26
35	19 48	19 47	19 47	19 47	19 46	19 44	43	41	39	37	35	32	29	26	23	19	16
30	32	32	32	32	31	30	29	28	26	25	23	20	18	15	13	19 10	19 07
N 20	19 08	19 08	19 08	19 08	19 08	19 07	19 07	19 06	19 05	19 04	19 03	19 01	19 00	18 58	18 56	18 54	18 52
N 10	18 47	18 48	18 48	18 48	18 48	18 48	18 48	18 47	18 47	18 46	18 45	18 45	18 43	42	41	40	39
0	29	30	30	31	31	31	32	32	32	32	32	32	31	31	30	30	29
S 10	18 12	18 13	18 14	18 14	18 15	16	16	17	17	18	18	19	19	19	19	19	19
20	17 55	17 56	17 57	17 58	17 59	18 00	18 01	18 02	18 03	18 04	18 05	18 06	18 07	18 07	18 08	18 09	18 09
S 30	17 36	17 37	17 38	17 40	17 41	17 42	17 44	17 45	17 47	17 49	17 50	17 52	17 53	17 55	17 57	17 58	18 00
35	26	27	28	30	31	33	35	36	38	40	42	44	46	48	50	52	17 54
40	14	15	17	18	20	22	24	26	29	31	33	36	38	41	43	46	49
45	17 01	17 02	17 04	17 05	17 08	17 10	17 12	15	17	20	23	26	29	32	36	39	42
50	16 45	16 46	16 48	16 50	16 53	16 55	16 58	17 01	17 04	08	11	15	19	23	26	30	34
S 52	16 37	16 39	16 41	16 43	16 46	16 49	16 52	16 55	16 59	17 02	17 06	17 10	17 14	17 18	17 22	17 27	17 31
54	29	31	33	35	38	41	45	48	52	46 56	17 00	17 04	09	13	18	23	27
56	20	22	24	27	30	33	37	41	45	49	16 54	16 58	17 03	08	13	18	23
58	16 10	12	14	17	21	24	28	32	37	42	46	52	16 57	17 02	08	13	19
S 60	15 58	16 01	16 03	16 06	16 10	16 14	16 18	16 23	16 28	16 33	16 38	16 44	16 50	16 56	17 02	17 08	17 14

SUNRISE

Lat	November								December																				Jan	
	19		22		25		28		1		4		7		10		13		16		19		22		25		28		31		3	
°	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m
N72	—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—	
70	10	14	10	40	11	19	—		—		—		—		—		—		—		—		—		—		—		—		—	
68	09	30	09	45	10	00	10	16	10	33	10	52	11	14	—		—		—		—		—		—		—		—		—	
66	09	01	09	12	09	23	09	34	09	45	09	55	10	05	10	14	10	22	10	28	10	32	10	35	10	35	10	33	10	30	10	25
64	08	39	08	48	08	57	09	06	09	15	09	23	09	30	09	36	09	42	09	47	09	50	09	52	09	53	09	52	09	51	09	48
62		21		29		37	08	45	08	52	08	59	09	05	09	10	09	15	09	19		22		24		24		24		23		22
N60	08	07	08	14	08	21	08	28	08	34	08	40	08	45	08	50	08	54	08	58	09	00	09	02	09	03	09	03	09	03	09	01
58	07	54	08	01	08	07		13		19		24		29		33		37		40	08	43	08	45	08	46	08	46	08	46	08	45
56		43	07	49	07	55	08	01	08	06	08	11		15		19		23		26		28		30		31		32		32		31
54		34		40		45	07	50	07	55	07	59	08	03	08	07	08	10		13		15		17		19		19		19		19
52		26		31		36		40		45		49	07	53	07	56	07	59	08	02	08	04	08	06	08	07	08	08	08	08	08	08
N50	07	18	07	23	07	28	07	32	07	36	07	40	07	43	07	47	07	50	07	52	07	54	07	56	07	57	07	58	07	59	07	58
45	07	02	07	06	07	10	07	14		17		21		24		27		29		32		34		35		37		38		38		38
40	06	49	06	53	06	56	06	59	07	02	07	05	07	08	07	10	07	13		15		17		18		20		21		22		22
35		38		41		44		46	06	49	06	52	06	54	06	57	06	59	07	01	07	03	07	04	07	06	07	07	07	08	07	08
30		28		30		33		35		38		40		43		45		47	06	49	06	50	06	52	06	53	06	54	06	55	06	56
N20	06	11	06	13	06	15	06	16	06	18	06	20	06	22	06	24	06	26	06	28	06	29	06	31	06	32	06	33	06	35	06	36
N10	05	56	05	57	05	58	06	00	06	01	06	03	06	04	06	06	06	07	06	09	06	10	06	12	06	13	06	15	06	16	06	17
0		42		42		43	05	44	05	45	05	46	05	48	05	49	05	50	05	52	05	53	05	55	05	56	05	58	05	59	06	01
S10		28		28		28		28		29		30		31		32		33		34		35		37		39		40		42	05	43
20	05	12	05	12	05	11	05	11	05	12	05	12	05	13	05	13	05	14	05	15	05	17	05	18	05	20	05	21		23		25
S30	04	54	04	53	04	52	04	52	04	51	04	51	04	52	04	52	04	52	04	53	04	55	04	56	04	58	04	59	05	01	05	03
35		44		42		41		40		39		39		39		39		40		41		42		43		45		46	04	48	04	51
40		32		30		28		27		26		25		25		25		25		26		27		28		29		31		34		36
45		18	04	15	04	13	04	11	04	09	04	08	04	07	04	07	04	07	04	08	04	08	04	10	04	11	04	13	04	16	04	19
50	04	00	03	57	03	54	03	51	03	49	03	47	03	45	03	45	03	45	03	45	03	46	03	47	03	49	03	51	03	54	03	57
52	03	52	03	48	03	45	03	42	03	39	03	37	03	35	03	35	03	34	03	34	03	35	03	36	03	38	03	40	03	43	03	46
54		43		39		35		31		29		26		23		23		22		22		23		24		26		28		31		34
56		32		28		23		19		16	03	13	03	09	03	09	03	09	03	08	03	09	03	10	03	12	03	14		17		21
58		21		15	03	10	03	06	03	02	02	58	02	53	02	53	02	52	02	52	02	52	02	53	02	55	02	57	03	01	03	05
60	03	06	03	00	02	54	02	49	02	44	02	40	02	34	02	34	02	32	02	32	02	31	02	31	02	32	02	34	02	37	02	41	02	45

SUNSET

Lat	November								December																				Jan	
	19		22		25		28		1		4		7		10		13		16		19		22		25		28		31		3	
°	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m
N72	—		—		—		—		—		—		—		—		—		—		—		—		—		—		—		—	
70	13	15	12	51	12	13	—		—		—		—		—		—		—		—		—		—		—		—		—	
68	14	00	13	47	13	33	13	19	13	04	12	47	12	27	—		—		—		—		—		—		—		—		—	
66		29	14	19	14	10	14	01	13	52	13	44	13	37	13	30	13	26	13	22	13	21	13	21	13	24	13	29	13	35	13	43
64	14	51	14	43		36		29	14	22	14	17	14	12	14	08	14	05	14	04	14	03	14	04	14	06	14	10	14	15	14	21
62	15	09	15	02	14	56	14	50	14	45	14	41		37		34		32		31		32		33		35		38	14	42	14	47
N60	15	23	15	18	15	12	15	08	15	03	15	00	14	57	14	55	14	54	14	53	14	53	14	55	14	57	14	59	15	03	15	07
58		36		31		26		22		19		16	15	13	15	12	15	11	15	10	15	11	15	12	15	14	15	17		20		24
56		46		42		38		35		32		29		27		26		25		25		26		27		29		31		34		38
54	15	56	15	52		48		45		43		41		39		38		38		38		39		40		42		44		47	15	50
52	16	04	16	01	15	58	15	55	15	53	15	51		50		49		48		49		49	15	51	15	52	15	55	15	58	16	01
N50	16	12	16	09	16	06	16	03	16	01	16	00	15	59	15	58	15	58	15	58	15	59	16	01	16	02	16	05	16	07	16	10
45		28		26		24		22		21		20	16	19	16	19	16	19	16	19	16	20		21		23		25		28		30
40		41		39		38		37		36		35		35		35		36		37		38		40		42		44	16	47		
35	16	53	16	51	16	50	16	49	16	49	16	48	16	48	16	48	16	49	16	50	16	51	16	52	16	54	16	56	16	58	17	00
30	17	03	17	01	17	01	17	00	17	00	17	00	17	00	17	01	17	01	17	02	17	04	17	05	17	07	17	09	17	10		13
N20	17	20	17	19	17	19	17	19	17	19	17	20	17	20	17	21	17	22	17	23	17	25	17	26	17	28	17	29	17	31	17	33
N10		35		35		35		36		37		37		38		39		41		42	17	43	17	45	17	46	17	48	17	50	17	51
0	17	49	17	50	17	51	17	52	17	53	17	54	17	55	17	56	17	58	17	59	18	01	18	02	18	04	18	05	18	07	18	08
S10	18	03	18	05	18	06	18	07	18	09	18	10	18	12	18	14	18	15	18	17		18		20		21		23		24		25
20		19		21		23		25		26		28		30		32		34		36		37	18	39	18	40	18	41	18	43	18	44
S30	18	37	18	39	18	42	18	44	18	47	18	49	18	51	18	54	18	56	18	58	18	59	19	01	19	02	19	03	19	04	19	05
35		47	18	50	18	53	18	56	18	59	19	02	19	04	19	06	19	09	19	11	19	12		14		15		16		17		18
40	18	59	19	03	19	06	19	09	19	13		16		18		21		23		26		27		29		30		31		32		32
45	19	14		18		22		25		29		32		36	19	39	19	41	19	44	19	45	19	47	19	48	19	49	19	50	19	50
50		31		36		41		45		50	19	54	19	57	20	01	20	03	20	06	20	08	20	10	20	11	20	12	20	12	20	11
52	19	40	19	45	19	50	19	55	19	59	20	04	20	07	20	11	20	14	20	17	20	19	20	21	20	22	20	22	20	22	20	22
54	19	49	19	55	20	00	20	05	20	10		15		19		23		26		29		31		33		34		34		34		34
56	20	00	20	06		12		18		23		28		33		37		40	20	43	20	45	20	47	20	48	20	49	20	48	20	47
58		12		19		25		32		38	20	43	20	48	20	53	20	57	21	00	21	02	21	04	21	05	21	05	21	05	21	03
60	20	20	20	34	20	41	20	48	20	55	21	01	21	07	21	12	21	17	21	20	21	23	21	25	21	25	21	25	21	24	21	22

CONVERSION OF ARC TO TIME

°	hour	min	°	hour	min	°	hour	min	°	hour	min	°	hour	min	°	hour	min	°	min	sec
0	0	00	60	4	00	120	8	00	180	12	00	240	16	00	300	20	00	0	0	00
1	0	04	61	4	04	121	8	04	181	12	04	241	16	04	301	20	04	1	0	04
2	0	08	62	4	08	122	8	08	182	12	08	242	16	08	302	20	08	2	0	08
3	0	12	63	4	12	123	8	12	183	12	12	243	16	12	303	20	12	3	0	12
4	0	16	64	4	16	124	8	16	184	12	16	244	16	16	304	20	16	4	0	16
5	0	20	65	4	20	125	8	20	185	12	20	245	16	20	305	20	20	5	0	20
6	0	24	66	4	24	126	8	24	186	12	24	246	16	24	306	20	24	6	0	24
7	0	28	67	4	28	127	8	28	187	12	28	247	16	28	307	20	28	7	0	28
8	0	32	68	4	32	128	8	32	188	12	32	248	16	32	308	20	32	8	0	32
9	0	36	69	4	36	129	8	36	189	12	36	249	16	36	309	20	36	9	0	36
10	0	40	70	4	40	130	8	40	190	12	40	250	16	40	310	20	40	10	0	40
11	0	44	71	4	44	131	8	44	191	12	44	251	16	44	311	20	44	11	0	44
12	0	48	72	4	48	132	8	48	192	12	48	252	16	48	312	20	48	12	0	48
13	0	52	73	4	52	133	8	52	193	12	52	253	16	52	313	20	52	13	0	52
14	0	56	74	4	56	134	8	56	194	12	56	254	16	56	314	20	56	14	0	56
15	1	00	75	5	00	135	9	00	195	13	00	255	17	00	315	21	00	15	1	00
16	1	04	76	5	04	136	9	04	196	13	04	256	17	04	316	21	04	16	1	04
17	1	08	77	5	08	137	9	08	197	13	08	257	17	08	317	21	08	17	1	08
18	1	12	78	5	12	138	9	12	198	13	12	258	17	12	318	21	12	18	1	12
19	1	16	79	5	16	139	9	16	199	13	16	259	17	16	319	21	16	19	1	16
20	1	20	80	5	20	140	9	20	200	13	20	260	17	20	320	21	20	20	1	20
21	1	24	81	5	24	141	9	24	201	13	24	261	17	24	321	21	24	21	1	24
22	1	28	82	5	28	142	9	28	202	13	28	262	17	28	322	21	28	22	1	28
23	1	32	83	5	32	143	9	32	203	13	32	263	17	32	323	21	32	23	1	32
24	1	36	84	5	36	144	9	36	204	13	36	264	17	36	324	21	36	24	1	36
25	1	40	85	5	40	145	9	40	205	13	40	265	17	40	325	21	40	25	1	40
26	1	44	86	5	44	146	9	44	206	13	44	266	17	44	326	21	44	26	1	44
27	1	48	87	5	48	147	9	48	207	13	48	267	17	48	327	21	48	27	1	48
28	1	52	88	5	52	148	9	52	208	13	52	268	17	52	328	21	52	28	1	52
29	1	56	89	5	56	149	9	56	209	13	56	269	17	56	329	21	56	29	1	56
30	2	00	90	6	00	150	10	00	210	14	00	270	18	00	330	22	00	30	2	00
31	2	04	91	6	04	151	10	04	211	14	04	271	18	04	331	22	04	31	2	04
32	2	08	92	6	08	152	10	08	212	14	08	272	18	08	332	22	08	32	2	08
33	2	12	93	6	12	153	10	12	213	14	12	273	18	12	333	22	12	33	2	12
34	2	16	94	6	16	154	10	16	214	14	16	274	18	16	334	22	16	34	2	16
35	2	20	95	6	20	155	10	20	215	14	20	275	18	20	335	22	20	35	2	20
36	2	24	96	6	24	156	10	24	216	14	24	276	18	24	336	22	24	36	2	24
37	2	28	97	6	28	157	10	28	217	14	28	277	18	28	337	22	28	37	2	28
38	2	32	98	6	32	158	10	32	218	14	32	278	18	32	338	22	32	38	2	32
39	2	36	99	6	36	159	10	36	219	14	36	279	18	36	339	22	36	39	2	36
40	2	40	100	6	40	160	10	40	220	14	40	280	18	40	340	22	40	40	2	40
41	2	44	101	6	44	161	10	44	221	14	44	281	18	44	341	22	44	41	2	44
42	2	48	102	6	48	162	10	48	222	14	48	282	18	48	342	22	48	42	2	48
43	2	52	103	6	52	163	10	52	223	14	52	283	18	52	343	22	52	43	2	52
44	2	56	104	6	56	164	10	56	224	14	56	284	18	56	344	22	56	44	2	56
45	3	00	105	7	00	165	11	00	225	15	00	285	19	00	345	23	00	45	3	00
46	3	04	106	7	04	166	11	04	226	15	04	286	19	04	346	23	04	46	3	04
47	3	08	107	7	08	167	11	08	227	15	08	287	19	08	347	23	08	47	3	08
48	3	12	108	7	12	168	11	12	228	15	12	288	19	12	348	23	12	48	3	12
49	3	16	109	7	16	169	11	16	229	15	16	289	19	16	349	23	16	49	3	16
50	3	20	110	7	20	170	11	20	230	15	20	290	19	20	350	23	20	50	3	20
51	3	24	111	7	24	171	11	24	231	15	24	291	19	24	351	23	24	51	3	24
52	3	28	112	7	28	172	11	28	232	15	28	292	19	28	352	23	28	52	3	28
53	3	32	113	7	32	173	11	32	233	15	32	293	19	32	353	23	32	53	3	32
54	3	36	114	7	36	174	11	36	234	15	36	294	19	36	354	23	36	54	3	36
55	3	40	115	7	40	175	11	40	235	15	40	295	19	40	355	23	40	55	3	40
56	3	44	116	7	44	176	11	44	236	15	44	296	19	44	356	23	44	56	3	44
57	3	48	117	7	48	177	11	48	237	15	48	297	19	48	357	23	48	57	3	48
58	3	52	118	7	52	178	11	52	238	15	52	298	19	52	358	23	52	58	3	52
59	3	56	119	7	56	179	11	56	239	15	56	299	19	56	359	23	56	59	3	56

The above table is for converting expressions in arc to their equivalent in time: its main use is this Almanac is for the conversion of longitude for application to L.M.T. (added if west, subtracted if east) to give UT or vice versa, particularly in the case of sunrise, sunset, etc.

SECTION 2

QUESTIONS

Subject	Pages		
CRP5.	33	to	57
Chart Theory.	58	to	68
Circles.	68	to	93
Magnetic Compasses.	93	to	114
Descents.	114	to	134
INS/IRS/FMS.	134	to	165
Plotting.	165	to	186
PSR/PET.	187	to	215
Scale.	215	to	231
Solar System & Time.	231	to	241

CRP5 1.
What is the ETA at Z if TAS = 120 Kts?

ATD 'X' is 1232 UTC ETA 'Y' is 1247 UTC ATA 'Y' is 1250 UTC

a. 1255 UTC.
b. 1305 UTC.
c. 1320 UTC.
d. 1325 UTC.

CRP5 2.
Given the following: True track: 192° Magnetic variation: 7°E Drift angle: 5° left What is the magnetic heading required to maintain the given track?

a. 190°M.
b. 192°M.
c. 197°M
d. 188°M.

CRP5 3.
Given the following: Magnetic heading: 060° Magnetic variation: 8°W Drift angle: 4° right, what is the true track?

a. 058°.
b. 054°.
c. 052°.
d. 056°.

CRP5 4.
An aircraft is following a true track of 048° at a constant TAS of 210 kt. The wind velocity is 350° / 30 kt. The GS and drift angle are?

a. 192 kt, 7°right.
b. 196 kt, 7.5°right.
c. 192 kt, 7° left.
d. 196 kt, 7.5° left.

CRP5 5.
Given: FL 350, Mach 0.80, OAT -55°C. Calculate the values for TAS and local speed of sound (LSS)?

a. 460 kt , LSS 575 kt.
b. 460 kt , LSS 570 kt.
c. 465 kt , LSS 575 kt.
d. 460 kt , LSS 567 kt.

CRP5 6.
For a given track the: Wind component = +45 kt Drift angle = 15° left TAS = 240 kt What is the wind component on the reverse track?

a. 85 kts.
b. -65 kts.
c. -85 kts.
d. -45 kts.

CRP5 7.
Given: Magnetic heading = 255° VAR = 40°W GS = 375 kt W/V = 235°(T) / 120 kt Calculate the drift angle?

a. 4° left.
b. 9° left.
c. 7° left.
d. 7° right.

CRP5 8.
Given: True Heading = 180° TAS = 500 kt W/V 225° / 100 kt Calculate the GS?

a. 435 kt.
b. 575 kt.
c. 400 kt.
d. 350 kt.

CRP5 9.
Given: True heading = 310° TAS = 200 kt GS = 176 kt Drift angle 7° right. Calculate the W/V?

a. 273° / 33 kt.
b. 270° / 33 kt.
c. 265° / 30 kt.
d. 270° / 43 kt

CRP5 10.
Given: True Heading = 090° TAS = 180 kt GS = 180 kt Drift 5° right Calculate the W/V?

a. 360° / 15 kt.
b. 360° / 25 kt.
c. 360° / 5 kt.
d. 300° / 15 kt.

CRP5 11.
Given: True Heading = 090° TAS = 200 kt W/V = 220° / 30 kt. Calculate the GS?

a. 200 kt.
b. 240 kt.
c. 180 kt.
d. 220 kt.

CRP5 12.
An aeroplane is flying at TAS 180 kt on a track of 090°. The W/V is 045° / 50kt. How far can the aeroplane fly out from its base and return in one hour?

a. 85 nm.
b. 90 nm.
c. 75 nm.
d. 100 nm.

CRP5 13.
The following information is displayed on an Inertial Navigation System: GS 520 kt, True HDG 090°, Drift angle 5° right, TAS 480 kt. SAT (static air temperature) -51°C. The W/V being experienced is?

a. 322° / 60 kt
b. 320° / 60 kt.
c. 320° / 45 kt.
d. 321° / 50 kt.

CRP5 14.
The reported surface wind from the Control Tower is 240°/35 kt. Runway 30 (300°). What is the cross-wind component?

a. 30kt.
b. 35kt.
c. 26kt.
d. 25kt.

CRP5 15.
Given: TAS = 485 kt, OAT = ISA +10°C, FL 410. Calculate the Mach number?

a. 0.852.
b. 0.833.
c. 0.825.
d. 0.815.

CRP5 16.
265 US-GAL equals? (Specific gravity 0.80)

a. 803 kg.
b. 810 kg.
c. 800 kg.
d. 813 kg.

CRP5 17.
730 ft/min equals?

a. 3.9 m/sec.
b. 3.4 m/sec.
c. 3.7 m/sec.
d. 3.2 m/sec

CRP5 18.
How long will it take to fly 5 NM at a groundspeed of 269 Kt ?

a. 1 min 11 sec.
b. 1 min 07 sec.
c. 1 min 10 sec.
d. 1 min 17 sec.

CRP5 19.
An aircraft travels 2.4 statute miles in 47 seconds. What is its groundspeed?

a. 160 kt.
b. 266 kt.
c. 26.6 kt.
d. 166 kt.

CRP5 20.
What is the ISA temperature value at FL 330?

a. -56.5^{0}C.
b. -53^{0}C
c. -50°C.
d. -52^{0}C.

CRP5 21.
Given: TAS 487kt, FL 330, Temperature ISA + 15. Calculate the MACH Number?

a. 0.81.

b. 0.80.
c. 0.83.
d. 0.79.

CRP5 22.
Given: M 0.80, OAT -50°C, FL 330, GS 490 kt, VAR 20°W, Magnetic heading 140°, Drift is 11° Right. Calculate the true W/V?

a. 025°/95 kts.
b. 020°/80 kts.
c. 025°/90 kts
d. 020°/95 kts.

CRP5 23.
Given: Pressure Altitude 29000 FT, OAT -55°C. Calculate the Density Altitude?

a. 28900 ft.
b. 28000 ft.
c. 27850 ft.
d. 27500ft.

CRP5 24.
Given: Compass Heading 090°, Deviation 2°W, Variation 12°E, TAS 160 kt. Whilst maintaining a radial 070° from a VOR station, the aircraft flies a ground distance of 14 NM in 6 MIN. What is the W/V °(T)?

a. 160°/50 kt.
b. 150°/50 kt.
c. 160°/60 kt.
d. 150°/60 kt.

CRP5 25.
How many NM would an aircraft travel in 1 MIN 45 SEC if GS is 135 kt?

a. 3.45.
b. 3.25.
c. 3.95.
d. 4.35.

CRP5 26.
Fuel flow per HR is 22 US-GAL, total fuel on board is 83 IMP GAL. What is the endurance?

a. 4 hr 32 min.

b. 3 hr 46 min.
c. 4 hr 46 min.
d. 3 hr 32 min.

CRP5 27.
What is the ratio between the litre and the US-GAL ?1 US-GAL equals?

a. 3.5 litres.
b. 4.3 litres.
c. 3.78 litres.
d. 3.65 litres.

CRP5 28.
Given: true track is 348°, drift 17° left, variation 32° W, deviation 4°E. What is the compass heading?

a. 041°.
b. 141°.
c. 044°
d. 033°.

CRP5 29.
An aircraft travels 100 statute miles in 20 min, how long does it take to travel 215 nm?

a. 50 min.
b. 46 min.
c. 48 min.
d. 51 min.

CRP5 30.
Given: TAS = 220 kt; Magnetic course = 212 °, W/V 160 °(M)/ 50kt, Calculate the GS?

a. 192 kt.
b. 186 kt.
c. 190 kt.
d. 180 kt.

CRP5 31.
Given: FL250, OAT -15 °C, TAS 250 kt. Calculate the Mach No.?

a. 0.45.
b. 0.40.
c. 0.46.

d. 0.38.

CRP5 32.
An aircraft travels 100 statute miles in 30 min, how long does it take to travel 215 nm?

a. 74 min.
b. 50 min.
c. 77 min.
d. 49 min.

CRP5 33.
Given: TAS = 250 kt; Magnetic course = 212 °, W/V 160 °(M)/ 50kt, Calculate the GS?

a. 222 kt.
b. 225 kt.
c. 215 kt.
d. 230 kt.

CRP5 34.
Given: True track 180° Drift 8°R Compass heading 195° Deviation -2° Calculate the variation?

a. 23°W.
b. 20°W.
c. 21°E.
d. 21°W.

CRP5 35.
Given: True track 175° Drift 10°R Compass heading 195° Deviation -3° Calculate the variation?

a. 25°W.
b. 27°W.
c. 25°E.
d. 29°W.

CRP5 36.
Given: True course 300° drift 8°R variation 10°W deviation -4° Calculate the compass heading?

a. 298°.
b. 296°
c. 304°.

d. 306°.

CRP5 37.
Given: true track 352° variation 11° W deviation is -5° drift 10°R. Calculate the compass heading?

a. 355°.
b. 358°.
c. 348°.
d. 350°.

CRP5 38.
Given: true track 070° variation 30°W deviation +1° drift 10°R Calculate the compass heading?

a. 089°.
b. 091°.
c. 087°.
d. 090°.

CRP5 39.
Given: TAS = 270 kt, True HDG = 270°, Actual wind 205°(T)/30kt, Calculate the drift angle and GS?

a. 12R - 269kt.
b. 6L - 259kt.
c. 6R - 259kt.
d. 6R - 269kt.

CRP5 40.
Given: TAS = 270 kt, True HDG = 145°, Actual wind = 205°(T)/30kt. Calculate the drift angle and GS?

a. 6°L - 256 kt.
b. 6°R - 256 kt
c. 6°L - 275 kt
d. 6°R - 275 kt.

CRP5 41.
Given: TAS = 470 kt, True HDG = 317° W/V = 045°(T)/45kt Calculate the drift angle and GS?

a. 5°R - 470 kt.
b. 5°L - 460 kt.
c. 5°L - 470 kt.

d. 5°R - 460 kt

CRP5 42.
Given: TAS = 140 kt, True HDG = 302°, W/V = 045°(T)/45kt Calculate the drift angle and GS?

a. 16°R - 156 kt.
b. 16°L - 156 kt.
c. 16°L - 166 kt.
d. 16°R - 166 kt.

CRP5 43.
Given: TAS = 290 kt, True HDG = 171°, W/V = 310°(T)/30kt Calculate the drift angle and GS?

a. 4°R - 314 kt.
b. 5°L - 325 kt
c. 5°R - 325 kt.
d. 4°L - 314 kt.

CRP5 44.
Given: TAS = 485 kt, True HDG = 226°, W/V = 110°(T)/95kt. Calculate the drift angle and GS?

a. 9°R - 533 kt.
b. 9°L - 533 kt.
c. 9°R - 540 kt.
d. 9°L - 540 kt.

CRP5 45.
Given: TAS = 472 kt, True HDG = 005°, W/V = 110°(T)/50kt. Calculate the drift angle and GS?

a. 6°R - 487 kt.
b. 6°L - 487 kt.
c. 4°R - 487 kt.
d. 4°L - 487 kt.

CRP5 46.
Given: TAS = 190 kt, True HDG = 085°, W/V = 110°(T)/50kt. Calculate the drift angle and GS?

a. 8°L - 146 kt.
b. 8°R - 146 kt.
c. 8°L - 140 kt.

d. 8°R - 140 kt

CRP5 47.
Given: TAS = 132 kt, True HDG = 257° W/V = 095°(T)/35kt. Calculate the drift angle and GS?

a. 4°L - 165 kt.
b. 4°R - 155 kt
c. 4°L - 155 kt.
d. 4°R - 165 kt.

CRP5 48.
Given: TAS = 370 kt, True HDG = 181°, W/V = 095°(T)/35kt. Calculate the true track and GS?

a. 186 - 370 kt.
b. 176 - 370 kt.
c. 186 - 350 kt
d. 176 - 350 kt.

CRP5 49.
Given: TAS = 375 kt, True HDG = 124°, W/V = 130°(T)/55kt. Calculate the true track and GS?

a. 125 - 320 kt
b. 123 - 320 kt.
c. 123 - 330 kt
d. 125 - 330 kt.

CRP5 50.
Given: TAS = 125 kt, True HDG = 355°, W/V = 320°(T)/30kt. Calculate the true track and GS?

a. 005 - 102 kt.
b. 345 - 102 kt
c. 005 - 112 kt.
d. 345 - 112 kt.

CRP5 51.
Given: TAS = 198 kt, HDG (°T) = 180, W/V = 359/25. Calculate the Track(°T) and GS?

a. 000 - 223 kt.
b. 180 - 213 kt.
c. 180 - 223 kt.

d. 000 - 213 kt.

CRP5 52.
Given: TAS = 135 kt, HDG (°T) = 278, W/V = 140/20kt Calculate the Track (°T) and GS?

a. 283 - 150 kt.
b. 005 - 150 kt.
c. 273 - 150 kt.
d. 280 - 150 kt

CRP5 53.
Given: TAS = 225 kt, HDG (°T) = 123°, W/V = 090/60kt. Calculate the Track (°T) and GS?

a. 134 - 168 kt.
b. 130 - 178 kt
c. 134 - 178 kt.
d. 130 - 168 kt.

CRP5 54.
Given: TAS = 480 kt, HDG (°T) = 040°, W/V = 090/60kt. Calculate the Track (°T) and GS?

a. 034 - 445 kt.
b. 046 - 445 kt.
c. 040 - 440 kt
d. 030 - 440 kt.

CRP5 55.
Given: TAS = 155 kt, HDG (T) = 216°, W/V = 090/60kt. Calculate the Track (°T) and GS?

a. 231 - 196 kt.
b. 201 - 196 kt.
c. 231 - 190 kt.
d. 201 - 190 kt.

CRP5 56.
Given: TAS = 170 kt, HDG(T) = 100°, W/V = 350/30kt. Calculate the Track (°T) and GS?

a. 91 - 182 kt.
b. 109 - 182 kt.
c. 109 - 186 kt

d. 91 - 186 kt.

CRP5 57.
Given: TAS = 235 kt, HDG (T) = 076° W/V = 040/40kt. Calculate the drift angle and GS?

a. 7R - 214 kt.
b. 7R - 204 kt.
c. 7L - 210 kt
d. 7L - 204 kt.

CRP5 58.
Given: TAS = 440 kt, HDG (T) = 349° W/V = 040/40kt. Calculate the drift and GS?

a. 4L - 415 kt.
b. 4R - 415 kt.
c. 4L - 405 kt.
d. 4L - 405 kt.

CRP5 59.
Given: TAS = 465 kt, HDG (T) = 124°, W/V = 170/80kt. Calculate the drift and GS?

a. 8R - 415 kt
b. 8L - 405 kt
c. 8L - 415 kt.
d. 8R - 405 kt

CRP5 60.
Given: TAS = 95 kt, HDG (T) = 075°, W/V = 310/20kt. Calculate the drift and GS?

a. 9L - 108 kt
b. 9L - 104 kt.
c. 9R - 104 kt.
d. 9R - 108 kt.

CRP5 61.
Given: TAS = 140 kt, HDG (T) = 005°, W/V = 265/25kt. Calculate the drift and GS?

a. 10L - 146 kt.
b. 10R - 146 kt.
c. 10R - 144 kt.

d. 10L - 144 kt

CRP5 62.
Given: TAS = 190 kt, HDG (T) = 355°, W/V = 165/25kt. Calculate the drift and GS?

a. 1R - 215 kt
b. 1L - 215 kt.
c. 1L - 212 kt
d. 1R - 212 kt

CRP5 63.
Given: TAS = 230 kt, HDG (T) = 250°, W/V = 205/10kt. Calculate the drift and GS?

a. 2L - 223 kt.
b. 2R - 220 kt.
c. 2L - 220 kt.
d. 2R - 223 kt.

CRP5 64.
Given: TAS = 205 kt, HDG (T) = 180°, W/V = 240/25kt. Calculate the drift and GS?

a. 6L - 192 kt.
b. 6L - 194 kt.
c. 6L - 196 kt.
d. 6R - 194 kt.

CRP5 65.
Given: TAS = 250 kt, HDG (T) = 029°, W/V = 035/45kt. Calculate the drift and GS?

a. 1L - 205 kt.
b. 1L - 202 kt.
c. 1R - 205 kt
d. 1R - 202 kt.

CRP5 66.
Given: TAS = 132 kt, HDG (T) = 053°, W/V = 205/15kt. Calculate the Track (°T) and GS?

a. 050 - 150 kt.
b. 055 - 145 kt.
c. 050 - 145 kt.

d. 055 - 140 kt.

CRP5 67.
Given: TAS = 90 kt, HDG (T) = 355°, W/V = 120/20kt. Calculate the Track (°T) and GS?

a. 344 - 102 kt
b. 346 - 102 kt.
c. 003 - 102 kt
d. 346 - 106 kt

CRP5 68.
Given: TAS = 485 kt, HDG (T) = 168°, W/V = 130/75kt. Calculate the Track (°T) and GS?

a. 174 - 428 kt.
b. 172 - 428 kt.
c. 170 - 425 kt
d. 179 - 425 kt

CRP5 69.
Given: TAS = 155 kt, Track (T) = 305°, W/V = 160/18kt. Calculate the HDG (°T) and GS?

a. 301 - 165 kt
b. 301 - 169 kt.
c. 293 - 169 kt.
d. 293 - 165 kt.

CRP5 70.
Given: TAS = 130 kt, Track (T) = 003°, W/V = 190/40kt. Calculate the HDG (°T) and GS?

a. 001 - 170 kt.
b. 003 - 170 kt
c. 000 - 172 kt.
d. 001 - 175 kt

CRP5 71.
Given: TAS = 227 kt, Track (T) = 316°, W/V = 205/15kt. Calculate the HDG (°T) and GS?

a. 310 - 232 kt.
b. 314 - 230 kt.
c. 312 - 232 kt.

d. 310 - 222 kt.

CRP5 72.
Given: TAS = 465 kt, Track (T) = 007°, W/V = 300/80kt. Calculate the HDG (°T) and GS?

a. 358 - 428 kt.
b. 356 - 428 kt
c. 358 - 420 kt.
d. 356 - 424 kt.

CRP5 73.
Given: TAS = 200 kt, Track (T) = 073°, W/V = 210/20kt. Calculate the HDG (°T) and GS?

a. 077 - 210 kt.
b. 070 - 215 kt
c. 073 - 213 kt
d. 077 - 215 kt.

CRP5 74.
Given: TAS = 200 kt, Track (T) = 110°, W/V = 015/40kt. Calculate the HDG (°T) and GS?

a. 099 - 199 kt.
b. 099 - 202 kt.
c. 096 - 199 kt.
d. 096 - 200 kt.

CRP5 75.
Given: TAS = 270 kt, Track (T) = 260°, W/V = 275/30kt. Calculate the HDG (°T) and GS?

a. 261 - 240 kt.
b. 262 - 241 kt.
c. 260 - 241 kt.
d. 260 - 242 kt

CRP5 76.
Given: True HDG = 307°, TAS = 230 kt, Track (T) = 313°, GS = 210 kt. Calculate the W/V?

a. 263/30kt.
b. 260/30kt.
c. 260/33kt.

d. 263/33kt

CRP5 77.
Given: True HDG = 233°, TAS = 480 kt, Track (T) = 240°, GS = 523 kt.
Calculate the W/V?

a. 110/75kt.
b. 109/70kt.
c. 110/80kt.
d. 109/80kt.

CRP5 78.
Given: True HDG = 133°, TAS = 225 kt, Track (T) = 144°, GS = 206 kt.
Calculate the W/V?

a. 072/50kt
b. 072/45kt.
c. 075/50kt.
d. 075/40kt.

CRP5 79.
Given: True HDG = 074°, TAS = 230 kt, Track (T) = 066°, GS = 242 kt.
Calculate the W/V?

a. 180/40kt.
b. 175/45kt.
c. 180/50kt.
d. 180/35kt.

CRP5 80.
Given: True HDG = 206°, TAS = 140 kt, Track (T) = 207°, GS = 135 kt.
Calculate the W/V?

a. 183/05kt.
b. 179/04kt
c. 184/03kt
d. 180/05kt.

CRP5 81.
Given: True HDG = 054°, TAS = 450 kt, Track (T) = 059°, GS = 416 kt.
Calculate the W/V?

a. 010/50kt.
b. 008/40kt.
c. 010/40kt.

d. 012/45kt.

CRP5 82.
Given: True HDG = 145°, TAS = 240 kt, Track (T) = 150°, GS = 210 kt.
Calculate the W/V?

a. 112/30kt
b. 118/33kt
c. 115/35kt.
d. 115/40kt.

CRP5 83.
Given: True HDG = 002°, TAS = 130 kt, Track (T) = 353°, GS = 132 kt.
Calculate the W/V?

a. 090/25kt.
b. 095/20kt
c. 090/30kt
d. 098/25kt.

CRP5 84.
Given: True HDG = 035°, TAS = 245 kt, Track (T) = 046°, GS = 220 kt.
Calculate the W/V?

a. 340/55kt.
b. 340/50kt.
c. 345/50kt.
d. 340/45kt.

CRP5 85.
Given: course required = 085° (T), Forecast W/V 030/100kt, TAS = 470 kt, Distance = 265 NM. Calculate the true HDG and flight time?

a. 075°, 39 min.
b. 075°, 42 min.
c. 070°, 39 min.
d. 073°, 42 min

CRP5 86.
Given: True course from A to B = 090°, TAS = 460 kt, W/V = 360/100kt, Average variation = 10°E, Deviation = -2°. Calculate the compass heading and GS?

a. 069° - 448 kt.
b. 065° - 449 kt.

c. 067° - 446 kt.
d. 069° - 458 kt.

CRP5 87.
For a landing on runway 23 (227° magnetic) surface W/V reported by the ATIS is 180/30kt. VAR is 13°E. Calculate the cross wind component?

a. 20 kt.
b. 22 kt.
c. 25 kt
d. 19 kt.

CRP5 88.
Given: Maximum allowable tailwind component for landing 10 kt. Planned runway 05 (047° magnetic). The direction of the surface wind reported by ATIS 210°. Variation is 17°E. Calculate the maximum allowable windspeed that can be accepted without exceeding the tailwind limit?

a. 5 kt.
b. 18 kt.
c. 14 kt.
d. 11 kt.

CRP5 89.
Given: Maximum allowable crosswind component is 20 kt. Runway 06, RWY QDM 063°(M). Wind direction 100°(M) Calculate the maximum allowable windspeed?

a. 33 kt.
b. 30 kt.
c. 36 kt.
d. 26 kt

CRP5 90.
Given: True course A to B = 250° Distance A to B = 315 NM TAS = 450 kt. W/V = 200°/60kt. ETD A = 0650 UTC. What is the ETA at B?

a. 0726 UTC.
b. 0659 UTC.
c. 0732 UTC.
d. 0736 UTC.

CRP5 91.
Given: GS = 510 kt. Distance A to B = 43 NM What is the time (MIN) from A to B?

a. 5.
b. 4.5.
c. 4.
d. 6.5.

CRP5 92.
Given: GS = 122 kt. Distance from A to B = 985 NM. What is time from A to B?

a. 6 hr 15 min.
b. 8 hr 04 min.
c. 8 hr 24 min.
d. 4 hr 08 min.

CRP5 93.
Given: GS = 236 kt. Distance from A to B = 354 NM. What is time from A to B?

a. 1hr 35 min.
b. 2 hr 03 min.
c. 1 hr 15 min.
d. 1 hr 30 min.

CRP5 94.
Given: GS = 435 kt. Distance from A to B = 1920 NM. What is time from A to B?

a. 4 hr 30 min.
b. 4 hr 20 min.
c. 4 hr 35 min.
d. 4 hr 25 min.

CRP5 95.
Given: GS = 345 kt. Distance from A to B = 3560 NM. What is time from A to B?

a. 10 hr 23 min.
b. 10 hr 15 min.
c. 10 hr 25 min.
d. 10 hr 19 min.

CRP5 96.
Given: GS = 480 kt. Distance from A to B = 5360 NM. What is time from A to B?

a. 11 hr 10 min.
b. 11 hr 15 min.
c. 11 hr 20 min.
d. 11 hr 1 min.

CRP5 97.
Given: GS = 95 kt. Distance from A to B = 480 NM. What is time from A to B?

a. 5 hr 05 min.
b. 5 hr 10 min.
c. 5 hr 03 min.
d. 5 hr 08 min.

CRP5 98.
Given: GS = 105 kt. Distance from A to B = 103 NM. What is time from A to B?

a. 00 hr 59 min.
b. 00 hr 50 min.
c. 00 hr 45 min.
d. 00 hr 54 min.

CRP5 99.
Given: GS = 120 kt. Distance from A to B = 84 NM. What is time from A to B?

a. 00 hr 40 min.
b. 00 hr 44 min.
c. 00 hr 41 min.
d. 00 hr 42 min.

CRP5 100.
Given: GS = 135 kt. Distance from A to B = 433 NM. What is time from A to B?

a. 3 hr 16 min.
b. 3 hr 12 min.
c. 3 hr 20 min.
d. 2 hr 05 min.

CRP5 101.
Given: Runway direction 083°(M), Surface W/V 035/35kt. Calculate the effective headwind component?

a. 24 kt.
b. 20 kt.
c. 22 kt.
d. 26 kt.

CRP5 102.
Given: For take-off an aircraft requires a headwind component of at least 10 kt and has a cross-wind limitation of 35 kt. The angle between the wind direction

and the runway is 60°, calculate the minimum and maximum allowable wind speeds?

a. 20 kt and 40 kt.
b. 20 kt and 45 kt.
c. 25 kt and 35 kt.
d. 25 kt and 30 kt.

CRP5 103.
Given: Runway direction 230°(T), Surface W/V 280°(T)/40 kt. Calculate the effective cross-wind component?

a. 31 kt.
b. 25 kts.
c. 33 kts.
d. 34 kts.

CRP5 104.
Given: Magnetic track = 075°, HDG = 066°(M), VAR = 11°E, TAS = 275 kt Aircraft flies 48 NM in 10 MIN. Calculate the true W/V °?

a. 345°/40 kt.
b. 340°/35 kt.
c. 340°/45 kt.
d. 345°/35 kt

CRP5 105.
Given: Magnetic track = 210°, Magnetic HDG = 215°, VAR = 15°E, TAS = 360 kt, Aircraft flies 64 NM in 12 MIN. Calculate the true W/V?

a. 265°/50 kt.
b. 265°/40 kt.
c. 260°/50 kt.
d. 260°/40 kt

CRP5 106.
Given: Course 040°(T), TAS is 120 kt, Wind speed 30 kt. Maximum drift angle will be obtained for a wind direction of:

a. 120°.
b. 130°.
c. 210°.
d. 330°.

CRP5 107.
Given: IAS 120 kt, FL 80, OAT +20°C. What is the TAS?

a. 145 kts.
b. 135 kts.
c. 144 kts.
d. 141 kts.

CRP5 108.
Given: FL120, OAT is ISA standard, CAS is 200 kt, Track is 222°(M), Heading is 215°(M), Variation is 15°W. Time to fly 105 NM is 21 MIN. What is the W/V?

a. 050°(T) / 75 kt.
b. 070°(T) / 70 kt.
c. 050°(T) / 50 kt.
d. 050°(T) / 70 kt.

CRP5 109.
Given: Course 095°(T), TAS is 220 kt, Wind speed 70 kt. Maximum drift angle will be obtained for a wind direction of:

a. 165°.
b. 185°.
c. 215°.
d. 335°.

CRP5 110.
What is the time to go if groundspeed is 240 knots distance to go is 500 nm?

a. 25 Min.
b. 29 Min.
c. 125 Min.
d. 134 Min.

CRP5 111.
What is the ETA at Z if TAS = 120 Kts?

ATA 'X' is 1232 UTC ETA 'Y' is 1247 UTC ATA 'Y' is 1252 UTC

a. 1255 UTC.
b. 1320 UTC.
c. 1330 UTC.
d. 1325 UTC.

CRP5 112.
What is the ETA at C?

ATA 'A' is 1010 UTC ETA 'B' is 1030 UTC ATA 'B' is 1027

a. 1035.
b. 1040.
c. 1036.
d. 1038.

CRP5 113.
What is the ETA at Z?

ATA 'X' is 1420 UTC ETA 'Y' is 1447 UTC ATA 'Y' is 1450 UTC?

a. 1506.
b. 1510.
c. 1512.
d. 1515.

CRP5 114.
What is the true altitude if OAT = +35°C and Pressure Altitude = 5000 feet?

a. 4290 ft.
b. 4555 ft.
c. 5320 ft.
d. 5550 ft.

CRP5 115.
What is the true altitude if OAT = +30°C and Pressure Altitude = 7000 feet?

a. 7750 ft.
b. 7555 ft.
c. 7320 ft.
d. 7050 ft.

CRP5 116.
Given: IAS 125 kt, FL 60, OAT +25°C. What is the TAS?

a. 142 kts.
b. 115 kts.

c. 124 kts.
d. 121 kts.

CRP5 117.
Given: IAS 130 kt, FL 160, OAT +5°C. What is the TAS?

a. 162 kts.
b. 173 kts.
c. 154 kts.
d. 181 kts.

CRP5 118.
What is the time to go if groundspeed is 440 knots distance to go is 500 nm?

a. 68 Min.
b. 59 Min.
c. 120 Min.
d. 114 Min.

CRP5 119.
How far will an aircraft fly in 42 minutes at a ground speed of 400 knots?

a. 328 Min.
b. 305 Min.
c. 280 Min.
d. 260 Min.

CRP5 120.
How far will an aircraft fly in 47 minutes at a ground speed of 420 knots?

a. 338 Min.
b. 329 Min.
c. 380 Min.
d. 360 Min.

CRP5 121.
Given: IAS 130 kt, FL 60, OAT +20°C. What is the TAS?

a. 139.5 kt.
b. 149.0 kt.
c. 150.0 kt.
d. 146.5 kt.

CRP5 122.
Given: IAS 110 kt, FL 20, OAT +25°C. What is the TAS?

a. 116 kt.
b. 119 kt.
c. 121 kt.
d. 113 kt.

CRP5 123.
Given: IAS 100 kt, FL 45, OAT +15°C. What is the TAS?

a. 108.5 kt.
b. 119.5 kt.
c. 112.0 kt.
d. 113 5 kt.

CRP5 124.
Given: IAS 97 kt, FL 75, OAT -15°C. What is the TAS?

a. 111.5 kt.
b. 107.5 kt.
c. 109.0 kt.
d. 105 5 kt.

CRP5 125.
Given: IAS 89 kt, FL 25, OAT +10°C. What is the TAS?

a. 92.5 kt.
b. 91.0 kt.
c. 90.5 kt.
d. 95 5 kt.

ANNEX A AERONAUTICAL CHART SYMBOLS

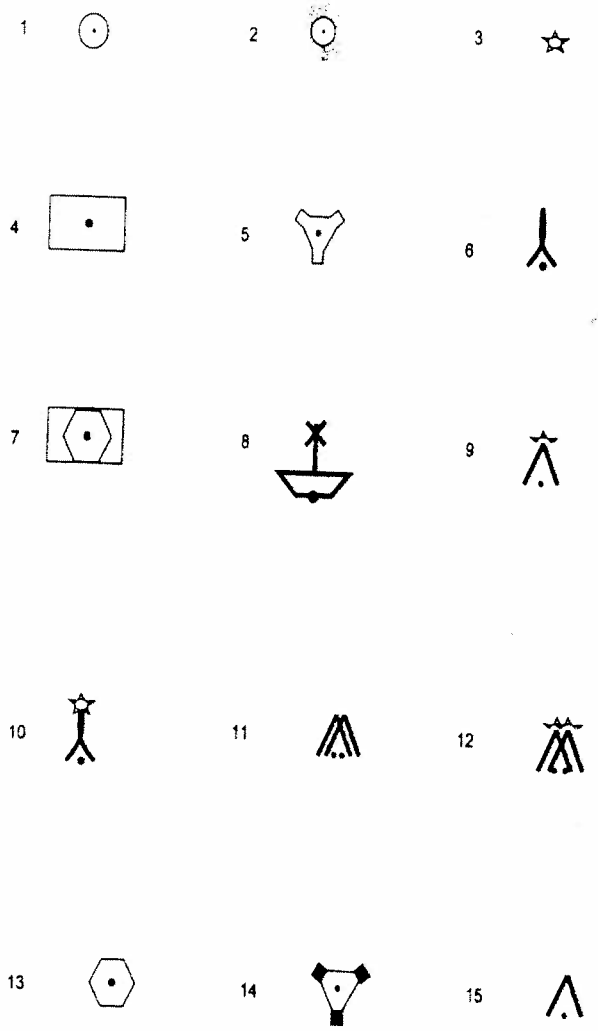


CHART THEORY 1.
A negative (westerly) magnetic variation signifies that?

a. True North is East of Magnetic North.
b. True North Is West of Magnetic North.
c. Magnetic North is West of Compass North.
d. Magnetic North Is East of Compass North.

CHART THEORY 2.
The nominal scale of a Lambert conformal conic chart is the?

a. Scale at the standard parallels.
b. Scale at the Equator.
c. Scale at the midway point between the two standard parallels .
d. Everywhere on the chart.

CHART THEORY 3.
A positive (easterly) magnetic variation signifies that?

a. True North Is East of Magnetic North.
b. True North is West of Magnetic North.
c. Magnetic North Is West of Compass North.
d. Magnetic North is East of Compass North.

CHART THEORY 4.
The chart that is generally used for navigation in polar areas is based on a?

a. Lambert's Conformal.
b. Transverse Mercator.
c. Stereographical projection.
d. Direct Mercator.

CHART THEORY 5.
On a Lambert conformal conic chart the convergence of the meridians is?

a. The same as earth convergency at the parallel of origin.
b. The same as the scale.
c. Most accurate at the standard parallels .
d. Least accurate at the parallel of origin.

CHART THEORY 6.
On a Direct Mercator chart, a rhumb line appears as a?

a. Curve concave to the nearest poles.
b. Curve conjvex to the nearest pole.

c. Straight line.
d. Curve convex to the equator.

CHART THEORY 7.
On a Lambert conformal conic projection, with two standard parallels the scale is?

a. Correct only along the parallel of origin.
b. Correct only at the poles.
c. Correct only along the standard parallels.
d. Correct at all points on the chart.

CHART THEORY 8.
On a Lambert conformal conic chart, with two standard parallels, the quoted scale is correct?

a. Midway between the two standard parallels.
b. Only along the two standard parallels.
c. Only at the parallel of origin.
d. Only at the centre of the chart.

CHART THEORY 9.
On a Direct Mercator chart a great circle will be represented by a?

a. Straight lines.
b. Curves convex to the equator.
c. Curve concave to the equator.
d. Curves concave to the nearest pole.

CHART THEORY 10.
On a Lambert Conformal Conic chart earth convergency is most accurately represented at the?

a. Standard parallels.
b. Outside the standard parallels.
c. At all points between the standard parallels.
d. Parallel of origin.

CHART THEORY 11.
On a Transverse Mercator chart, scale is exactly correct along the?

a. Meridian of tangency.
b. Prime meridian.
c. Standard latitudes.
d. latitude of origin.

CHART THEORY 12.
The angular difference, on a Lambert conformal conic chart, between the arrival and departure track is equal to?

a. Departure angle.
b. Map convergence.
c. Secant of ½ latitude.
d. Secant of longitude.

CHART THEORY 13.
Parallels of latitude, except the equator, are?

a. Rhumb lines.
b. Great circles.
c. Curves convex to the nearest pole.
d. Curves concave to the nearest pole.

CHART THEORY 14.
On a Direct Mercator chart, meridians are?

a. Parallel, equally spaced, horizontal straight lines.
b. Conveging curved lines.
c. Parallel, equally spaced, vertical straight lines.
d. Diverging curved lines.

CHART THEORY 15.
On which of the following chart projections is it not possible to represent the north or south poles?

a. Polar Stereographic.
b. Transverse Mercator.
c. Lambert's Conical.
d. Direct Mercator.

CHART THEORY 16.
Which one of the following, concerning great circles on a Direct Mercator chart, is correct?

a. With the exception of meridians and the equator, they are curves concave to the equator.
b. Straight lines.
c. Curves concave to the nearest pole.
d. With the exception of meridians and the equator, as curves convex to the equator.

CHART THEORY 17.

On a Lambert conformal conic chart, the distance between parallels of latitude spaced the same number of degrees apart?

a. Increases between and reduces outside of the standard parallels.
b. Reduces between, and expands outside, the standard parallels.
c. Is constant between the standard parallels.
d. Is constant outside of the standard parallels.

CHART THEORY 18.

Which one of the following statements is correct concerning the appearance of great circles, with the exception of meridians, on a Polar Stereographic chart whose tangency is at the pole?

a. The higher the latitude the closer they approximate to a straight line.
b. The lower the latitude the closer they approximate to straight lines.
c. Never approximate to straight lines.
d. Always approximate to straight lines.

CHART THEORY 19.

Which one of the following describes the appearance of rhumb lines, except meridians, on a Polar Stereographic chart?

a. Straight lines.
b. Curves concave to the Pole.
c. Approximately straight lines.
d. Curves closer to the pole than the equivalent Great Circle.

CHART THEORY 20.

What is the value of the convergence factor on a Polar Stereographic chart?

a. 2.0.
b. 1.5.
c. 1.0.
d. 0.5.

CHART THEORY 21.

On a Direct Mercator, rhumb lines are?

a. Straight lines.
b. Cuves concave to the nearest pole.
c. Curves convex to the nearest pole.
d. Curves concave to the Equator.

CHART THEORY 22.

A perfectly straight line on a Lamberts chart is?

a. A parallel of latitude.
b. A rhumb line.
c. A meridian of longitude.
d. A great circle.

CHART THEORY 23.

Which of the following statements best describes how scale varies on a Mercator chart?

a. It is correct on the standard parallels, but expands outside them, and contracts within them.
b. Expands as the secant of the East/West great circle distance.
c. Expands as the secant (½ x co-latitude).
d. Expands directly with the secant of the latitude.

CHART THEORY 24.

How do rhumb lines, (other than meridians), appear on Polar Stereographic charts?

a. As straight lines.
b. As lines concave to the nearer pole.
c. As lines convex to the nearer pole.
d. As ellipses around the pole.

CHART THEORY 25.

Where is the convergency correct on a Transverse Mercator chart?

a. At the datum meridian and the Equator.
b. Only at the Equator and Poles.
c. Only at the datum meridian.
d. At the Parallel of Origin.

CHART THEORY 26.

In which of the following projections will a plane surface touch the reduced earth at one of the Poles?

c. Lambert's.
d. Direct Mercator.
a. Transverse Mercator.
d. Stereographic.

CHART THEORY 27.
How are great circles shown on a direct Mercator chart?

a. Curves concave to the nearest pole.
b. Curves convex to the nearest pole.
c. Straight lines.
d. Rhumb lines.

CHART THEORY 28.
The scale on a Lambert's conformal conic chart?

a. Is constant.
b. Is constant along a parallel of latitude.
c. Is constant along a meridian of longitude.
d. Varies slightly as a function of longitude and latitude.

CHART THEORY 29.
The scale is correct on a Transverse Mercator chart?

a. Along the datum meridian and meridians at 90° to it.
b. At the prime meridian.
c. Along the great circle of tangency.
d. At the poles and the equator.

CHART THEORY 30.
What is the symbol for an FIR boundary?

a. .....
b. -
c. .-.-.-.

a. 1.
b. 3.
c. 7.
d. 14.

CHART THEORY 38.
Please refer to 58. Which of the following is the symbol for an exceptionally high (over 300m above terrain) lighted obstruction?

a. 9.
b. 11.
c. 10.
d. 15.

CHART THEORY 39.
Please refer to page 58. Which of the following is the symbol for an unlighted obstacle?

a. 9.
b. 11.
c. 10.
d. 15.

CHART THEORY 40.
Please refer to page 58. Which of the following is the symbol for a group of obstacles?

a. 9.
b. 11.
c. 10.
d. 15.

CHART THEORY 41.
Please refer to page 58. Which of the following is the symbol for a VOR DME?

a. 4.
b. 5.
c. 7.
d. 14.

CHART THEORY 42.
Please refer to page 58. Which of the following is the symbol for a VOR TAC?

a. 4.
b. 5.

c. 7.
d. 14.

CHART THEORY 43.
Please refer to page 58. Which of the following is the symbol for a TACAN?

a. 4.
b. 5.
c. 7.
d. 14.

CHART THEORY 44.
Please refer to page 58. Which of the following is the symbol for a DME?

a. 4.
b. 5.
c. 7.
d. 14.

CHART THEORY 45.
Please refer to page 58. Which of the following is the symbol for an NDB?

a. 1.
b. 2.
c. 3.
d. 4.

CHART THEORY 46.
Please refer to page 58. Which of the following is the symbol for a lighted group of obstacles?

a. 9.
b. 10.
c. 11.
d. 12.

CHART THEORY 47.
Please refer to page 58. Which of the following is the symbol for a lighted Obstacle?

a. 9.
b. 10.
c. 11.
d. 12.

CHART THEORY 48.
Please refer to page 58. Which of the following is the symbol for a lighted group of obstacles?

a. 6.
b. 10.
c. 11.
d. 12.

CHART THEORY 49.
The nominal scale of a Lambert conformal conic chart is the?

a. Scale at the standard parallels.
b. Scale at the parallel of origin.
c. Scale at the poles.
d. Constant at all points on the chart.

CHART THEORY 50.
What type of projection is generally used for charts used for navigation in North and South polar areas?

a. Lanbert's Conformal.
b. Polar Stereographical projection.
c. Direct Mercator.
d. Oblique Mercator.

CIRCLES 1.
A great circle track joins position A (59° S 141°W) and B (61° S 148°W). What is the difference between the great circle track at A and B?

a. It increases by 6°.
b. It decreases by 6°.
c. It increases by 3°.
d. It decreases by 3°.

CIRCLES 2.
Given: Position A 45° N, ?° E, Position B 45° N, 45° 15'E Distance A-B = 280 NM, B is to the East of A, What is the longitude of position A?

a. 38° 39'E.
b. 49° 57'E.
c. 51° 51'E.
d. 40° 33'E.

CIRCLES 3.
A Lambert conformal conic chart has a constant of the cone of 0.75. The initial course of a straight-line track drawn on this chart from A (40° N 050° W) to B is 043° (T) at A; course at B is 055° (T). What is the longitude of B?

a. 34°W.
b. 36°W.
c. 38°W.
d. 41°W.

CIRCLES 4.
What is the great circle track (measured from the starting position) from 70°S 030°W, to 70°S 060°E?

a. 048°T.
b. 090°T.
c. 132°T.
d. 228°T.

CIRCLES 5.
What is the longitude of a position 6 NM to the east of 58° 42'N 094° 00'W?

a. 093° 53.1'W.
b. 094° 12.0'W.
c. 093° 48.5'W.
d. 093° 54.0'W.

CIRCLES 6.
As the INS position of the departure aerodrome, coordinates 35° 32.7'N 139° 46.3'W are input instead of 35° 32.7'N 139° 46.3'E. When the aircraft subsequently passes point 52° N 180°W, the longitude value shown on the INS will be?

a. 080° 27.4'W.
b. 099° 32.6'W.
c. 099° 32.6'E.
d. 080° 27.4'E.

CIRCLES 7.
An aircraft files the following rhumb line tracks and distances from position 04° 00'N 030° 00'W: 600 NM South, then 600 NM East, then 600 NM North, then 600 NM West. The final position of the aircraft is?

a. 04° 00'N 030° 00'W.
b. 03° 58'N 030° 02'W.

c. 04° 00'N 029° 55'W.
d. 04° 00'N 030° 02'W.

CIRCLES 8.
Which of the following differences in latitude will produce the greatest difference between the initial great circle track and the mean great circle track, between two points, which are separated by 10° change of longitude?

a. 30°S and 25°S.
b. 30°S and 30°N.
c. 60°N and 55°N.
d. 60°N and 60°S.

CIRCLES 9.
What is the final position after the following rhumb line tracks and distances have been followed from position 60° 00'N 030° 00'W? South for 3600 NM, East for 3600 NM, North for 3600 NM, West for 3600 NM?

a. 59° 00'N 090° 00'W.
b. 60° 00'N 090° 00'W.
c. 60° 00'N 030° 00'E.
d. 59° 00'N 060° 00'W.

CIRCLES 10.
The Great Circle bearing of 'B' (70° S 060° E), from 'A' (70° S 030° W), is approximately?

a. 150° (T).
b. 090° (T).
c. 315° (T).
d. 135° (T).

CIRCLES 11.
An aircraft at position 60° N 005° W tracks 090° (T) for 315 km. On completion of the flight the longitude will be?

a. 002° 10'W.
b. 000° 15'E.
c. 000° 40'E.
d. 005° 15'E.

CIRCLES 12.
An aircraft autopilot is coupled to the INS steering from Waypoint 1 at 60°N 040°W. to Waypoint 2 at 60°N 030°W. What is the approximate latitude of the aircraft on passing 35°W?

a. 60°05'N.
b. 60°19'N.
c. 60°30'N.
d. 59°15'N.

CIRCLES 13.
A Lambert conformal conic chart has a constant of the cone of 0.80. A straight line course drawn on this chart from A (53° N 004°W) to B is 080° at A Course at B is 092° (T). What is the longitude of B?

a. 011° E.
b. 009° 36'E.
c. 008° E.
d. 019° E.

CIRCLES 14.
An aircraft is flying with the aid of an inertial navigation system (INS) connected to the autopilot. The following points have been entered in the INS computer: WPT 1: 60° N 030°W, WPT 2: 60° N 020°W. When 025° W has been passed, the latitude shown on the display unit of the inertial navigation system will be?

a. 60° 10.0'N.
b. 59° 49.0'N.
c. 60° 11.0'N.
d. 60° 05.0'N.

CIRCLES 15.
The 'departure' between positions 60°N 160° E and 60° N 'x' is 900 NM. What is the longitude of 'x'?

a. 170°W.
b. 140°W.
c. 145° E.
d. 175° E.

CIRCLES 16.
Given: The autopilot is coupled to the Inertial Navigation System steering from Waypoint 1 at 60°N 030°W, to Waypoint 2 at 60°N 020°W, to Waypoint 3 at 60°N 010°W. What is the approximate track change on passing WPT 2?

a. Zero.
b. 4° decrease.
c. 9° decrease.
d. 9° increase.

CIRCLES 17.
An aircraft autopilot is coupled to the INS steering from Waypoint 1 at 60°N 050°W, to Waypoint 2 at 60°N 040°W. What is the approximate latitude of the aircraft on passing 45°W?

a. 60°30'N.
b. 59°15'N.
c. 60°05'N.
d. 60°19'N.

CIRCLES 18.
The 'departure' between positions 60°N 160° E and 60° N 'x' is 1200 NM. What is the longitude of 'x'?

a. 160°W.
b. 140°W.
c. 145° E.
d. 175° E.

CIRCLES 19.
The 'departure' between positions 60°N 60° E and 60° N 'x' is 1800 NM East. What is the longitude of 'x'?

a. 145° E.
b. 145° E.
c. 120°E.
d. 120°W.

CIRCLES 20.
An aircraft with its autopilot connected to its inertial system, flies from point A at 45°S 010°W, to point B at 45°S 030°W. What is the true course of the aircraft (to the nearest degree) when it arrives at B?

a. 265°.
b. 275°.
c. 277°.
d. 286°.

CIRCLES 21.
The automatic flight control system (AFCS) in an aircraft is coupled to the guidance outputs from an inertial navigation system (INS). The aircraft is flying between inserted waypoints No. 3 (55° 00'N 020° 00'W) and No.4 (55° 00'N 030° 00'W). With DSRTK/STS selected on the CDU, to the nearest whole degree, the initial track read-out from waypoint No. 3 will be?

a. 266°.
b. 270°.
c. 274°.
d. 278°.

CIRCLES 22.
An aeroplane flies from A (59° S 142° W) to B (61° S 148° W) with a TAS of 480 kt. The autopilot is engaged and coupled with an Inertial Navigation System in which AB track is active. On route AB, the true track?

a. Varies by 10°.
b. Decreases by 6°.
c. Varies by 4°.
d. Increases by 5°.

CIRCLES 23.
The automatic flight control system is coupled to the guidance outputs from an inertial navigation system. Which pair of latitudes will give the greatest difference between initial track read-out and the average true course given, in each case, a difference of longitude of 10°?

a. 60° N to 60°N.
b. 60° N to 50°N.
c. 30° S to 30°N.
d. 30° S to 25°S.

CIRCLES 24.
Position A is 55°N 030°W and B is 54°N 020°W. What is the rhumb line bearing from A to B, if the great circle track from A to B, measured at A, is 100°T?
a. 110°T.
b. 284°T.
c. 104°T.
d. 090°T.

CIRCLES 25.
The automatic flight control system (AFCS) in an aircraft is coupled to the guidance outputs from an inertial navigation system (INS) and the aircraft is flying from waypoint No. 2 (60° 00'S 070° 00'W) to No. 3 (60° 00'S 080° 00'W). Comparing the initial track (° T) at 070° 00'W and the final track (° T) at 080° 00'W, the difference between them is that the initial track is approximately?

a. 9° greater than the final one.
b. 5° less than the final one.
c. 9° less than the final one.
d. 5° greater than the final one.

CIRCLES 26.
An aircraft travels from point A to point B, using the autopilot connected to the aircraft's inertial system. The coordinates of A (45° S 010°W) and B (45° S 030°W) have been entered. The true course of the aircraft on its arrival at B, to the nearest degree, is?

a. 277°.
b. 284°.
c. 263°.
d. 270°.

CIRCLES 27.
The following points are entered into an inertial navigation system (INS). WPT 1: 60° N 30°W, WPT 2: 60° N 20°W, WPT 3: 60° N 10°W. The inertial navigation system is connected to the automatic pilot on route (1-2-3). The track change when passing WPT 2 will be approximately?

a. Zero.
b. A 9° increase.
c. A 4° decrease.
d. A 9° decrease.

CIRCLES 28.
What is a rhumb line?

a. The vertex of a conformal polyformic projection.
b. The shortest distance between any two points on the Earth's surface.
c. A straight line on a Lambert's conformal chart.
d. A line on the Earth which cuts all meridians at the same angle.

CIRCLES 29.
Given: Waypoint 1. 60° S 030°W, Waypoint 2. 60° S 020°W. What will be the approximate latitude shown on the display unit of an inertial navigation system at longitude 025°W?

a. 060° 11'S.
b. 059° 49'S.
c. 060° 00'S.
d. 060° 06'S.

CIRCLES 30.
In order to fly from position A (10° 00'N, 030° 00'W) to position B (30° 00'N, 050° 00'W), maintaining a constant true course, it is necessary to fly?

a. The great-circle route.

b. A straight line plotted on a Lambert chart.
c. A rhumb line track.
d. The constant average drift route.

CIRCLES 31.
The angle between the true great-circle track and the true rhumb line track joining the following points: A (60° S 165° W) B (60° S 177° E), at the place of departure A, is?

a. 7.8°.
b. 9°.
c. 15.6°.
d. 5.2°.

CIRCLES 32.
Which of the following is true of all parallels of latitude?

a. They are neither rhumb lines nor great circles.
b. They are rhumb lines but not great circles.
c. They are both rhumb lines and great circles.
d. They are great circles but not rhumb lines.

CIRCLES 33.
An aircraft departs from position A (04° 10' S 178° 22'W) and flies northward following the meridian for 2950 NM. It then flies westward along the parallel of latitude for 382 NM to position B. The coordinates of position B are?

a. 53° 20'N 172° 38'E.
b. 45° 00'N 172° 38'E.
c. 53° 20'N 169° 22W.
d. 45° 00'N 169° 22W.

CIRCLES 34.
A Rhumb line is?

a. A line convex to the nearest pole on a Mercator projection.
b. A line on the surface of the earth cutting all meridians at the same angle.
c. The shortest distance between two points on a Polyconic projection.
d. Any straight line on a Lambert projection.

CIRCLES 35.
Given: A is N55° 000° B is N54° E010°. The average true course of the great circle is 100°. The true course of the rhumb line at point A is?

a. 096°.

b. 104°.
c. 107°.
d. 100°.

CIRCLES 36.
An aircraft passes position A (60° 00'N 120° 00'W) on route to position B (60° 00'N 140° 30'W). What is the great circle track on departure from A?

a. 279°.
b. 288°.
c. 261°.
d. 270°.

CIRCLES 37.
Parallels of latitude, except the equator, are?

a. Rhumb lines.
b. Great circles.
c. Both Rhumb lines and Great circles.
d. Neither Rhumb lines nor Great circles.

CIRCLES 38.
Given: The coordinates of the heliport at Issy les Moulineaux are N48° 50' E002° 16.5'. The coordinates of the antipodes are?

a. S41° 10' W177° 43.5'.
b. S41° 10' E177° 43.5'.
c. S48° 50' W177° 43.5'.
d. S48° 50' E177° 43.5'.

CIRCLES 39
On a Lambert Conformal Conic chart great circles that are not meridians are?

a. Curves concave to the pole of projection.
b. Straight lines within the standard parallels.
c. Curves concave to the parallel of origin.
d. Straight lines regardless of distance.

CIRCLES 40.
On a Direct Mercator chart, a rhumb line appears as a?

a. Curves convex to the Equator.
b. Curves concave to the nearest pole..
c. Straight line.
d. Complex curves cancave to the Equator..

CIRCLES 41.
On a polar stereographic projection chart showing the South Pole, a straight line joins position A (70° S 065° E) to position B (70° S 025° W). The true course on departure from position A is approximately?

a. 315°.
b. 225°.
c. 250°.
d. 135°.

CIRCLES 42.
On a Direct Mercator chart a great circle will be represented by a?

a. Straight lines.
b. Complex curves convex to the Equator.
c. Curve concave to the equator.
d. Complex curves concave to the Poles.

CIRCLES 43.
Parallels of latitude, except the equator, are?

a. Rhumb lines.
b. Complex curves.
c. Great circle.
d. Curves convex to the nearest pole.

CIRCLES 44.
On a Direct Mercator chart a great circle will be represented by a?

a. Curve convex to the equator.
b. Curve concave to the equator.
c. Complex curve.
d. Straight line.

CIRCLES 45.
Which one of the following, concerning great circles on a Direct Mercator chart, is correct?

a. With the exception of meridians and the equator, they are curves concave to the equator.
b. Their centre cannot be that of the Earth.
c. They are represented by straight lines.
d. They do not include the meridians nor the equator.

CIRCLES 46.
On a Direct Mercator chart, a rhumb line appears as a?

a. Small circle concave to the nearer pole.
b. Spiral curve.
c. Curve convex to the nearer pole.
d. Straight line.

CIRCLES 47.
Which one of the following statements is correct concerning the appearance of great circles, with the exception of meridians, on a Polar Stereographic chart whose tangency is at the pole ?

a. The higher the latitude the closer they approximate to a straight line.
b. The lower the latitude the closer they approximate to a straight line.
c. They are all represented by straight lines.
d. They can never be approximated as straight lines.

CIRCLES 48.
A perfectly straight line on a Lamberts chart is?

a. A parallel of latitude.
b. A rhumb line.
c. A meridian of longitude.
d. A great circle.

CIRCLES 49.
How do rhumb lines, (other than meridians), appear on Polar Stereographic charts?

a. As straight lines.
b. As lines concave to the nearer pole.
c. As lines convex to the nearer pole.
d. As ellipses around the pole.

CIRCLES 50.
How are great circles shown on a direct Mercator chart?

a. Curves concave to the nearest pole.
b. Curves convex to the nearest pole.
c. Straight lines.
d. Rhumb lines.

CIRCLES 51.
On a Polar Stereographic chart, the initial great circle course from A 70° N 060° W to B 70° N 060° E is approximately?

a. 030° (T).
b. 330° (T).
c. 150° (T).
d. 210° (T).

CIRCLES 52.
A straight line on a Lambert Conformal Projection chart for normal flight planning purposes?

a. Is approximately a Great Circle.
b. Is a Loxodromic line.
c. Is a Rhumb line.
d. Can only be a parallel of latitude.

CIRCLES 53.
On a Direct Mercator, rhumb lines are?

a. Ellipses.
b. Curves convex to the equator.
c. Straight lines.
d. Curves concave to the equator.

CIRCLES 54.
Which one of the following describes the appearance of rhumb lines, except meridians, on a Polar Stereographic chart?

a. Ellipses around the Pole.
b. Curves convex to the Pole.
c. Straight lines.
d. Curves concave to the Pole.

CIRCLES 55.
On a Lambert chart (standard parallels 37° N and 65° N), with respect to the straight line drawn on the map between A (N49° W030°) and B (N48° W040°), the?

a. Great circle and rhumb line are to the south.
b. Great circle and rhumb line are to the north.
c. Great circle is to the north, the rhumb line is to the south.
d. Rhumb line is to the north, the great circle is to the south.

CIRCLES 56.
On a polar stereographic projection chart showing the South Pole, a straight line joins position A (75°S 065°E) to position B (75°S 025°W). The true course on departure from position A is approximately?

a. 225°.
b. 450°.
c. 313°.
d. 320°.

CIRCLES 57.
Two positions plotted on a polar stereographic chart, A (80°N 000°) and B (70°N 102°W) are joined by a straight line whose highest latitude is reached at 035°W. At point B, the true course is?

a. 230°.
b. 203°.
c. 23°.
d. 30°.

CIRCLES 58.
An aircraft is flying with the aid of an inertial navigation system (INS) connected to the autopilot. The following two points have been entered in the INS computer: WPT 1: 60°S 030°W WPT 2: 60°S 020°W. When 025°W is passed the latitude shown on the display unit of the inertial navigation system will be?

a. 60°57'S.
b. 60°05.7'S.
c. 60°75'S.
d. 57°06'S.

CIRCLES 59
Given: Position A 45° N, ?° E, Position B 45° N, 45° 15'E Distance A-B = 350 NM, B is to the East of A, What is the longitude of position A?

a. 37° 00'E
b. 48° 00'E.
c. 51° 15'E.
d. 8° 15'E.

CIRCLES 60.
Given: Position A 45° N, ?° E, Position B 45° N, 45° 15'E Distance A-B = 200 NM, B is to the East of A, What is the longitude of position A?

a. 51° 20'E.
b. 48° 33'E.

c. 40° 32'E.
d. 51° 58'E.

CIRCLES 61.
A great circle track joins position A (57° S 140°W) and B (63° S 150°W). What is the difference between the great circle track at A and B?

a. It increases by 9°.
b. It decreases by 9°.
c. It increases by 6°.
d. It decreases by 6°.

CIRCLES 62.
Given: Position A 45° N, ?° E, Position B 45° N, 50° 15'E Distance A-B = 280 NM, B is to the East of A, What is the longitude of position A?

a. 43° 39'E.
b. 45° 57'E.
c. 52° 53'E.
d. 40° 33'E.

CIRCLES 63.
A Lambert conformal conic chart has a constant of the cone of 0.85. The initial course of a straight-line track drawn on this chart from A (40° N 050° W) to B is 043° (T) at A; course at B is 055° (T). What is the longitude of B?

a. 34°W.
b. 36°W.
c. 38°W.
d. 41°W.

CIRCLES 64.
What is the great circle track (measured from the starting position) from 70°S 035°W, to 70°S 065°E?

a. 048°T.
b. 090°T.
c. 137°T.
d. 228°T.

CIRCLES 65.
What is the longitude of a position 15 NM to the east of 58° 42'N 094° 00'W?

a. 093° 51.3'W.
b. 094° 13.0'W.

c. 093° 31.1'W.
d. 122° 31.1'W.

CIRCLES 66.
The INS position of the departure aerodrome, coordinates 45° 32.7'N 139° 46.3'W are input instead of the correct coordinates, 45° 32.7'N 139° 46.3'E. When the aircraft subsequently passes point 52° N 180°W, the longitude value shown on the INS will be?

a. 081° 26.4'W.
b. 099° 32.6'W.
c. 099° 32.6'E.
d. 081° 26.4'E.

CIRCLES 67.
An aircraft flies the following rhumb line tracks and distances from position 04° 00'N 030° 00'W: 700 NM South, then 700 NM East, then 700 NM North, then 700 NM West. The final position of the aircraft is?

a. 04° 00'N 030° 30'W.
b. 03° 58'N 030° 02'W.
c. 04° 00'N 029° 55'W.
d. 04° 00'N 029° 55'E.

CIRCLES 68.
Which of the following differences in latitude will produce the greatest difference between the initial great circle track and the mean great circle track, between two points, which are separated by 15° change of longitude?

a. 30°S and 25°S.
b. 30°S and 30°N.
c. 60°N and 55°N.
d. 60°N and 60°S.

CIRCLES 69.
What is the final position after the following rhumb line tracks and distances have been followed from position 60° 00'N 030° 00'W? South for 360 NM, East for 360 NM, North for 360 NM, West for 360 NM?

a. 59° 00'N 090° 00'W.
b. 60° 00'N 031° 48'W.
c. 60° 00'N 031° 48'E.
d. 59° 00'N 060° 00'W.

CIRCLES 70.
The Great Circle bearing of 'B' (70° S 050° E), from 'A' (70° S 030° W), is approximately?

a. 150° (T).
b. 090° (T).
c. 115° (T).
d. 128° (T).

CIRCLES 71.
An aircraft at position 60° N 005° W tracks 090° (T) for 350 km. On completion of the flight the longitude will be?

a. 002° 10'W.
b. 000° 15'E.
c. 001° 19'E.
d. 001° 19'W.

CIRCLES 72.
An aircraft autopilot is coupled to the INS steering from Waypoint 1 at 60°N 050°W. to Waypoint 2 at 60°N 020°W. What is the approximate latitude of the aircraft on passing 35°W?

a. 60°51'N.
b. 60°05'N.
c. 60°30'N.
d. 59°15'N.

CIRCLES 73.
A Lambert conformal conic chart has a constant of the cone of 0.80. A straight line course drawn on this chart from A (53° N 004°W) to B is 075° at A Course at B is 095° (T). What is the longitude of B?

a. 021° E.
b. 009° 36'E.
c. 021° W.
d. 019° E.

CIRCLES 74.
An aircraft is flying with the aid of an inertial navigation system (INS) connected to the autopilot. The following two points have been entered in the INS computer: WPT 1: 60° N 040°W, WPT 2: 60° N 010°W. When 025° W has been passed, the latitude shown on the display unit of the inertial navigation system will be?

a. 60° 55.0'N.

b. 59° 49.0'N.
c. 60° 11.0'N.
d. 60° 05.0'N.

CIRCLES 75.
The 'departure' between positions 60°N 100° E and 60° N 'x' is 1200 NM. What is the longitude of 'x'?

a. 140°E.
b. 140°W.
c. 175° W.
d. 175° E.

CIRCLES 76.
Given: The autopilot is coupled to the Inertial Navigation System steering from Waypoint 1 at 60°N 040°W, to Waypoint 2 at 60°N 030°W, to Waypoint 3 at 60°N 020°W. What is the approximate track change on passing WPT 2?

a. Zero.
b. 4° decrease.
c. 9° decrease.
d. 9° increase.

CIRCLES 77.
An aircraft autopilot is coupled to the INS steering from Waypoint 1 at 60°N 060°W, to Waypoint 2 at 60°N 030°W. What is the approximate latitude of the aircraft on passing 45°W?

a. 60°54'N.
b. 59°15'N.
c. 60°23'N.
d. 60°19'N.

CIRCLES 78.
The 'departure' between positions 60°N 90° E and 60° N 'x' is 1200 NM. What is the longitude of 'x'?

a. 130°E.
b. 130°W.
c. 145° E.
d. 145° W.

CIRCLES 79.
The 'departure' between positions 60°N 160° E and 60° N 'x' is 1800 NM East. What is the longitude of 'x'?

a. 120° E.
b. 140° E.
c. 140°W.
d. 120°W.

CIRCLES 80.
An aircraft with its autopilot connected to its inertial system, flies from point A at 50°S 010°W, to point B at 50°S 030°W. What is the true course of the aircraft (to the nearest degree) when it arrives at B?

a. 265°.
b. 275°.
c. 279°.
d. 286°.

CIRCLES 81.
The automatic flight control system (AFCS) in an aircraft is coupled to the guidance outputs from an inertial navigation system (INS). The aircraft is flying between inserted waypoints No. 3 (65° 00'N 020° 00'W) and No.4 (65° 00'N 030° 00'W). With DSRTK/STS selected on the CDU, to the nearest whole degree, the initial track read-out from waypoint No. 3 will be?

a. 266°.
b. 270°.
c. 275°.
d. 279°.

CIRCLES 82.
An aeroplane flies from A (59° S 140° W) to B (61° S 149° W) with a TAS of 480 kt. The autopilot is engaged and coupled with an Inertial Navigation System in which AB track is active. On route AB, the true track?

a. Varies by 10°.
b. Decreases by 6°.
c. Varies by 4°.
d. Increases by 8°.

CIRCLES 83.
The automatic flight control system is coupled to the guidance outputs from an inertial navigation system. Which pair of latitudes will give the greatest difference between initial track read-out and the average true course given, in each case, a difference of longitude of 10°?

a. 35° S to 35°N.
b. 30° S to 25°S.
c. 60° N to 60°N.

d. 65° N to 65°N.

CIRCLES 84.
Position A is 58°N 030°W and position B is 51°N 020°W. What is the rhumb line bearing from A to B, if the great circle track from A to B, measured at A, is 100°T?

a. 110°T.
b. 284°T.
c. 104°T.
d. 090°T.

CIRCLES 85.
The automatic flight control system (AFCS) in an aircraft is coupled to the guidance outputs from an inertial navigation system (INS) and the aircraft is flying from waypoint No. 2 (70° 00'S 070° 00'W) to No. 3 (70° 00'S 080° 00'W). Comparing the initial track (° T) at 070° 00'W and the final track (° T) at 080° 00'W, the difference between them is that the initial track is approximately?

a. 9.4° greater than the final one.
b. 5.4° less than the final one.
c. 9.4° less than the final one.
d. 5.4° greater than the final one.

CIRCLES 86.
An aircraft travels from point A to point B, using the autopilot connected to the aircraft's inertial system. The coordinates of A (65° S 010°W) and B (65° S 020°W) have been entered. The true course of the aircraft on its arrival at B, to the nearest degree, is?

a. 275°.
b. 286°.
c. 265°.
d. 270°.

CIRCLES 87.
The following points are entered into an inertial navigation system (INS). WPT 1: 70° N 50°W, WPT 2: 70° N 40°W, WPT 3: 70° N 30°W. The inertial navigation system is connected to the automatic pilot on route (1-2-3). The track change when passing WPT 2 will be approximately?

a. Zero.
b. A 9° increase.
c. A 6° decrease.
d. A 9° decrease.

CIRCLES 88.
What is a rhumb line?

a. A line on the Earth which cuts all meridians at the same angle.
b. The vertex of a conformal polyformic projection.
c. The shortest distance between any two points on the Earth's surface.
d. A straight line on a Lambert's conformal chart.

CIRCLES 89.
Given: Waypoint 1. 75° S 030°W, Waypoint 2. 75° S 020°W. What will be the approximate latitude shown on the display unit of an inertial navigation system at longitude 025°W?

a. 060° 11'S.
b. 059° 49'S.
c. 060° 00'S.
d. 060° 07'S.

CIRCLES 90.
In order to fly from position A (10° 00'N, 030° 00'W) to position B (30° 00'N, 050° 00'W), maintaining a constant true course, it is necessary to fly?

a. A rhumb line track.
b. The constant average drift route.
c. The great-circle route.
d. A straight line plotted on a Lambert chart.

CIRCLES 91.
The angle between the true great-circle track and the true rhumb line track joining the following points: A (70° S 160° W) B (70° S 179° E), at the place of departure A, is?

a. 8.9°.
b. 6.9°.
c. 15.6°.
d. 5.2°.

CIRCLES 92.
Which of the following is true of all parallels of latitude?

a. They are both rhumb lines and great circles.
b. They are great circles but not rhumb lines.
c. They are neither rhumb lines nor great circles.
d. They are rhumb lines but not great circles.

CIRCLES 93.
An aircraft departs from position A (09° 10' S 178° 22'W) and flies northward following the meridian for 2750 NM. It then flies westward along the parallel of latitude for 400 NM to position B. The coordinates of position B are?

a. 53° 20'N 172° 38'E.
b. 36° 40'N 173° 19'E.
c. 36° 20'N 169° 22W.
d. 40° 00'N 169° 22W.

CIRCLES 94.
A Rhumb line is?

a. The shortest distance between two points on a Polyconic projection.
b. Any straight line on a Lambert projection.
c. A line convex to the nearest pole on a Mercator projection.
d. A line on the surface of the earth cutting all meridians at the same angle.

CIRCLES 95.
Given: A is N55° 000° B is N54° E010°. The average true course of the great circle is 100°. The true course of the rhumb line at point A is?

a. 100°.
b. 096°.
c. 104°.
d. 107°.

CIRCLES 96.
An aircraft passes position A (75° 00'N 120° 00'W) on route to position B (75° 00'N 140° 30'W). What is the great circle track on departure from A?

a. 280°.
b. 285°.
c. 267°.
d. 275°.

CIRCLES 97.
Parallels of latitude, except the equator, are?

a. Both Rhumb lines and Great circles.
b. Neither Rhumb lines nor Great circles.
c. Rhumb lines.
d. Great circles.

CIRCLES 98.
Given: The coordinates a position are N48° 50' E002° 16.5'. The coordinates of the antipodes of that position are?

a. S48° 50' W177° 43.5'.
b. S48° 50' E177° 43.5'.
c. S41° 10' W177° 43.5'.
d. S41° 10' E177° 43.5'.

CIRCLES 99
On a Lambert Conformal Conic chart great circles that are not meridians are?

a. Curves concave to the parallel of origin.
b. Straight lines regardless of distance.
c. Curves concave to the pole of projection.
d. Straight lines within the standard parallels.

CIRCLES 100.
On a Direct Mercator chart, a rhumb line appears as a?

a. Curves convex to the Equator.
b. Complex curves concave to the Equator.
c. Curves concave to the nearest pole.
d. Straight line.

CIRCLES 101.
On a polar stereographic projection chart showing the South Pole, a straight line joins position A (75° S 065° E) to position B (75° S 025° W). The true course on departure from position A is approximately?

a. 315°.
b. 225°.
c. 250°.
d. 135°.

CIRCLES 102.
On a Direct Mercator chart a great circle will be represented by a?

a. Curve concave to the equator.
b. Complex curves concave to the Poles.
c. Straight lines.
d. Complex curves convex to the Equator.

CIRCLES 103.
Parallels of latitude, except the equator, are?

a. Great circle.
b. Curves convex to the nearest pole.
c. Rhumb lines.
d. Complex curves.

CIRCLES 104.
On a Direct Mercator chart a great circle will be represented by a?

a. Complex curve.
b. Straight line.
c. Curve convex to the equator.
d. Curve concave to the equator.

CIRCLES 105.
Which one of the following, concerning great circles on a Direct Mercator chart, is correct?

a. They are represented by straight lines.
b. They do not include the meridians nor the equator.
c. With the exception of meridians and the equator, they are curves concave to the equator.
d. Their centre cannot be that of the Earth.

CIRCLES 106.
On a Direct Mercator chart, a rhumb line appears as a?

a. Curve convex to the nearer pole.
b. Straight line.
c. Small circle concave to the nearer pole.
d. Spiral curve.

CIRCLES 107.
Which one of the following statements is correct concerning the appearance of great circles, with the exception of meridians, on a Polar Stereographic chart whose tangency is at the pole ?

a. They are all represented by straight lines.
b. They can never be approximated as straight lines.
c. The higher the latitude the closer they approximate to a straight line.
d. The lower the latitude the closer they approximate to a straight line.

CIRCLES 108.
A perfectly straight line on a Lamberts chart is?

a. A meridian of longitude.
b. A great circle.
c. A parallel of latitude.
d. A rhumb line.

CIRCLES 109.
How do rhumb lines, other than meridians appear on Polar Stereo charts?

a. As lines convex to the nearer pole.
b. As straight lines.
c. As lines concave to the nearer pole.
d. As ellipses around the pole.

CIRCLES 110.
How are great circles shown on a direct Mercator chart?

a. Curves concave to the nearest pole.
b. Rhumb lines.
c. Curves convex to the nearest pole.
d. Straight lines.

CIRCLES 111.
On a Polar Stereographic chart, the initial great circle course from A 75° N 060° W to B 75° N 060° E is approximately?

a. 032° (T).
b. 330° (T).
c. 150° (T).
d. 210° (T).

CIRCLES 112.
A straight line on a Lambert Conformal Projection chart for normal flight planning purposes?

a. Is a Rhumb line.
b. Can only be a parallel of latitude.
c. Is approximately a Great Circle.
d. Is a Loxodromic line.

CIRCLES 113.
On a Direct Mercator, rhumb lines are?

a. Ellipses.
b. Curves concave to the equator.
c. Curves convex to the equator.

d. Straight lines.

CIRCLES 114.
Which one of the following describes the appearance of rhumb lines, except meridians, on a Polar Stereographic chart?

a. Ellipses around the Pole.
b. Curves concave to the Pole.
c. Curves convex to the Pole.
d. Straight lines.

CIRCLES 115.
On a Lambert chart (standard parallels 37° N and 65° N), with respect to the straight line drawn on the map between A (N49° W030°) and B (N48° W040°), the?

a. Great circle and rhumb line are to the north.
b. Great circle is to the north, the rhumb line is to the south.
c. Rhumb line is to the north, the great circle is to the south.
d. Great circle and rhumb line are to the south.

CIRCLES 116.
On a polar stereographic projection chart showing the South Pole, a straight line joins position A (75°S 045°E) to position B (75°S 025°W). The true course on departure from position A is approximately?

a. 235°.
b. 450°.
c. 320°.
d. 225°.

CIRCLES 117.
Two positions plotted on a polar stereographic chart, A (80°N 000°) and B (70°N 102°W) are joined by a straight line whose highest latitude is reached at 035°W. At point B, the true course is?

a. 230°.
b. 203°.
c. 23°.
d. 30°.

CIRCLES 118.
An aircraft is flying with the aid of an inertial navigation system (INS) connected to the autopilot. The following two points have been entered in the INS

computer: WPT 1: 60°S 030°W WPT 2: 60°S 020°W. When 025°W is passed the latitude shown on the display unit of the inertial navigation system will be?

a. 60°57'S.
b. 60°05.7'S.
c. 60°75'S.
d. 57°06'S.

CIRCLES 119
Given: Position A 45° N, ?° E, Position B 45° N, 45° 15'E Distance A-B = 350 NM, B is to the East of A, What is the longitude of position A?

a. 37° 00'E.
b. 48° 00'E.
c. 51° 15'E.
d. 8° 15'E.

CIRCLES 120.
Given: Position A 45° N, ?° E, Position B 45° N, 45° 15'E Distance A-B = 200 NM, B is to the East of A, What is the longitude of position A?

a. 51° 20'E.
b. 48° 33'E.
c. 38° 32'E.
d. 51° 58'E.

MAGNETISM & COMPASSES 1.
When accelerating on an easterly heading in the Northern hemisphere, the compass card of a direct reading magnetic compass will turn?

a. Anti-clockwise giving an apparent turn toward the south.
b. Clockwise giving an apparent turn toward the north.
c. Clockwise giving an apparent turn toward the south.
d. Anti-clockwise giving an apparent turn toward the north.

MAGNETISM & COMPASSES 2.
Sensitivity of a direct reading magnetic compass is?

a. Proportional to the vertical component of the magnetic field of the earth.
b. Inversely proportional to the vertical and horizontal components of the magnetic field of the earth.
c. Inversely proportional to horizontal component of the magnetic field of the earth.
d. Proportional to horizontal component of the magnetic field of the earth.

MAGNETISM & COMPASSES 3.
When turning right from 320° (C) to 050° (C) in the Southern hemisphere, the reading of a direct reading magnetic compass will?

a. Over-indicate the turn and liquid swirl will decrease the effect.
b. Under-indicate the turn and liquid swirl will decrease the effect.
c. Over-indicate the turn and liquid swirl will increase the effect.
d. Under-indicate the turn and liquid swirl will increase the effect.

MAGNETISM & COMPASSES 4.
An aircraft is completing a timed turn in the Northern hemisphere from 330°C to 040°C. After the turn has been stopped but before the direct indicating magnetic compass settles down, will the compass (1) over-read or under-read, and (2) is this error increased or decreased by liquid swirl?

a. (1) over-read (2) increased.
b. (1) over-read (2) decreased.
c. (1) under-read (2) increased.
d. (1) under-read (2) decreased.

MAGNETISM & COMPASSES 5.
What is magnetic variation?

a. The angle between Magnetic North and True North.
b. The angle between Magnetic Heading and Magnetic North.
c. The angle between the direction indicated on the compass and Magnetic North.
d. The angle between True North and Compass North.

MAGNETISM & COMPASSES 6.
An aircraft in the northern hemisphere makes an accurate rate one turn to the right/starboard. If the initial heading was 330°, after 30 seconds of the turn the direct reading magnetic compass should read?

a. 060°.
b. More than 060°.
c. More or less than 060° depending on the pendulous suspension used.
d. Less than 060°.

MAGNETISM & COMPASSES 7.
At the magnetic equator?

a. Deviation is zero.
b. The isogonal is an agonic line.
c. Dip is zero.
d. Variation is zero.

MAGNETISM & COMPASSES 8.
Which of the following is the correct conversion from True to Compass?

	T	V	M	D	C
a.	130	2W	128	-1	127.
b.	130	2E	128	-1	129.
c.	130	2E	132	-1	133.
d.	130	2W	132	-1	133.

MAGNETISM & COMPASSES 9.
The horizontal component of the earth's magnetic field?

a. Weakens with increasing distance from the magnetic poles.
b. Weakens with increasing distance from the nearer magnetic pole.
c. Is approximately the same at all magnetic latitudes less than 60°.
d. Is approximately the same at magnetic latitudes 50° N and 50°S.

MAGNETISM & COMPASSES 10.
What is the maximum value of dip that can be caused by the vertical component of terrestrial magnetism?

a. 45°.
b. 6o°.
c. 90°.
d. 180°.

MAGNETISM & COMPASSES 11.
Which of the following is correct when the variation is West?

a. True North is East of Magnetic North.
b. Magnetic North is West of Compass North.
c. True North is West of Magnetic North.
d. Compass North is West of Magnetic North.

MAGNETISM & COMPASSES 12.
A line drawn on a chart which joins all points where the value of magnetic variation is zero is called an?

a. Agonic line.
b. Aclinic line.
c. Isogonal.
d. Isotach.

MAGNETISM & COMPASSES 13.
How is the direct reading magnetic compass made aperiodic or dead beat?

a. Using a pendulous suspension system for the magnetic assembly.
b. Using the lowest possible viscosity liquid in the compass.
c. Using short magnets.
d. Positioning the magnetic assembly mass close to the compass point and using damping wires.

MAGNETISM & COMPASSES 14.
Isogonals converge at the?

a. Magnetic equator.
b. North magnetic pole only.
c. North and South magnetic poles only.
d. North and South geographic and magnetic poles.

MAGNETISM & COMPASSES 15.
Why does the value of magnetic variation on a chart change with time?

a. Movements of the magnetic poles, cause it to increase.
b. Movements of the magnetic poles, cause it to increase or decrease.
c. Increases in the magnetic field, cause it to increase.
d. Reductions in the magnetic field, cause it to decrease.

MAGNETISM & COMPASSES 16.
What is the compass heading if true track is 348°, drift is 17° left, variation is 32° W, and deviation is 4°E?

a. 009°.
b. 033°.
c. 339°.
d. 337°.

MAGNETISM & COMPASSES 17.
The value of magnetic variation?

a. Must be 0° at the magnetic equator.
b. Varies between a maximum of 45° East and 45° West.
c. Cannot exceed 90°.
d. Has a maximum of 180°.

MAGNETISM & COMPASSES 18.
At what point on the earth is a magnetic compass most effective?

a. At the geographic equator.
b. Close to the magnetic North Pole.

c. Close to the magnetic South Pole.
d. Approximately midway between the magnetic poles.

MAGNETISM & COMPASSES 19.
Which of the following is true of the value of magnetic variation?

a. It is 0° at the magnetic equator.
b. It varies between 45° East and 45° West.
c. It cannot exceed 90°.
d. It cannot exceed 180°.

MAGNETISM & COMPASSES 20.
An aircraft in the northern hemisphere is making an accurate rate one turn to the right. If the initial heading was 135°, after 30 seconds the direct reading magnetic compass should read?

a. 225°.
b. Less than 225°.
c. More or less than 225° depending on the pendulous suspension used.
d. More than 225°.

MAGNETISM & COMPASSES 21.
When using a direct reading magnetic compass in the northern hemisphere?

a. A longitudinal acceleration on a Westerly heading causes an apparent turn to the South.
b. A longitudinal acceleration on an Easterly heading causes an apparent turn to the North.
c. A longitudinal deceleration on a Westerly heading causes an apparent turn to the North.
d. A longitudinal acceleration on an Easterly heading causes an apparent turn to the South.

MAGNETISM & COMPASSES 22.
What is the main cause of permanent magnetism in aircraft?

a. Electrical currents in internal wiring and electrical storms.
b. Exposure to the terrestrial magnetic field during normal operation.
c. The combined effect of aircraft electrical equipment and the terrestrial magnetic field.
d. Hammering, and the effect of the earth's magnetic field, whilst under construction.

MAGNETISM & COMPASSES 23.
When accelerating on a westerly heading in the northern hemisphere, the compass card of a direct reading magnetic compass will turn?

a. Clockwise giving an apparent turn towards the north.
b. Clockwise giving an apparent turn towards the south.
c. Anti-clockwise giving an apparent turn towards the north.
d. Anti-clockwise giving an apparent turn towards the south.

MAGNETISM & COMPASSES 24.
What is the main advantage of a remote indicating compass compared to a direct reading compass is that it?

a. It has less moving parts.
b. It requires less maintenance.
c. It magnifies the earth's magnetic field in order to attain greater accuracy.
d. It senses, rather than seeks, the magnetic meridian.

MAGNETISM & COMPASSES 25.
Where do the isogonal lines converge?

a. At the both the North and South Geographic Poles.
b. At both the North and South Magnetic Poles.
c. Only at the Magnetic equator.
d. Only at the Magnetic North Pole.

MAGNETISM & COMPASSES 26.
When decelerating on a westerly heading in the Northern hemisphere, the compass card of a direct reading magnetic compass will turn?

a. Anti-clockwise giving an apparent turn towards the north.
b. Clockwise giving an apparent turn toward the south.
c. Anti-clockwise giving an apparent turn towards the south.
d. Clockwise giving an apparent turn towards the north.

MAGNETISM & COMPASSES 27.
Why are the detector units in slaved gyro compasses usually fitted in or close to the wingtips of an aircraft?

a. In order to isolate the detector unit from the terrestrial magnetic field.
b. In order to reduce or eliminate turning and acceleration errors.
c. Having one detector in each wingtip, cancels out compass deviation.
d. In order to isolate the detector unit from the aircraft deviation sources.

MAGNETISM & COMPASSES 28.
Which of the following statements is true of the Earth's magnetic field?

a. It may be permanent, temporary, transient.
b. It does not affect aircraft deviation.
c. It acts like a large blue magnetic pole in Northern Canada.
d. The dip angle is between the vertical and the total magnetic force.

MAGNETISM & COMPASSES 29.
In a remote indicating compass system the amount of deviation caused by aircraft magnetism and electrical circuits may be minimised by?

a. Positioning the master unit in the centre of the aircraft.
b. Using a vertically mounted gyroscope.
c. Mounting the detector unit in the wingtip.
d. The use of repeater cards.

MAGNETISM & COMPASSES 30.
What is the angle between True North and Magnetic North?

a. Drift.
b. Variation.
c. Dip.
d. Deviation.

MAGNETISM & COMPASSES 31.
An aircraft using a direct reading magnetic compass in the Northern hemisphere starts a Rate 1 turn to the right from 145°C. What will be the indicated heading if it rolls out of the turn after 30 seconds?

a. It is not possible to answer this question using the information given.
b. Greater than 235°.
c. Less than 235°.
d. 235°.

MAGNETISM & COMPASSES 32.
The sensitivity of a direct reading compass varies?

a. Inversely with the vertical component of the earth's magnetic field.
b. Directly with the horizontal component of the earth's magnetic field.
c. Directly with the vertical component of the earth's magnetic field.
d. Inversely with both vertical and horizontal components of the earth's magnetic field

MAGNETISM & COMPASSES 33.
An aircraft's compass must be swung?

a. If the aircraft has been in the hangar for a long time and has been moved several times.
b. If the aircraft has been subjected to hammering.
c. Every maintenance inspection.
d. After a change of theatre of operations which leads to a change of magnetic longitude.

MAGNETISM & COMPASSES 34.
What is the dip angle at the South Magnetic Pole?

a. 00°.
b. 90°.
c. 180°.
d. 64°.

MAGNETISM & COMPASSES 35.
At the magnetic equator, when accelerating after take off on heading West, a direct reading compass?

a. Underreads.
b. The heading indicates a turn to the south.
c. Indicates the correct heading.
d. Overreads the heading.

MAGNETISM & COMPASSES 36.
What is the name for a line of equal magnetic variation?

a. An isocline.
b. An isogonal.
c. An isogriv.
d. An isovar.

MAGNETISM & COMPASSES 37.
The agonic line?

a. Is midway between the magnetic North and South Poles.
b. Follows the geographic equator.
c. Is the shorter distance between the respective True and Magnetic North and South Poles.
d. Follows separate paths out of the North polar regions, one currently running through Western Europe and the other through the USA.

MAGNETISM & COMPASSES 38.
Isogrives are lines that connect positions that have?

a. The same variation.
b. O° magnetic dip.
c. The same grivation.
d. The same horizontal magnetic field strength.

MAGNETISM & COMPASSES 39.
Which of the following statements concerning earth magnetism is completely correct?

a. An isogonal is a line which connects places of equal dip; the aclinic is the line of zero magnetic dip.
b. An isogonal is a line which connects places with the same magnetic variation; the aclinic connects places with the same magnetic field strength.
c. An isogonal is a line which connects places with the same magnetic variation; the aclinic is the line of zero magnetic dip.
d. An isogonal is a line which connects places with the same magnetic variation; the agonic line is the line of zero magnetic dip.

MAGNETISM & COMPASSES 40.
An aircraft is accelerating in the Northern hemisphere heading West. Will a direct reading magnetic compass (1) over-read or under-read and (2) Indicate a turn to the north or to the south?

a. (1) over-read (2) north.
b. (1) over-read (2) south.
c. (1) under-read (2) north.
d. (1) under-read (2) south.

MAGNETISM & COMPASSES 41.
What is the advantage of the remote indicating compass (slaved gyro compass) over the direct reading magnetic compass?

a. It is lighter.
b. It is connected to a source of electrical power and so is more accurate.
c. It senses the earth's magnetic field rather than seeks it, so is more sensitive.
d. It is not affected by aircraft deviation.

MAGNETISM & COMPASSES 42.
Isogrivs on a chart indicate lines of?

a. Zero magnetic variation.

b. Equal magnetic dip.
c. Equal horizontal directive force.
d. Equal grivation.

MAGNETISM & COMPASSES 43.
Compass deviation is defined as the angle between?

a. True North and Compass North.
b. The horizontal and the total intensity of the earth's magnetic field.
c. Magnetic North and Compass North.
d. True North and Magnetic North.

MAGNETISM & COMPASSES 44.
Isogonic lines connect positions that have?

a. The same angle of magnetic dip.
b. The same variation.
c. 0° variation.
d. The same elevation.

MAGNETISM & COMPASSES 45.
When an aircraft on a westerly heading on the northern hemisphere accelerates, the effect of the acceleration error causes the magnetic compass to?

a. Lag behind the turning rate of the aircraft.
b. Indicate a turn towards the south.
c. Turn faster than the actual turning rate of the aircraft.
d. Indicate a turn towards the north.

MAGNETISM & COMPASSES 46.
When is the magnetic compass most effective?

a. In the region of the magnetic North Pole.
b. On the geographic equator.
c. About midway between the magnetic poles.
d. In the region of the magnetic South Pole.

MAGNETISM & COMPASSES 47.
An Agonic line is a line that connects?

a. Positions that have 0° variation.
b. Positions that have the same variation.
c. Points of equal magnetic dip.
d. Points of equal magnetic horizontal field strength.

MAGNETISM & COMPASSES 48.
A direct reading compass should be swung when?

a. The aircraft has made more than a stated number of landings.
b. There is a large, and permanent, change in magnetic latitude.
c. There is a large change in magnetic longitude.
d. The aircraft is stored for a long period and is frequently moved.

MAGNETISM & COMPASSES 49.
The annunciator of a remote indicating compass system is used when?

a. Synchronising the magnetic and gyro compass elements.
b. Compensating for deviation.
c. Setting local magnetic variation.
d. Setting the 'heading' pointer.

MAGNETISM & COMPASSES 50.
The direct reading magnetic compass is made aperiodic (dead beat) by?

a. Using long magnets.
b. Pendulous suspension of the magnetic assembly.
c. Keeping the magnetic assembly mass close to the compass point and by using damping wires.
d. Using the lowest acceptable viscosity compass liquid.

MAGNETISM & COMPASSES 51.
The Earth can be considered as being a magnet with the?

a. Red pole near the north pole of the earth and the direction of the magnetic force pointing straight down to the earth's surface.
b. Blue pole near the north pole of the earth and the direction of the magnetic force pointing straight up from the earth's surface.
c. Red pole near the north pole of the earth and the direction of the magnetic force pointing straight up from the earth's surface.
d. Blue pole near the north pole of the earth and the direction of the magnetic force pointing straight down to the earth's surface.

MAGNETISM & COMPASSES 52.
Deviation applied to magnetic heading gives?

a. Magnetic track.
b. Compass heading.
c. True heading.
d. Magnetic course.

MAGNETISM & COMPASSES 53.

The angle between Magnetic North and Compass North is called?

a. Compass deviation.
b. Compass error.
c. Magnetic variation.
d. Alignment error.

MAGNETISM & COMPASSES 54.

Which of the following is an occasion for carrying out a compass swing on a Direct Reading Compass?

a. Before an aircraft goes on any flight that involves a large change of magnetic latitude.
b. After any of the aircraft radio equipment has been changed due to unserviceability.
c. Whenever an aircraft carries a large freight load regardless of its content.
d. After an aircraft has passed through a severe electrical storm, or has been struck by lightning.

MAGNETISM & COMPASSES 55.

Which of the following statements is correct concerning the effect of turning errors on a direct reading compass?

a. Turning errors are greatest on east/west headings, and are greatest at high latitudes.
b. Turning errors are greatest on north/south headings, and are greatest at high latitudes.
c. Turning errors are greatest on east/west headings, and are least at high latitudes.
d. Turning errors are greatest on north/south headings, and are least at high latitudes.

MAGNETISM & COMPASSES 56.

Which one of the following is an advantage of a remote reading compass as compared with a standby compass?

a. It eliminates the effect of turning and acceleration errors by pendulously suspending the detector unit.
b. It is more reliable because it is operated electrically and power is always available from sources within the aircraft.
c. It senses the magnetic meridian instead of seeking it, increasing compass sensitivity.
d. It is lighter than a direct reading compass because it employs, apart from the detector unit, existing aircraft equipment.

MAGNETISM & COMPASSES 57.

Complete the following statement regarding magnetic variation. The charted values of magnetic variation on earth normally change annually due to?

a. Magnetic pole movement causing numerical values at all locations to increase or decrease.
b. Magnetic pole movement causing numerical values at all locations to increase.
c. A reducing field strength causing numerical values at all locations to decrease.
d. An increasing field strength causing numerical values at all locations to increase.

MAGNETISM & COMPASSES 58.

The north and south magnetic poles are the only positions on the earth's surface where?

a. The value of magnetic variation equals 90°.
b. A freely suspended compass needle will stand vertical.
c. Isogonals converge.
d. A freely suspended compass needle will stand horizontal.

MAGNETISM & COMPASSES 59.

The main reason for mounting the detector unit of a remote reading compass in the wingtip of an aeroplane is?

a. To ensure that the unit is in the most accessible position on the aircraft for ease of maintenance.
b. By having detector units on both wingtips, to cancel out the deviation effects caused by the aircraft strucure.
c. To minimise the amount of deviation caused by aircraft magnetism and electrical circuits.
d. To maximise the units exposure to the earth's magnetic field.

MAGNETISM & COMPASSES 60.

The main advantage of a remote indicating compass over a direct reading compass is that it?

a. Requires less maintenance.
b. Is able to magnify the earth's magnetic field in order to attain greater accuracy.
c. Senses, rather than seeks, the magnetic meridian.
d. Has less moving parts.

MAGNETISM & COMPASSES 61.
The main reason for usually mounting the detector unit of a remote indicating compass in the wingtip of an aeroplane is to?

a. Place it where it will not be subjected to electrical or magnetic interference from the aircraft.
b. Reduce the amount of deviation caused by aircraft magnetism and electrical circuits.
c. Facilitate easy maintenance of the unit and increase its exposure to the Earth's magnetic field.
d. Place it in a position where there is no electrical wiring to cause deviation errors.

MAGNETISM & COMPASSES 62.
Permanent magnetism in aircraft arises chiefly from?

a. The combined effect of aircraft electrical equipment and the earth's magnetic field.
b. The effect of internal wiring and exposure to electrical storms.
c. Hammering, and the effect of the earth's magnetic field, whilst under construction.
d. Exposure to the earth's magnetic field during normal operation.

MAGNETISM & COMPASSES 63.
Which of the following statements concerning the earth's magnetic field is completely correct?

a. Dip is the angle between total magnetic field and vertical field component.
b. The blue pole of the earth's magnetic field is situated in North Canada.
c. At the earth's magnetic equator, the inclination varies depending on whether the geographic equator is north or south of the magnetic equator.
d. The earth's magnetic field can be classified as transient, semi-permanent or permanent.

MAGNETISM & COMPASSES 64.
The lines on the earth's surface that join points of equal magnetic variation are called?

a. Isogrives.
b. Isoclines.
c. Isogonals.
d. Isotachs.

MAGNETISM & COMPASSES 65.
Concerning direct reading magnetic compasses, in the northern hemisphere, it can be said that?

a. On an Easterly heading, a longitudinal acceleration causes an apparent turn to the South.
b. On a Westerly heading, a longitudinal acceleration causes an apparent turn to the South.
c. On a Westerly heading, a longitudinal deceleration causes an apparent turn to the North.
d. On an Easterly heading, a longitudinal acceleration causes an apparent turn to the North.

MAGNETISM & COMPASSES 66.
At a specific location, the value of magnetic variation?

a. Depends on the type of compass installed.
b. Depends on the magnetic heading.
c. Depends on the true heading.
d. Varies slowly over time.

MAGNETISM & COMPASSES 67.
Isogonals are lines of equal?

a. Wind velocity.
b. Magnetic variation.
c. Compass deviation.
d. Pressure.

MAGNETISM & COMPASSES 68.
In northern hemisphere, during an acceleration in an easterly direction, the magnetic compass will indicate?

a. A heading of East.
b. A decrease in heading.
c. An increase in heading.
d. An apparent turn to the South.

MAGNETISM & COMPASSES 69.
A negative (westerly) magnetic variation signifies that?

a. Compass North is East of Magnetic North.
b. Compass North is West of Magnetic North.
c. True North is East of Magnetic North.
d. True North is West of Magnetic North.

MAGNETISM & COMPASSES 70.
The purpose of compass check swing is to?

a. Cancel out the horizontal component of the earth's magnetic field.
b. Cancel out the effects of the magnetic fields found on board the aeroplane.
c. Measure the angle between Magnetic North and Compass North.
d. Cancel out the vertical component of the earth's magnetic field.

MAGNETISM & COMPASSES 71.
You are turning from 330°C to 040°C in the northern hemisphere. At the time that you stop the turn, but before the compass settles down, will the compass over-read or under-read (i), and will liquid swirl tend to increase or decrease the error (ii)?

a. (i) Over-read (ii) Decrease.
b. (i) Over-read (ii) Increase.
c. (i) Under-read (ii) Decrease.
d. (i) Under-read (ii) Increase.

MAGNETISM & COMPASSES 72.
The sensitivity of a direct reading magnetic compass is?

a. Inversely proportional to the horizontal and vertical components of the earth's magnetic field.
b. Directly proportional to the horizontal and vertical components of the earth's magnetic field.
c. Proportional to the horizontal component of the earth's magnetic field.
d. Proportional to the vertical component of the earth's magnetic field.

MAGNETISM & COMPASSES 73.
The magnitude of variation?

a. Has a maximum of 90°.
b. Has a maximum of 180°.
c. Is zero at the equator.
d. Has a maximum value of 45°E or 45°W.

MAGNETISM & COMPASSES 74.
Which of the following statements about the earth's magnetic field is most accurate?

a. It has no effect on aircraft deviation.
b. It may be permanent, temporary or transient.
c. It acts as if there were a large red magnetic pole in northern Canada.
d. The dip angle is the angle between the total magnetic field and the earth horizontal.

MAGNETISM & COMPASSES 75.
At the magnetic equator?

a. Variation is zero.
b. Deviation is zero.
c. Dip is zero.
d. The agonic line is also an isogonal line.

MAGNETISM & COMPASSES 76.
Which of the following is the best definition of magnetic variation?

a. The angle between the magnetic heading and the magnetic north.
b. The angle between the magnetic north and the true north.
c. The angle between the true north and the compass north.
d. The angle between the direction indicated on a magnetic compass and magnetic north.

MAGNETISM & COMPASSES 77.
At which point on the surface of the earth is a magnetic compass most effective?

a. On the geographical equator.
b. Close to the magnetic north pole.
c. Close to the magnetic South Pole.
d. Approximately midway between the magnetic poles.

MAGNETISM & COMPASSES 78.
Which of the following statements about the earth's magnetic field is most accurate?

a. It has no effect on aircraft deviation.
b. It may be permanent, temporary or transient.
c. It acts as if there were a large blue magnetic pole in northern Canada.
d. The dip angle is the angle between the total magnetic field and the earth vertical.

MAGNETISM & COMPASSES 79.
An aircraft is accelerating on a westerly heading in the northern hemisphere. Will the compass be over-reading or under-reading (i) and will it indicate a turn to the north or south (ii)?

a. (i) Over-reading (ii) South turn.
b. (i) Over-reading (ii) North turn.
c. (i) Under-reading (ii) South turn.
d. (i) Under-reading (ii) North turn.

MAGNETISM & COMPASSES 80.
What advantage does the remote indicating or slaved gyro compass have in comparison to the direct reading magnetic compass?

a. Not affected by deviation.
b. Lighter.
c. More accurate because it is not connected to any source of electrical power.
d. Is more sensitive because it senses the earth's magnetic field rather than seeking it.

MAGNETISM & COMPASSES 81.
An aircraft is on a heading of 135°C using a direct reading magnetic compass in the northern hemisphere. After carrying out a rate 1 turn for 30 seconds on what indicated heading should it roll out of the turn?

a. 225.
b. More than 225.
c. Less than 225.
d. It is not possible to answer this question using the data provided.

MAGNETISM & COMPASSES 82.
What are indicated by isogrivs on a chart?

a. Lines of equal grivation.
b. Lines of zero magnetic variation.
c. Lines of equal magnetic dip.
d. Lines of equal effective horizontal magnetic force.

MAGNETISM & COMPASSES 83.
The variation is 20°E and you are heading 345°M when you take a radar bearing of an island which is 30° left of the nose. What bearing do you plot?

a. 155°T.
b. 160°T.
c. 170°T.
d. 180°T.

MAGNETISM & COMPASSES 84.
The agonic line?

a. Follows the geographical equator.
b. Follows two separate paths out of the North polar regions. One currently passes through the USA while the other passes through Western Europe.
c. Is midway between the magnetic north and South Poles.

d. Is the shorter of the distance between the true and Magnetic North and South Poles.

MAGNETISM & COMPASSES 85.
What is the angle between True North and Magnetic North known as?

a. Alignment error.
b. Dip.
c. Deviation
d. Variation.

MAGNETISM & COMPASSES 86.
Why does the value of magnetic variation on a chart changes with time?

a. Reduction in the magnetic field, causing a decrease.
b. Movement of the magnetic poles, which can cause either an increase or a decrease.
c. Movement of the magnetic poles, causing an increase.
a. Increase in the magnetic field, causing an increase.

MAGNETISM & COMPASSES 87.
Where do isogonal lines converge?

a. At the North and South Magnetic Poles.
b. At the Magnetic equator.
c. A the North Magnetic Pole.
d. At the North and South Magnetic and Geographical Poles.

MAGNETISM & COMPASSES 88.
Why are the detector units of a slaved gyro-compass system usually located in or near to the aircraft wingtips?

a. Having one detector unit in each wingtip, cancels out compass deviations.
b. To isolate the detector unit from the aircraft deviation sources.
c. To isolate the detector unit from the magnetic field of the Earth.
d. To minimise turning and acceleration errors.

MAGNETISM & COMPASSES 89.
What is the maximum possible value of Dip Angle?

a. 45°.
b. 66°.
c. 90°.
d. 180°.

MAGNETISM & COMPASSES 90.
When must the compass of an aircraft be swung?

a. If the aircraft has been in the hangar for a long time and has been moved several times.
b. After a change of theatre of operations at the same magnetic latitude.
c. If the aircraft has been subjected to hammering.
d. Every maintenance inspection.

MAGNETISM & COMPASSES 91.
What is the dip angle at the South Magnetic Pole?

a. 0°.
b. 64°.
c. 90°.
d. 180°.

MAGNETISM & COMPASSES 92.
What is the title of a line of equal magnetic variation?

a. An isocline.
b. An isobar.
c. An isogonal.
d. An isogriv.

MAGNETISM & COMPASSES 93.
How is the direct reading magnetic compass made to be aperiodic (dead beat)?

a. Using long magnets.
b. Using a pendulous suspension system for the magnetic assembly.
c. Using the lowest practicable viscosity compass liquid
d. By keeping the magnetic assembly mass close to the compass point and by using damping wires.

MAGNETISM & COMPASSES 94.
If variation is West?

a. True North is West of Magnetic North.
b. True North is East of Magnetic North.
c. Magnetic North is West of Compass North.
d. Compass North is West of Magnetic North.

MAGNETISM & COMPASSES 95.
Which of the following conversions from True to Compass is correct?

	T	V	M	D	C
a.	130	2W	132	+1	131.
b.	130	2E	132	+1	131
c.	130	2W	132	+1	133.
d.	130	2E	132	+1	133.

MAGNETISM & COMPASSES 96.
What will be the effect on its direct reading compass when an aircraft on the Equator accelerates whilst traveling westwards?

a. No change.
b. Indicates a decrease in heading.
c. Indicates an increase in heading.
d. Indicates an apparent turn to the North

MAGNETISM & COMPASSES 97.
Given: Magnetic heading 311°, Drift angle 10° left, Relative bearing of NDB 270°, What is the magnetic bearing of the NDB measured from the aircraft?

a. 208°.
b. 211°.
c. 180°.
d. 221°.

MAGNETISM & COMPASSES 98.
A ground feature appears 30° to the left of the centre line of the CRT of an airborne weather radar. If the heading of the aircraft is 355° (M) and the magnetic variation is 15° East, the true bearing of the aircraft from the feature is?

a. 310°.
b. 130°.
c. 160°.
d. 220°.

MAGNETISM & COMPASSES 99.
An aircraft is over position HO (55° 30'N 060° 15'W), where YYR VOR (53° 30'N 060° 15'W) can be received. The magnetic variation is 31° W at HO and 28° W at YYR. What is the radial from YYR?

a. 031°.
b. 332°.
c. 028°.
d. 208°.

MAGNETISM & COMPASSES 100.
The angle between True North and Magnetic North is called?

a. Drift.
b. Variation.
c. Deviation.
d. Compass error.

DESCENTS 1.
At what approximate distance from the threshold would an aircraft intercept the glide path if the aircraft height is 2500 feet, and the ILS glide path angle is 3°?

a. 7.0 nm.
b. 7.8 nm.
c. 13.0 nm.
d. 14.5 nm.

DESCENTS 2.
Convert 70 metres/second into knots?

a. 35 kts.
b. 55 kts.
c. 136 kts.
d. 146 kts.

DESCENTS 3.
If there is a 10 knot increase in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 30 ft/min.
b. It must be decreased by 30 ft/min.
c. It must be decreased by 50 ft/min.
d. It must be increased by 50 ft/min.

DESCENTS 4.
What will be the rate of descent when flying down a 12% glide slope, at a groundspeed of 540 knots?

a. 3130 ft/min.
b. 4830 ft/min.
c. 6550 ft/min.
d. 8740 ft/min.

DESCENTS 5.
An aircraft flying down a 3° ILS glideslope is at 25 nm DME from the threshold.

Using the 1 in 60 rule and approximating 1 nm to 6000 ft, calculate the aircraft height above the runway threshold, assuming that the ILS glidepath crosses the threshold at a height of 50 ft?

a. 6450 ft.
b. 7455 ft.
c. 7650 ft.
d. 8015 ft.

DESCENTS 6.
730 FT/MIN equals?

a. 5.2 m/sec.
b. 1.6 m/sec.
c. 2.2 m/sec.
d. 3.7 m/sec.

DESCENTS 7.
If there is a 15 knot increase in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be decreased by 79 ft/min.
b. It must be increased by 79 ft/min.
c. It must be increased by 35 ft/min.
d. It must be decreased by 35 ft/min.

DESCENTS 8.
What will be the rate of descent when flying down a 10^0 glide slope, at a groundspeed of 500 knots?

a. 7440 ft/min.
b. 5900 ft/min.
c. 6500 ft/min.
d. 8440 ft/min.

DESCENTS 9.
An aircraft at FL370 is required to commence descent when 100 NM from a DME facility and to cross the station at FL120. If the mean GS during the descent is 396 kt, the minimum rate of descent required is approximately?

a. 1650 FT/MIN.
b. 2400 FT/MIN.
c. 1000 FT/MIN.
d. 1550 FT/MIN.

DESCENTS 10.
An aircraft is descending down a 12% slope whilst maintaining a GS of 540 kt. The rate of descent of the aircraft is approximately?

a. 4500 FT/MIN.
b. 3900 FT/MIN.
c. 6500 FT/MIN.
d. 650 FT/MIN.

DESCENTS 11.
If there is a 25 knot increase in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be decreased by 125 ft/min.
b. It must be increased by 125 ft/min.
c. It must be increased by 135 ft/min.
d. It must be decreased by 135 ft/min.

DESCENTS 12.
What will be the rate of descent when flying down a 5% glide slope, at a groundspeed of 450 knots?

a. 1540 ft/min.
b. 1750 ft/min.
c. 2175 ft/min.
d. 2124 ft/min.

DESCENTS 13.
At 0422 an aircraft at FL370, GS 320kt, is on the direct track to VOR 'X' 185 NM distant. The aircraft is required to cross VOR 'X' at FL80. For a mean rate of descent of 1800 FT/MIN at a mean GS of 232 kt, the latest time at which to commence descent is?

a. 0451.
b. 0454.
c. 0445.
d. 0448.

DESCENTS 14.
An aircraft is maintaining a 5.2% gradient is at 7 NM from the runway, on a flat terrain. Its height is approximately?

a. 3640 FT.
b. 2210 FT.
c. 680 FT.
d. 1890 FT.

DESCENTS 15.
If there is a 10 knot decrease in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 30 ft/min.
b. It must be decreased by 30 ft/min.
c. It must be increased by 50 ft/min.
d. It must be decreased by 50 ft/min.

DESCENTS 16.
What will be the rate of descent when flying down a 8% glide slope, at a groundspeed of 400 knots?

a. 3242 ft/min.
b. 3500ft/min.
c. 4320 ft/min.
d. 3420 ft/min.

DESCENTS 17.
An aircraft at FL350 is required to commence descent when 85 NM from a VOR and to cross the VOR at FL80. The mean GS for the descent is 340 kt. What is the minimum rate of descent required?

a. 1800 FT/MIN.
b. 1900 FT/MIN.
c. 1600 FT/MIN.
d. 1700 FT/MIN.

DESCENTS 18.
If there is a 15 knot decrease in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 50 ft/min.
b. It must be decreased by 50 ft/min.
c. It must be decreased by 75 ft/min.
d. It must be increased by 75 ft/min.

DESCENTS 19.
An aircraft at FL290 is required to commence descent when 50 NM from a VOR and to cross that VOR at FL80. Mean GS during descent is 271kt. What is the minimum rate of descent required?

a. 1800 FT/MIN.
b. 1900 FT/MIN.
c. 2000 FT/MIN.
d. 1700 FT/MIN.

DESCENTS 20.
The equivalent of 70 m/sec is approximately?

a. 136 kt.
b. 145 kt.
c. 210 kt.
d. 35 kt.

DESCENTS 21.
What will be the rate of descent when flying down a 10% glide slope, at a groundspeed of 350 knots?

a. 3000ft/min.
b. 3405ft/min.
c. 3545 ft/min.
d. 3455 ft/min.

DESCENTS 22.
An aircraft at FL330 is required to commence descent when 65 NM from a VOR and to cross the VOR at FL100. The mean GS during the descent is 330 kt. What is the minimum rate of descent required?

a. 1850 FT/MIN.
b. 1950 FT/MIN.
c. 1650 FT/MIN.
d. 1750 FT/MIN.

DESCENTS 23.
If there is a 20 knot increase in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 210 ft/min.
b. It must be decreased by 210 ft/min.
c. It must be decreased by 100 ft/min.
d. It must be increased by 100 ft/min.

DESCENTS 24.
Assuming zero wind, what distance is covered by an aircraft descending 15000 FT with a TAS of 320 kt and maintaining a rate of descent of 3000 FT/MIN?

a. 16.0 NM.
b. 26.7 NM.
c. 19.2 NM.
d. 38.4 NM.

DESCENTS 25.
What will be the rate of descent when flying down a 7% glide slope, at a groundspeed of 250 knots?

a. 1575 ft/min.
b. 1737 ft/min.
c. 1773 ft/min.
d. 1377 ft/min.

DESCENTS 26.
An aircraft at FL370 is required to commence descent at 120 NM from a VOR and to cross the facility at FL130. If the mean GS for the descent is 288 kt, the minimum rate of descent required is?

a. 860 FT/MIN.
b. 890 FT/MIN.
c. 920 FT/MIN.
d. 960 FT/MIN.

DESCENTS 27.
If there is a 20 knot decrease in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 210 ft/min.
b. It must be decreased by 210 ft/min.
c. It must be increased by 100 ft/min.
d. It must be decreased by 100 ft/min.

DESCENTS 28.
Given: Aircraft height 2500 FT, ILS GP angle 3°. At what approximate distance from THR can you expect to capture the GP?

a. 8.3 NM.
b. 7.0 NM.
c. 13.1 NM.
d. 14.5 NM.

DESCENTS 29.
What will be the rate of descent when flying down a 12% glide slope, at a groundspeed of 240 knots?

a. 2198 ft/min.
b. 2189 ft/min.
c. 2819 ft/min.
d. 2918 ft/min.

DESCENTS 30.
Given: ILS GP angle = 3.5 DEG, GS = 150 kt. Approximate rate of descent is?

a. 900 FT/MIN.
b. 1000 FT/MIN.
c. 700 FT/MIN.
d. 800 FT/MIN.

DESCENTS 31.
If there is a 17 knot decrease in headwind by what amount must the rate of descent be changed in order to maintain a 3° glidesiope?

a. It must be increased by 58 ft/min.
b. It must be decreased by 58 ft/min.
c. It must be increased by 85 ft/min.
d. It must be decreased by 85 ft/min.

DESCENTS 32.
An aircraft at FL350 is required to descend to cross a DME facility at FL80. Maximum rate of descent is 1800 FT/MIN and mean GS for descent is 276 kt. The minimum range from the DME at which descent should start is?

a. 69 NM.
b. 79 NM.
c. 49 NM.
d. 59 NM.

DESCENTS 33.
An aircraft at FL390 is required to descend to cross a DME facility at FL70. Maximum rate of descent is 2500 FT/MIN, mean GS during descent is 248 kt. Minimum range from the DME at which descent should commence is?

a. 68 NM.
b. 53 NM.
c. 58 NM.
d. 63 NM.

DESCENTS 34.
What will be the rate of descent when flying down a 8% glide slope, at a groundspeed of 340 knots?

a. 2577 ft/min.
b. 2757 ft/min.
c. 2755 ft/min.
d. 2775 ft/min.

DESCENTS 35.
An aircraft at FL350 is required to cross a VOR/DME facility at FL110 and to commence descent when 100 NM from the facility. If the mean GS for the descent is 335 kt, the minimum rate of descent required is?

a. 1340 FT/MIN.
b. 1390 FT/MIN.
c. 1240 FT/MIN.
d. 1290 FT/MIN.

DESCENTS 36.
Given: TAS = 197 kt, True course = 240°, W/V = 180/30kt. Descent is initiated at FL 220 and completed at FL 40. Distance to be covered during descent is 39 NM. What is the approximate rate of descent?

a. 800 FT/MIN.
b. 950 FT/MIN.
c. 1500 FT/MIN.
d. 1400 FT/MIN.

DESCENTS 37.
By what amount must you change the rate of descent to maintain a 3^{0} glideslope if you meet an increase in headwind of 10 knots?

a. 30 feet per minute increase.
b. 30 feet per minute decrease.
c. 50 feet per minute increase.
d. 50 feet per minute decrease.

DESCENTS 38.
What will be the rate of descent when flying down a 12% glide slope, at a groundspeed of 150 knots?

a. 1823 ft/min.
b. 1283 ft/min.
c. 1382 ft/min.
d. 1832 ft/min.

DESCENTS 39.
When 65 nm from a VOR you commence a descent from FL330 with the intention of arriving at the VOR at FL100. What rate of descent is required if your mean ground speed is 240 knots?

a. 1259 ft/min.
b. 1420 ft/min.
c. 1650 ft/min.

d. 1800 ft/min.

DESCENTS 40.
What is the rate of descent on a 12% glide slope if groundspeed is 540 knots?

a. 3150 ft/min.
b. 4620 ft/min.
c. 6550 ft/min.
d. 8640 ft/min.

DESCENTS 41.
What will be the rate of descent when flying down a 12% glide slope, at a groundspeed of 175 knots?

a. 2127 ft/min.
b. 2217 ft/min.
c. 1227 ft/min.
d. 7122 ft/min.

DESCENTS 42.
At 100 nm from a VOR an aircraft commences a descent from FL330 in order to arrive overhead the VOR at FL100. What rate of descent is required if the mean groundspeed in the descent is to be 240 knots?

a. 1300 ft/min.
b. 920 ft/min.
c. 1130 ft/min.
d. 820 ft/min.

DESCENTS 43.
An aircraft is on an ILS 3 degree glideslope, which passes over the runway threshold at a height of 50 feet. The DME range is 25 nm from the threshold. What is the height above the runway threshold elevation? (Use the 1 in 60 rule and the approximation 6000 feet = 1 nautical mile)

a. 6550 feet.
b. 7450 feet.
c. 7550 feet.
d. 8110 feet.

DESCENTS 44.
What will be the rate of descent when flying down a 5% glide slope, at a groundspeed of 540 knots?

a. 2375 ft/min.

b. 2537 ft/min.
c. 2735 ft/min.
d. 2573 ft/min.

DESCENTS 45.
For an aircraft at a height of 2500 feet, interception of a 3° ILS glide path will occur at approximately?

a. 7.0 nm from the threshold.
b. 8.0 nm from the threshold.
c. 13.1 nm from the threshold.
d. 14.5 nm from the threshold.

DESCENTS 46.
What will be the rate of descent when flying down a 6% glide slope, at a groundspeed of 500 knots?

a. 3903 ft/min.
b. 3309 ft/min.
c. 3039 ft/min.
d. 9303 ft/min.

DESCENTS 47.
At 0430 an aircraft is in level cruise flight at groundspeed of 350 knots, at FL370, 185 nm from a VOR. It is required to descend at a mean rate of 1800 feet/min, to be at FL 80 overhead the VOR. What is the latest time to commence descent, if the mean ground speed in the descent is to be 232 knots?

a. 0456.
b. 0432.
c. 0451.
d. 0421.

DESCENTS 48.
When 65 nm from a VOR you commence a descent from FL330 with the intention of arriving at the VOR at FL100. What rate of descent is required if your mean ground speed is 340 knots?

a. 1500 ft/min.
b. 1750 ft/min.
c. 2000 ft/min.
d. 2100 ft/min.

DESCENTS 49.
At 75 nm from a VOR an aircraft commences a descent from FL350 in order to arrive overhead the VOR at FL120. What rate of descent is required if the mean groundspeed in the descent is to be 250 knots?

a. 1500 ft/min.
b. 1474 ft/min.
c. 1744 ft/min.
d. 1447 ft/min.

DESCENTS 50.
An aircraft is on an ILS 3 degree glideslope, which passes over the runway threshold at a height of 50 feet. The DME range is 25 nm from the threshold. What is the height above the runway threshold elevation? (Use the 1 in 60 rule and the approximation 6000 feet = 1 nautical mile)

a. 7550 feet.
b. 8110 feet.
c. 6550 feet.
d. 7450 feet.

DESCENTS 51.
At what approximate distance from the threshold would an aircraft intercept the glide path if the aircraft height is 2500 feet, and the ILS glide path angle is 8°?

a. 2.8 nm.
b. 3.1 nm.
c. 8.0 nm.
d. 4.5 nm.

DESCENTS 52.
Convert 95 metres/second into knots?

a. 135 kts.
b. 155 kts.
c. 185 kts.
d. 166 kts.

DESCENTS 53.
If there is a 12 knot increase in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 35 ft/min.
b. It must be decreased by 35 ft/min.
c. It must be decreased by 61 ft/min.
d. It must be increased by 61 ft/min.

DESCENTS 54.
What will be the rate of descent when flying down a 7% glide slope, at a groundspeed of 540 knots?

a. 3130 ft/min.
b. 4830 ft/min.
c. 3830 ft/min.
d. 3740 ft/min.

DESCENTS 55.
An aircraft flying down a 3° ILS glideslope is at 35 nm DME from the threshold. Using the 1 in 60 rule and approximating 1 nm to 6000 ft, calculate the aircraft height above the runway threshold, assuming that the ILS glidepath crosses the threshold at a height of 50 ft?

a. 6450 ft.
b. 7455 ft.
c. 10550 ft.
d. 10015 ft.

DESCENTS 56.
850 FT/MIN equals?

a. 5.2 m/sec.
b. 4.6 m/sec.
c. 3.2 m/sec.
d. 4.3 m/sec.

DESCENTS 57.
If there is a 35 knot increase in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be decreased by 186 ft/min.
b. It must be increased by 186 ft/min.
c. It must be increased by 235 ft/min.
d. It must be decreased by 235 ft/min.

DESCENTS 58.
What will be the rate of descent when flying down a 10^0 glide slope, at a groundspeed of 400 knots?

a. 6440 ft/min.
b. 6900 ft/min.
c. 6700 ft/min.
d. 6753 ft/min.

DESCENTS 59.
An aircraft at FL370 is required to commence descent when 120 NM from a DME facility and to cross the station at FL100. If the mean GS during the descent is 390 kt, the minimum rate of descent required is approximately?

a. 1460 FT/MIN.
b. 1400 FT/MIN.
c. 1500 FT/MIN.
d. 1550 FT/MIN.

DESCENTS 60.
An aircraft is descending down a 10% slope whilst maintaining a GS of 540 kt. The rate of descent of the aircraft is approximately?

a. 4500 FT/MIN.
b. 5900 FT/MIN.
c. 5470 FT/MIN.
d. 5650 FT/MIN.

DESCENTS 61.
If there is a 5 knot increase in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be decreased by 25 ft/min.
b. It must be increased by 25 ft/min.
c. It must be increased by 35 ft/min.
d. It must be decreased by 35 ft/min.

DESCENTS 62.
What will be the rate of descent when flying down a 5.5% glide slope, at a groundspeed of 450 knots?

a. 2540 ft/min.
b. 2290 ft/min.
c. 2390 ft/min.
d. 2324 ft/min.

DESCENTS 63.
At 0400 an aircraft at FL370, GS 420kt, is on the direct track to VOR 'X' 185 NM distant. The aircraft is required to cross VOR 'X' at FL80. For a mean rate of descent of 1800 FT/MIN at a mean GS of 250 kt, the latest time at which to commence descent is?

a. 0451.
b. 0434.
c. 0417.

d. 0428.

DESCENTS 64.
An aircraft maintaining a 5.5% gradient is at 9 NM from the runway, on a flat terrain. Its height is approximately?

a. 2640 FT.
b. 2870 FT.
c. 2680 FT.
d. 2830 FT.

DESCENTS 65.
If there is a 45 knot decrease in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 130 ft/min.
b. It must be decreased by 130 ft/min.
c. It must be increased by 225 ft/min.
d. It must be decreased by 225 ft/min.

DESCENTS 66.
What will be the rate of descent when flying down a 7.5% glide slope, at a groundspeed of 400 knots?

a. 3040 ft/min.
b. 3100ft/min.
c. 4170 ft/min.
d. 3020 ft/min.

DESCENTS 67.
An aircraft at FL350 is required to commence descent when 105 NM from a VOR and to cross the VOR at FL80. The mean GS for the descent is 370 kt. What is the minimum rate of descent required?

a. 1955 FT/MIN.
b. 1855 FT/MIN.
c. 1920 FT/MIN.
d. 1790 FT/MIN.

DESCENTS 68.
If there is a 65 knot decrease in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 255 ft/min.
b. It must be decreased by 255 ft/min.

c. It must be decreased by 325 ft/min.
d. It must be increased by 325 ft/min.

DESCENTS 69.
An aircraft at FL290 is required to commence descent when 75 NM from a VOR and to cross that VOR at FL80. Mean GS during descent is 290kt. What is the minimum rate of descent required?

a. 1855 FT/MIN.
b. 1355 FT/MIN.
c. 2055 FT/MIN.
d. 1700 FT/MIN.

DESCENTS 70.
The equivalent of 170 m/sec is approximately?

a. 330 kt.
b. 345 kt.
c. 300 kt.
d. 355 kt.

DESCENTS 71.
What will be the rate of descent when flying down a 10% glide slope, at a groundspeed of 450 knots?

a. 5000ft/min.
b. 4405ft/min.
c. 4560 ft/min.
d. 4455 ft/min.

DESCENTS 72.
An aircraft at FL330 is required to commence descent when 95 NM from a VOR and to cross the VOR at FL100. The mean GS during the descent is 360 kt. What is the minimum rate of descent required?

a. 1485 FT/MIN.
b. 1455 FT/MIN.
c. 1650 FT/MIN.
d. 1750 FT/MIN.

DESCENTS 73.
If there is a 12 knot increase in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 42 ft/min.

b. It must be decreased by 42 ft/min.
c. It must be decreased by 60 ft/min.
d. It must be increased by 60 ft/min.

DESCENTS 74.
Assuming zero wind, what distance is covered by an aircraft descending 15000 FT with a TAS of 375 kt and maintaining a rate of descent of 3000 FT/MIN?

a. 23.35 NM.
b. 31.25 NM.
c. 29.25 NM.
d. 38.45 NM.

DESCENTS 75.
What will be the rate of descent when flying down a 7% glide slope, at a groundspeed of 375 knots?

a. 2575 ft/min.
b. 2737 ft/min.
c. 2660 ft/min.
d. 2377 ft/min.

DESCENTS 76.
An aircraft at FL370 is required to commence descent at 65 NM from a VOR and to cross the facility at FL130. If the mean GS for the descent is 290 kt, the minimum rate of descent required is?

a. 1860 FT/MIN.
b. 1895 FT/MIN.
c. 1920 FT/MIN.
d. 1791 FT/MIN.

DESCENTS 77.
If there is a 22 knot decrease in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 120 ft/min.
b. It must be decreased by 120 ft/min.
c. It must be increased by 110 ft/min.
d. It must be decreased by 110 ft/min.

DESCENTS 78.
Given: Aircraft height 3000 FT, ILS GP angle 3°. At what approximate distance from THR can you expect to capture the GP?

a. 9.9 NM.
b. 9.0 NM.
c. 9.1 NM.
d. 9.5 NM.

DESCENTS 79,
What will be the rate of descent when flying down a 12% glide slope, at a groundspeed of 340 knots?

a. 4190 ft/min.
b. 2190 ft/min.
c. 2925 ft/min.
d. 4135 ft/min.

DESCENTS 80,
Given: ILS GP angle = 3.5 DEG, GS = 250 kt. Approximate rate of descent is?

a. 1480 FT/MIN.
b. 1400 FT/MIN.
c. 1780 FT/MIN.
d. 1800 FT/MIN.

DESCENTS 81,
If there is a 27 knot decrease in headwind by what amount must the rate of descent be changed in order to maintain a 3° glideslope?

a. It must be increased by 158 ft/min.
b. It must be decreased by 158 ft/min.
c. It must be increased by 135 ft/min.
d. It must be decreased by 135 ft/min.

DESCENTS 82,
An aircraft at FL350 is required to descend to cross a DME facility at FL80. Maximum rate of descent is 2000 FT/MIN and mean GS for descent is 275 kt. The minimum range from the DME at which descent should start is?

a. 62 NM.
b. 69 NM.
c. 49 NM.
d. 59 NM.

DESCENTS 83,
An aircraft at FL390 is required to descend to cross a DME facility at FL70. Maximum rate of descent is 2500 FT/MIN, mean GS during descent is 290 kt. Minimum range from the DME at which descent should commence is?

a. 68 NM.
b. 62 NM.
c. 58 NM.
d. 73 NM.

DESCENTS 84,
What will be the rate of descent when flying down a 8% glide slope, at a groundspeed of 240 knots?

a. 1577 ft/min.
b. 1757 ft/min.
c. 1945 ft/min.
d. 1975 ft/min.

DESCENTS 85,
An aircraft at FL350 is required to cross a VOR/DME facility at FL110 and to commence descent when 125 NM from the facility. If the mean GS for the descent is 350 kt, the minimum rate of descent required is?

a. 1120 FT/MIN.
b. 1290 FT/MIN.
c. 1140 FT/MIN.
d. 1190 FT/MIN.

DESCENTS 86,
Given: TAS = 197 kt, True course = 240°, W/V = 180/30kt. Descent is initiated at FL 220 and completed at FL 40. Distance to be covered during descent is 50 NM. What is the approximate rate of descent?

a. 1800 FT/MIN.
b. 950 FT/MIN.
c. 1200 FT/MIN.
d. 1092 FT/MIN.

DESCENTS 87,
By what amount must you change the rate of descent to maintain a 3^0 glideslope if you meet an increase in headwind of 14 knots?

a. 50 feet per minute increase.
b. 50 feet per minute decrease.
c. 70 feet per minute increase.
d. 70 feet per minute decrease.

DESCENTS 88.
What will be the rate of descent when flying down a 12% glide slope, at a groundspeed of 350 knots?

a. 4255 ft/min.
b. 4283 ft/min.
c. 4382 ft/min.
d. 4832 ft/min.

DESCENTS 89.
When 95 nm from a VOR you commence a descent from FL330 with the intention of arriving at the VOR at FL100. What rate of descent is required if your mean ground speed is 250 knots?

a. 1059 ft/min.
b. 1010 ft/min.
c. 1150 ft/min.
d. 1100 ft/min.

DESCENTS 90.
What is the rate of descent on a 12% glide slope if groundspeed is 320 knots?

a. 3750 ft/min.
b. 3620 ft/min.
c. 3890 ft/min.
d. 3640 ft/min.

DESCENTS 91.
What will be the rate of descent when flying down a 12% glide slope, at a groundspeed of 375 knots?

a. 4560 ft/min.
b. 4217 ft/min.
c. 4227 ft/min.
d. 4422 ft/min.

DESCENTS 92.
At 80 nm from a VOR an aircraft commences a descent from FL330 in order to arrive overhead the VOR at FL100. What rate of descent is required if the mean groundspeed in the descent is to be 240 knots?

a. 1300 ft/min.
b. 1150 ft/min.
c. 1120 ft/min.
d. 1020 ft/min.

DESCENTS 93.
An aircraft is on an ILS 3 degree glideslope, which passes over the runway threshold at a height of 50 feet. The DME range is 15 nm from the threshold. What is the height above the runway threshold elevation? (Use the 1 in 60 rule and the approximation 6000 feet = 1 nautical mile)

a. 3550 feet.
b. 4450 feet.
c. 4550 feet.
d. 4310 feet.

DESCENTS 94.
What will be the rate of descent when flying down a 5% glide slope, at a groundspeed of 175 knots?

a. 1375 ft/min.
b. 537 ft/min.
c. 886 ft/min.
d. 973 ft/min.

DESCENTS 95.
For an aircraft at a height of 1500 feet, interception of a 3° ILS glide path will occur at approximately?

a. 7.0 nm from the threshold.
b. 5.0 nm from the threshold.
c. 6.0 nm from the threshold.
d. 4.5 nm from the threshold.

DESCENTS 96.
What will be the rate of descent when flying down a 6% glide slope, at a groundspeed of 250 knots?

a. 1403 ft/min.
b. 1509 ft/min.
c. 1520 ft/min.
d. 1303 ft/min.

DESCENTS 97.
At 0430 an aircraft is in level cruise flight at groundspeed of 350 knots, at FL370, 165 nm from a VOR. It is required to descend at a mean rate of 1800 feet/min, to be at FL 80 overhead the VOR. What is the latest time to commence descent, if the mean ground speed in the descent is to be 200 knots?

a. 0456.
b. 0439.

c. 0449.
d. 0421.

DESCENTS 98.
When 85 nm from a VOR you commence a descent from FL330 with the intention of arriving at the VOR at FL100. What rate of descent is required if your mean ground speed is 340 knots?

a. 1503 ft/min.
b. 1650 ft/min.
c. 1633 ft/min.
d. 1533 ft/min.

DESCENTS 99.
At 105 nm from a VOR an aircraft commences a descent from FL350 in order to arrive overhead the VOR at FL120. What rate of descent is required if the mean groundspeed in the descent is to be 250 knots?

a. 950 ft/min.
b. 913 ft/min.
c. 744 ft/min.
d. 847 ft/min.

DESCENTS 100.
An aircraft is on an ILS 3 degree glideslope, which passes over the runway threshold at a height of 50 feet. The DME range is 18 nm from the threshold. What is the height above the runway threshold elevation? (Use the 1 in 60 rule and the approximation 6000 feet = 1 nautical mile)

a. 5522 feet.
b. 5110 feet.
c. 6550 feet.
d. 5650 feet.

INS IRS FMS EFIS 1.
Gyro compassing of an inertial reference system (IRS) is accomplished with the mode selector switched to?

a. ALIGN.
b. STBY.
c. NAV.
d. ATT REF.

INS IRS FMS EFIS 2.
Which of the following lists all of the methods that can be used to enter 'Created Waypoints' into the CDU of a B737-400 Electronic Flight Instrument System?

a. Identifier range, location name; Height above MSL; latitude and longitude.
b. Identifier bearing/distance; place bearing/place bearing; along-track displacement; latitude and longitude.
c. Identifier name and range; location name; Height above MSL; latitude and longitude.
d. Identifier grid reference, location name, Height above MSL, latitude and Rhumb line position.

INS IRS FMS EFIS 3.
Some inertial reference and navigation systems are known as "strapdown". This means that?

a. The accelerometers are fixed to the aircraft structure but the gyros are stabilised.
b. The gyros are stabilised but the accelerometers are fixed to the aircraft structure.
c. The gyroscopes and accelerometers become part of the unit's fixture to the aircraft structure.
d. The indicator units are strapped to the aircraft structure.

INS IRS FMS EFIS 4.
As the INS position of the departure aerodrome, coordinates 35°32.7'N 139°46.3'W are input instead of 35°32.7'N 139°46.3'E. When the aircraft subsequently passes point 52°N 180°W, the longitude value shown on the INS will be?

a. 099° 32.6'E.
b. 099° 32.6'W.
c. 199° 32.6'W.
d. 299° 32.6'W.

INS IRS FMS EFIS 5.
In order to maintain an accurate vertical using a pendulous system, an aircraft inertial platform incorporates a device?

a. With damping and a period of 84.4 MIN.
b. With damping and a period of 84.4 SEC.
c. With damping and a period of 48.4 MIN.
d. With damping and a period of 48.4 SEC.

INS IRS FMS EFIS 6.
In what way does IRS differ from INS?

a. Has a shorter spin-up time and suffers from laser lock.
b. Does not need to correct for coriolis and central acceleration.
c. Has a longer spin-up time and is not affected by vertical accelerations due to gravity.
d. Does not experience Schuler errors as accelerometers are strapped down.

INS IRS FMS EFIS 7.
Which of the following statements is true of a Ring Laser Gyro?

a. It is not necessarily fixed to true north and is quick to erect
b. It is fixed to true north and is quick to erect
c. It doesn't suffer from 'lock in' and is unaffected by the earth's gravitational force
d. It is not necessarily fixed to true north but takes along time to erect

INS IRS FMS EFIS 8.
In a laser reference system (IRS), as compared to a gyro reference system (INS):

a. The accelerometers are strapped down but the platform is gyro stabilised.
b. Accelerometers and platform are both strapped down
c. The platform is strapped down but the accelerometers are gyro-stabilised.
d. Accelerometers and platform are both gyro-stabilised.

INS IRS FMS EFIS 9.
In a ring laser gyro, the purpose of the dither motor is to:

a. Compensate for transport wander.
b. Stabilise the laser frequencies.
c. Enhance the accuracy of the gyro at all rotational rates.
d. Overcome laser lock.

INS IRS FMS EFIS 10.
A pilot turns off the power to his IRS whilst in flight. He switches it on again after just a few seconds. What will be the effect?

a. It can be repositioned whilst in flight
b. There will be no effect
c. It cannot be used and must be shut down
d. It cannot be used for navigation, but can be used to provide attitude information.

INS IRS FMS EFIS 11.
In which IRS mode does gyro-compassing take place?

a. ATT
b. ALIGN
c. ON
d. NAV

INS IRS FMS EFIS 12.
A gyro is said to drift when its spin axis moves in the ?

a. Horizontal and vertical
b. Neither, because its definition is not related to these axes
c. Horizontal
d. Vertical

INS IRS FMS EFIS 13.
What do the sensors of an INS measure?

a. Acceleration
b. The horizontal component of the earth's rotation
c. Velocity
d. Precession

INS IRS FMS EFIS 14.
The IRS position is updated?

a. Updating is normally carried out by the crew when over-flying a known position (VOR station or NDB)
b. IRS positions are updated by pressing the 'Take-off/ Go-around' button at the start of the take-off roll
c. During flight IRS positions are automatically updated by the FMC
d. Only on the ground during the alignment procedure.

INS IRS FMS EFIS 15.
Some inertial reference systems are known as 'strapdown'. This means:

a. The system is mounted on a stabilised platform.
b. The gyros are fixed but the accelerometers are stabilised.
c. The system is mounted and fixed to the aircraft structure.
d. The accelerometers are fixed but the gyros are stabilised.

INS IRS FMS EFIS 16.
Double integration of the output from the east/west accelerometer of an inertial navigation system (INS) in the NAV MODE gives:

a. Vehicle longitude.
b. Distance east/west.
c. Distance north/south.
d. Velocity east/west.

INS IRS FMS EFIS 17.
The principle of 'Schuler Tuning' as applied to the operation of Inertial Navigation Systems/Inertial Reference Systems is applicable to:

a. Only gyro-stabilised systems.
b. Both gyro-stabilised platform and strapdown systems.
c. Both gyro-stabilised and laser gyro systems but only when operating in the non 'strapdown' mode.
d. Only to 'strapdown' laser gyro systems.

INS IRS FMS EFIS 18.
In an Inertial Navigation System (INS), what is the output of the first stage North/South integrator?

a. Velocity along the local meridian.
b. Groundspeed.
c. Latitude.
d. Change of latitude.

INS IRS FMS EFIS 19.
Alignment of INS and IRS equipments can take place in which of the following modes?

a. ALIGN only.
b. ALIGN and ATT.
c. ATT and ALIGN.
d. NAV and ALIGN.

INS IRS FMS EFIS 20.
On a triple-fit IRS system, present positions on the CDU?

a. Are likely to differ as the information comes from different sources.
b. Will only differ if one IRS has been decoupled due to a detected malfunction.
c. Will only differ if an initial input error of aircraft position has been made.
d. Will not differ as the information is averaged

INS IRS FMS EFIS 21.
What are the positions (in the order left to right) on the Boeing 737-400 IRS Mode Selector Unit (MSU)?

a.	OFF	STBY	ATT	NAV.
b.	OFF	ALIGN	NAV	ATT.
c.	OFF	STBY	NAV	ATT.
d.	OFF	STBY	ALIGN	NAV.

INS IRS FMS EFIS 22.
Gyro-compassing in an INS?

a. It is not possible in flight because the gyros cannot differentiate between acceleration due to aircraft movement and initial alignment errors.
b. d. Is possible in flight as the gyros cannot differentiate between acceleration due to aircraft movement and initial alignment errors.
c. Is possible in flight as the gyros can differentiate between acceleration due to aircraft movement and initial alignment errors.
d. Is not possible in flight as the gyros can differentiate between acceleration due to aircraft movement and initial alignment errors.

INS IRS FMS EFIS 23.
In an INS/IRS, an azimuth gyro is found to have a drift rate. If *t* is the time since selecting the MSU from ALIGN to NAV the azimuth gyro heading error is?

a. Proportional to t.
b. Proportional to the square root of t.
c. Proportional to t/2.
d. Sinusoidal.

INS IRS FMS EFIS 24.
On the IRS, selection of ATT mode gives attitude?

a. Altitude, and heading.
b. Only.
c. And heading.
d. Heading, and groundspeed.

INS IRS FMS EFIS 25.
How long does it take to align an IRS (Laser Ring Gyros)?

a. 1 minute.
b. 5 minutes.
c. 10 minutes.
d. 15 minutes.

INS IRS FMS EFIS 26.
What is the purpose of the plezo-electric motor in an IRS system?

a. Dither.
b. Vibrate.
c. Shake.
d. Shudder.

INS IRS FMS EFIS 27.
In order to maintain an accurate vertical using a pendulous system, an Aircraft inertial platform incorporates a device?

a. Without damping and a period of 84.4 MIN.
b. Without damping and a period of 84.4 SEC.
c. With damping and a period of 84.4 MIN.
d. With damping and a period of 84.4 SEC.

INS IRS FMS EFIS 28.
The platform of an Inertial navigation system (INS) is maintained at right angles to the local vertical by applying corrections for the effects of?

a. Aircraft manoeuvres, earth rotation, transport wander and coriolis.
b. Movement in the yawing plane, secondary precession and pendulous oscillation.
c. Gyroscopic inertia, earth rotation and real drift.
d. Vertical velocities, earth precession, centrifugal forces and transport drift.

INS IRS FMS EFIS 29.
In an Inertial Navigation System (INS), Ground Speed (GS) is calculated?

a. By integrating gyro precession in N/S and E/W directions respectively.
b. From TAS and WN from Air Data Computer (ADC).
c. By integrating measured acceleration.
d. From TAS and WN from RNAV data.

INS IRS FMS EFIS 30.
An aircraft equipped with an Inertial Navigation System (INS) flies with INS 1 coupled with autopilot 1. Both inertial navigation systems are navigating from way-point A to B. The inertial systems' Central Display Units (CDU) show:

XTK on INS 1 = 0 XTK on INS 2 = 8L (XTK = cross track)

What can be deduced from this information?

a. Only inertial navigation system No.1 is drifting.
b. At least one of the inertial navigation systems is drifting.

c. Only inertial navigation system No.2 is drifting.
d. The autopilot is unserviceable in NAV mode.

INS IRS FMS EFIS 31.
If an IRS loses its position mid-flight it must?

a. Not be used in NAV mode.
b. Be turned OFF.
c. Have a new position inserted.
d. Be selected to ALIGN and then to NAV.

INS IRS FMS EFIS 32.
What does INS need for wind calculations?

a. EAS.
b. TAS.
c. Mach Number.
d. Heading.

INS IRS FMS EFIS 33.
What do you call a system of gyros and accelerometers that is fixed to the aircraft?

a. Laser.
b. Stabilised.
c. Fixed.
d. Strapdown.

INS IRS FMS EFIS 34.
When is the last point at which an INS or IRS may be selected to NAV mode?

a. After passengers and freight are aboard.
b. Immediately prior to push back or taxi from the gate.
c. At the holding point.
d. On operation of TOGA switch when opening the throttles for the take-off.

INS IRS FMS EFIS 35.
In what form are positions entered in all INS systems?

a. Geographic coordinates.
b. Ranges and bearings.
c. Waypoint names.
d. Hexadecimals.

INS IRS FMS EFIS 36.
Which mode selection on the CDU of an INS is required to display Initial Great Circle track?

a. HDG\DA.
b. DSRTK\STS.
c. TK\GS.
d. XTK\TKE.

INS IRS FMS EFIS 37.
An IRS differs from an INS in that it?

a. **Has a longer spin-up time and is not affected by vertical accelerations due to gravity.**
b. **Does not need to correct for coriolis and central acceleration.**
c. **Does not experience Schuler errors as accelerometers are strapped down.**
d. **Has a shorter spin-up time and suffers from laser lock.**

INS IRS FMS EFIS 38.
Which of the following statements is true of a Ring Laser Gyro?

a. **It doesn't suffer from 'lock in' and is unaffected by the earth's gravitational force**
b. **It is not necessarily fixed to true north but takes along time to erect**
c. **It is not necessarily fixed to true north and is quick to erect**
d. **It is fixed to true north and is quick to erect**

INS IRS FMS EFIS 39.
In a laser reference system (IRS), as compared to a gyro reference system (INS):

a. **The accelerometers are strapped down but the platform is gyro stabilised.**
b. **Accelerometers and platform are both strapped down**
c. **The platform is strapped down but the accelerometers are gyro-stabilised.**
d. **Accelerometers and platform are both gyro-stabilised.**

INS IRS FMS EFIS 40.
The dither motor in a ring laser gyro sis used to?

a. **Compensate for transport wander.**
b. **Stabilise the laser frequencies.**
c. **Enhance the accuracy of the gyro at all rotational rates.**
d. **Overcome laser lock.**

INS IRS FMS EFIS 41.
A pilot turns off his IRS whilst in flight, then switches it on again after just a few seconds. What will be the effect?

a. **It can be repositioned whilst in flight**
b. **There will be no effect**
c. **It cannot be used and must be shut down**
d. **It cannot be used for navigation, but can be used to provide attitude information**

INS IRS FMS EFIS 42.
In which IRS mode does gyro-compassing take place?

a. ATT
b. ALIGN
c. ON
d. NAV

INS IRS FMS EFIS 43.
Gyro drift occurs when the spin axis moves in the?

a. **Horizontal and vertical**
b. **Neither, because its definition is not related to these axes**
c. **Horizontal**
d. **Vertical**

INS IRS FMS EFIS 44.
What do the sensors of an INS measure?

a. **Acceleration**
b. **The horizontal component of the earth's rotation**
c. **Velocity**
d. **Precession**

INS IRS FMS EFIS 45.
Where and when are the IRS positions updated?

a. **During flight IRS positions are automatically updated by the FMC**
b. **Only on the ground during the alignment procedure .**
c. **Updating is normally carried out by the crew when over-flying a known position (VOR station or NDB)**
d. **IRS positions are updated by pressing the 'Take-off/ Go-around' button at the start of the take-off roll**

INS IRS FMS EFIS 46.
Some inertial reference systems are known as 'strapdown'. This means:

a. The system is mounted on a stabilised platform.
b. The gyros are fixed but the accelerometers are stabilised.
c. The system is mounted and fixed to the aircraft structure.
d. The accelerometers are fixed but the gyros are stabilised.

INS IRS FMS EFIS 47.
What is produced by double integration of the output from the east/west accelerometer of an inertial navigation system (INS) when it is in the NAV MODE?

a. Distance north/south.
b. Velocity east/west.
c. Vehicle longitude.
d. Distance east/west.

INS IRS FMS EFIS 48.
The principle of 'Schuler Tuning' as applied to the operation of Inertial Navigation Systems/Inertial Reference Systems is applicable to:

a. Only gyro-stabilised systems.
b. Both gyro-stabilised platform and strapdown systems.
c. Both gyro-stabilised and laser gyro systems but only when operating in the non 'strapdown' mode.
d. Only to 'strapdown' laser gyro systems.

INS IRS FMS EFIS 49.
In an Inertial Navigation System (INS), what is the output of the first stage North/South integrator?

a. Velocity along the local meridian.
b. Groundspeed.
c. Latitude.
d. Change of latitude.

INS IRS FMS EFIS 50.
Alignment of INS and IRS equipments can take place in which of the following modes?

a. ATT and ALIGN.
b. NAV and ALIGN.
c. ALIGN only.
d. ALIGN and ATT.

INS IRS FMS EFIS 51.
On an aircraft equipped with a triple-fit IRS system, present positions on the CDU?

a. Will only differ if an initial input error of aircraft position has been made.
b. Will not differ as the information is averaged
c. Are likely to differ as the information comes from different sources.
d. Will only differ if one IRS has been decoupled due to a detected malfunction.

INS IRS FMS EFIS 52.
What are the positions (in the order left to right) on the Boeing 737-400 IRS Mode Selector Unit (MSU)?

a.	OFF	STBY	ATT	NAV.
b.	OFF	STBY	NAV	ATT.
c.	OFF	STBY	ALIGN	NAV.
d.	OFF	ALIGN	NAV	ATT.

INS IRS FMS EFIS 53.
Gyro-compassing in an INS?

a. It is not possible in flight because the gyros cannot differentiate between acceleration due to aircraft movement and initial alignment errors
b. d. Is possible in flight as the gyros cannot differentiate between acceleration due to aircraft movement and initial alignment errors.
c. Is possible in flight as the gyros can differentiate between acceleration due
to aircraft movement and initial alignment errors.
d. Is not possible in flight as the gyros can differentiate between acceleration due to aircraft movement and initial alignment errors.

INS IRS FMS EFIS 54.
If *t* is the time since selecting the MSU from ALIGN to NAV the azimuth gyro heading error caused by drift rate of an INS/IRS azimuth gyro is?

a. Proportional to t/2.
b. Sinusoidal.
c. Proportional to t.
d. Proportional to the square root of t.

INS IRS FMS EFIS 55.
On the IRS, selection of ATT mode gives attitude?

a. Altitude, and heading.
b. Only.
c. And heading.

d. Heading, and groundspeed.

INS IRS FMS EFIS 56.
How long does it take to align an IRS (Laser Ring Gyros)?

a. 10 minutes.
b. 15 minutes.
c. 1 minute.
d. 5 minutes.

INS IRS FMS EFIS 57.
What principle is utilized by the piezo-electric motor in an IRS system?

a. Shake.
b. Shudder.
c. Dither.
d. Vibrate.

INS IRS FMS EFIS 58.
By what means is an accurate vertical maintained using a pendulous system, an aircraft inertial platform incorporates a device?

a. With damping and a period of 84.4 MIN.
b. With damping and a period of 84.4 SEC.
c. Without damping and a period of 84.4 MIN.
d. Without damping and a period of 84.4 SEC.

INS IRS FMS EFIS 59.
The platform of an inertial navigation system (INS) is maintained at right angles to the local vertical by applying corrections to counter the effects of?

a. Gyroscopic inertia, earth rotation and real drift.
b. Vertical velocities, earth precession, centrifugal forces and transport drift.
c. Aircraft manoeuvres, earth rotation, transport wander and coriolis.
d. Movement in the yawing plane, secondary precession and pendulous oscillation.

INS IRS FMS EFIS 60.
In an Inertial Navigation System (INS), Ground Speed (GS) is calculated?

a. By integrating gyro precession in N/S and E/W directions respectively.
b. From TAS and WN from Air Data Computer (ADC).
c. By integrating measured acceleration.
d. From TAS and WN from RNAV data.

INS IRS FMS EFIS 61.
An aircraft equipped with an Inertial Navigation System (INS) flies with INS 1 coupled with autopilot 1. Both inertial navigation systems are navigating from waypoint A to B. The inertial systems' Central Display Units (CDU) show?

XTK on INS 1 = 0 XTK on INS 2 = 15L (XTK = cross track)

What can be deduced from this information?

a. Only inertial navigation system No.1 is drifting.
b. Only inertial navigation system No.2 is drifting.
c. The autopilot is unserviceable in NAV mode.
d. At least one of the inertial navigation systems is drifting.

INS IRS FMS EFIS 62.
If an IRS loses its position mid-flight it must?

a. Not be used in NAV mode.
b. Be turned OFF.
c. Have a new position inserted.
d. Be selected to ALIGN and then to NAV.

INS IRS FMS EFIS 63.
What does INS need for wind calculations?

a. EAS.
b. TAS.
c. Mach Number.
d. Heading.

INS IRS FMS EFIS 64.
What do you call a system of gyros and accelerometers that is fixed to the aircraft?

a. Laser.
b. Stabilised.
c. Fixed.
d. Strapdown.

INS IRS FMS EFIS 65.
The latest point at which an INS or IRS may be selected to NAV mode is?

a. At the holding point.
b. On operation of TOGA switch when opening the throttles for the take-off.
c. After passengers and freight are aboard.
d. Immediately prior to push back or taxi from the gate.

INS IRS FMS EFIS 66.
What format is used to enter positions into INS systems?

a. Waypoint names.
b. Hexadecimals.
c. Ranges and bearings.
d. Geographic coordinates.

INS IRS FMS EFIS 67.
Which mode on the CDU of an INS must be selected in order to display initial Great Circle track?

a. DSRTK\STS.
b. TK\GS.
c. XTK\TKE.
d. HDG\DA.

INS IRS FMS EFIS 68.
When can a pilot change the data in the FMS database?

a. Every 28 days.
b. When it is deemed to be necessary.
c. When there is a fault.
d. Never, because the FMS database is read-only

INS IRS FMS EFIS 69.
The FMC position is?

a. The average of the IRS positions.
b. Computer generated from the radio navigation positions.
c. Half way between the IRS and radio navigation positions.
d. Computer generated from the IRS and radio navigation positions.

INS IRS FMS EFIS 70.
What is the source of magnetic variation information in a Flight Management System (FMS)?

a. The main directional gyro, which is coupled to the magnetic sensor (flux valve) positioned in the wingtip.
b. The FMS calculates MH and MT from the FMC position.
c. Magnetic variation information is stored in each IRS memory; it is applied to the true heading calculated by the respective IRS.
d. Magnetic variation is calculated by each IRS based on the respective IRS position and the aircraft magnetic heading.

INS IRS FMS EFIS 71.
What are, in order of highest priority followed by lowest, the two levels of message produced by the CDU of the B737-400 Electronic Flight Instrument System?

a. Warning and Advisory.
b. Caution and Advisory.
c. Urgent and Routine.
d. Warning and Caution.

INS IRS FMS EFIS 72.
In the B737-400 Flight Management System the CDUs are used during preflight to?

a. Manually initialise the IRSs and FMC with dispatch information.
b. Manually initialise the IRSs, FMC and Autothrottle with dispatch information.
c. Automatically initialise the IRSs and FMC with dispatch information.
d. Manually initialise the Flight Director System and FMC with dispatch information.

INS IRS FMS EFIS 73.
The FMS on a 737-400 provides?

a. Automatic navigation & manual performance management.
b. Automatic navigation & automatic performance management.
c. Manual navigation & manual performance management.
d. Manual navigation & automatic performance management.

INS IRS FMS EFIS 74.
What is the sequence of pages on start-up of the Boeing 737- 400 FMS?

a. POS INIT, IDENT, DEPARTURES.
b. IDENT, POS INIT, RTE.
c. POS INIT, RTE, IDENT.
d. IDENT, POS INIT, DEPARTURES.

INS IRS FMS EFIS 75.
FMC aircraft position determined by radio navigation is derived on the B737-400 FMS from?

a. VOR/DME.
b. DME /ADF.
c. VOR/VOR.
d. DME/DME.

INS IRS FMS EFIS 76.
When initial position is put into a B737-400 FMS, the system?

a. Rejects initial latitude error, but it will accept longitude error.
b. Rejects initial longitude error, but it will accept latitude error.
c. Rejects initial latitude or longitude error.
d. Cannot detect input errors, and accepts whatever is put in.

INS IRS FMS EFIS 77.
The period of validity of an FMS database is?

a. 56 days.
b. One week.
c. 28 days.
d. Variable.

INS IRS FMS EFIS 78.
On the Boeing 737-400 EFIS EHSI, on which modes is a Weather Radar Display available?

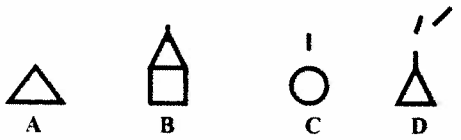
a. MAP, PLAN, FULL VOR/ILS.
b. MAP, PLAN, EXP VOR/ILS.
c. MAP, EXP VOR/ILS, EXP NAV.
d. MAP, FULL VOR/ILS, FULL NAV.

INS IRS FMS EFIS 79.
In what formats can created waypoints be entered into the scratch pad of the B737-400 FMS?

a. Place Bearing/Distance, Place Bearing/Place Bearing, Along-Track Displacement, Latitude and Longitude.
b. Place Bearing/Distance, Place Distance/Place Distance, Along-Track Displacement, Latitude and Longitude.
c. Place Bearing/Distance, Place Bearing/Place Bearing, Across-Track Displacement, Latitude and Longitude.
d. Place, Place Bearing/Distance, Along-Track Displacement, Latitude and Longitude.

INS IRS FMS EFIS 80.
Which EFIS symbol below represents the selected course?

a. A.
b. B.
c. C.
d. D.



INS IRS FMS EFIS 81.
How does the FMS calculate groundspeed ?

a. Input from DME with change of range integrated with respect to time.
b. Input of heading from either the IRS or gyro compass, TAS from ADC and wind velocity from selected meteorological data
c. Input from IRS.
d. input from ADC of TAS and wind velocity.

INS IRS FMS EFIS 82.
When can a pilot change the data in the FMS database?

a. When there is a fault.
b. Never, because the FMS database is read-only
c. Every 28 days.
d. When it is deemed to be necessary.

INS IRS FMS EFIS 83.
How is the FMC position produced?

a. The average of the IRS positions.
b. Computer generated from the IRS and radio navigation positions.
c. Computer generated from the radio navigation positions.
d. Half way between the IRS and radio navigation positions.

INS IRS FMS EFIS 84.
From what source does an FMS obtain magnetic variation information?

a. Magnetic variation information is stored in each IRS memory; it is applied to the true heading calculated by the respective IRS.
b. Magnetic variation is calculated by each IRS based on the respective IRS position and the aircraft magnetic heading.
c. The main directional gyro which is coupled to the magnetic sensor (flux valve) positioned in the wingtip.
d. The FMS calculates MH and MT from the FMC position.

INS IRS FMS EFIS 85.
What are, in order of highest priority followed by lowest, the two levels of message produced by the CDU of the B737-400 EFIS?

a. Caution and Advisory.
b. Urgent and Routine.
c. Warning and Caution.
d. Warning and Advisory.

INS IRS FMS EFIS 86
The CDUs in the B737-400 Flight Management System are used during preflight to?

a. Manually initialise the IRSs and FMC with dispatch information.
b. Manually initialise the IRSs, FMC and Autothrottle with dispatch information.
c. Automatically initialise the IRSs and FMC with dispatch information.
d. Manually initialise the Flight Director System and FMC with dispatch information.

INS IRS FMS EFIS 87,
The Boeing 737-400 Flight Management System (FMS) provides?

a. Manual navigation & manual performance management.
b. Manual navigation & automatic performance management.
c. Automatic navigation & manual performance management.
d. Automatic navigation & automatic performance management.

INS IRS FMS EFIS 88,
List the sequence of pages on start-up of the Boeing 737- 400 FMS?

a. IDENT, POS INIT, RTE.
b. POS INIT, RTE, IDENT.
c. IDENT, POS INIT, DEPARTURES.
d. POS INIT, IDENT, DEPARTURES.

INS IRS FMS EFIS 89,
In the Boeing 737-400 aircraft the FMC aircraft position determined by radio navigation is derived from?

a. DME/DME.
b. VOR/DME.
c. DME /ADF.
d. VOR/VOR.

INS IRS FMS EFIS 90,
When aligning the B737-400 FMS, the system?

a. Rejects initial latitude or longitude error.
b. Cannot detect input errors, and accepts whatever is put in.
c. Rejects initial latitude error, but it will accept longitude error.
d. Rejects initial longitude error, but it will accept latitude error.

INS IRS FMS EFIS 91,
What is the period of validity of an FMS database?

a. 56 days.
b. One week.
c. 28 days.
d. Variable.

INS IRS FMS EFIS 92,
In what modes is the Weather Radar Display available on the Boeing 737-400 EFIS EHSI?

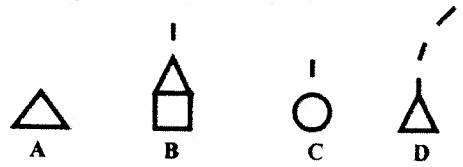
a. MAP, EXP VOR/ILS, EXP NAV.
b. MAP, FULL VOR/ILS, FULL NAV.
c. MAP, PLAN, FULL VOR/ILS.
d. MAP, PLAN, EXP VOR/ILS.

INS IRS FMS EFIS 93,
In what formats can created waypoints be entered into the scratch pad of the B737-400 FMS?

a. Place Bearing/Distance, Place Distance/Place Distance, Along-Track Displacement, Latitude and Longitude.
b. Place Bearing/Distance, Place Bearing/Place Bearing, Across-Track Displacement, Latitude and Longitude.
c. Place, Place Bearing/Distance, Along-Track Displacement, Latitude and Longitude.
d. Place Bearing/Distance, Place Bearing/Place Bearing, Along-Track Displacement, Latitude and Longitude.

INS IRS FMS EFIS 94,
Which EFIS symbol below represents the Trend vector?

a. A.
b. B.
c. C.
d. D.



INS IRS FMS EFIS 95,
What information is required by the FMS to enable it to calculate groundspeed ?

a. Input from IRS.
b. Input from ADC of TAS and wind velocity.
c. Input from DME with change of range integrated with respect to time.

d. Input of heading from either the IRS or gyro compass, TAS from ADC and wind velocity from selected meteorological data

INS IRS FMS EFIS 96.
Which FMC/CDU page normally appears on initial power application to the B737-400 Electronic Flight Instrument System?

a. IDENT.
b. POS INIT.
c. PERF INIT.
d. RTE.

INS IRS FMS EFIS 97.
Which of the following lists the first three pages of the FMC/CDU normally used to enter data on initial start-up of the B737-400 Electronic Flight Instrument System?

a. POS INIT – IDENT- RTE.
b. RTE-POS INT- IDENT.
c. IDENT - POS INIT - RTE
d. PERF INIT – POD IDENT- INIT.

INS IRS FMS EFIS 98.

A pilot accidentally turning OFF the INS in flight, and then turns it back ON a few moments later. Following this incident?

a. It cannot be used for the remainder of the flight.

b. It can only be used for attitude reference
c. It must be switched off or its gyros will toppie.
d. It can be used as normal.

INS IRS FMS EFIS 99.

If an INS temporarily loses its power supply in flight?

a. It will functions normally.
b. It will be usable only in the NASV mode.
c. It must be switched off for the remainder of the flight.

d. It can only be used for attitude reference.

INS IRS FMS EFIS 100.
The sensors of an INS measure?

a. Position.
b. Acceleration
c. Velocity.
d. TAS.

INS IRS FMS EFIS 101.
Waypoints can be entered in an INS memory in different formats. In which of the following formats can waypoints be entered into all INS systems?

a. Grid references.
b. Airport names.
c. Geographic coordinates
d. Index numbers.

INS IRS FMS EFIS 102.
An aircraft equipped with an Inertial Navigation System (INS) flies with INS 1 coupled with autopilot 1. Both inertial navigation systems are navigating from waypoint A to B. The inertial systems' Central Display Units (CDU) shows. XTK on INS 1 = 0 - XTK on INS 2 = 10L (XTK = cross track). What can be deduced from this information?

a. Both systems are drifting.
b. Both systems are serviceable as this error is within limits.
c. The INS2 is drifting.
d. At least one of the inertial navigation systems is drifting.

INS IRS FMS EFIS 103.
How often can a pilot update the data in the FMS database?

a. Every 28 days.
b. When it is deemed to be necessary.
c. When there is a fault.
d. Never, because the FMS database is read-only

INS IRS FMS EFIS 104.
From what information is the FMC position calculated?

a. Computer generated from the IRS and radio navigation positions.
b. The average of the IRS positions.
c. Computer generated from the radio navigation positions.
d. Half way between the IRS and radio navigation positions.

INS IRS FMS EFIS 105.
How does an FMS obtain magnetic variation information?

a. The main directional gyro, which is coupled to the magnetic sensor (flux valve) positioned in the wingtip.
b. The FMS calculates MH and MT from the FMC position.
c. Magnetic variation is calculated by each IRS based on the respective IRS position and the aircraft magnetic heading.
d. Magnetic variation information is stored in each IRS memory; it is applied to the true heading calculated by the respective IRS.

INS IRS FMS EFIS 106.
What is the highest priority and lowest priority, message produced by the CDU of the B737-400 EFIS?

a. Caution and Advisory.
b. Warning and Advisory.
c. Urgent and Routine.
d. Warning and Caution.

INS IRS FMS EFIS 107.
What is the function of the MCDUs in the B737-400 Flight Management System when carrying out preflight checks?

a. Manually initialise the IRSs, FMC and Autothrottle with dispatch information.
b. Automatically initialise the IRSs and FMC with dispatch information.
c. Manually initialise the Flight Director System and FMC with dispatch information.
d. Manually initialise the IRSs and FMC with dispatch information.

INS IRS FMS EFIS 108.
The functions of the Boeing 737-400 FMS include?

a. Automatic navigation & automatic performance management.
b. Manual navigation & manual performance management.
c. Manual navigation & automatic performance management.
d. Automatic navigation & manual performance management.

INS IRS FMS EFIS 109.
In a Boeing 737-400 FMS the sequence of pages on start-up is?

a. POS INIT, IDENT, DEPARTURES.
b. IDENT, POS INIT, RTE.
c. IDENT, POS INIT, DEPARTURES.
d. INIT, POS, RTE, IDENT.

INS IRS FMS EFIS 110.
From what source is the FMC aircraft position determined by radio navigation in the Boeing 737-400 aircraft derived?

a. VOR/DME.
b. DME/DME.
c. DME /ADF.
d. VOR/VOR.

INS IRS FMS EFIS 111.
When the Boeing B737-400 FMS is being initialized prior to flight, the system?

a. Rejects initial latitude error, but it will accept longitude error.
b. Cannot detect input errors, and accepts whatever is put in.
c. Rejects initial longitude error, but it will accept latitude error.
d. Rejects initial latitude or longitude error.

INS IRS FMS EFIS 112.
For how long does the data in the FMS database remain valid?

a. 56 days.
b. One week.
c. 28 days.
d. Variable.

INS IRS FMS EFIS 113.
Weather radar Displays are available on the Boeing 737-400 EFIS EHSI, when the system is set to?

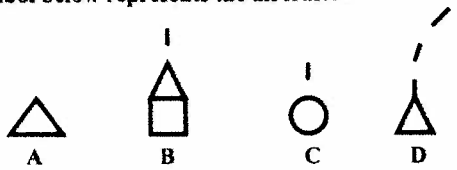
a. MAP, PLAN, FULL VOR/ILS.
b. MAP, PLAN, EXP VOR/ILS.
c. MAP, EXP VOR/ILS, EXP NAV.
d. MAP, FULL VOR/ILS, FULL NAV.

INS IRS FMS EFIS 114.
In what formats can created waypoints be entered into the scratch pad of the B737-400 FMS?

a. Place Bearing/Distance, Place Bearing/Place Bearing, Across-Track Displacement, Latitude and Longitude.
b. Place, Place Bearing/Distance, Along-Track Displacement, Latitude and Longitude.
c. Place Bearing/Distance, Place Bearing/Place Bearing, Along-Track Displacement, Latitude and Longitude.
d. Place Bearing/Distance, Place Distance/Place Distance, Along-Track Displacement, Latitude and Longitude.

INS IRS FMS EFIS 115.
Which white EFIS symbol below represents the aircraft?

a. A.
b. B.
c. C.
d. D.



INS IRS FMS EFIS 116.
How does the FMS calculate groundspeed ?

a. Input from IRS.
b. Input from ADC of TAS and wind velocity.
c. Input from DME with change of range integrated with respect to time.
d. Input of heading from either the IRS or gyro compass, TAS from ADC and wind velocity from selected meteorological data

INS IRS FMS EFIS 117.
In what way does IRS differ from INS?

a. Has a longer spin-up time and is not affected by vertical accelerations due to gravity.
b. Does not experience Schuler errors as accelerometers are strapped down.
c. Has a shorter spin-up time and suffers from laser lock.
d. Does not need to correct for coriolis and central acceleration.

INS IRS FMS EFIS 118.
A Ring Laser Gyro?

a. It is fixed to true north and is quick to erect
b. It doesn't suffer from 'lock in' and is unaffected by the earth's gravitational force
c. It is not necessarily fixed to true north but takes along time to erect
d. It is not necessarily fixed to true north and is quick to erect

INS IRS FMS EFIS 119.
In a laser reference system (IRS), as compared to a gyro reference system (INS):

a. The accelerometers are strapped down but the platform is gyro stabilised.
b. Accelerometers and platform are both strapped down
c. The platform is strapped down but the accelerometers are gyro-stabilised.
d. Accelerometers and platform are both gyro-stabilised.

INS IRS FMS EFIS 120.
In a ring laser gyro, the purpose of the dither motor is to:

a. Compensate for transport wander.
b. Stabilise the laser frequencies.
c. Enhance the accuracy of the gyro at all rotational rates.
d. Overcome laser lock.

INS IRS FMS EFIS 121.
What will be the effect if the crew of an aircraft switch off the power to his IRS whilst in flight, before switching it back on a few seconds later?

a. It cannot be used for navigation, but can be used to provide attitude information.
b. It must be re-aligned whilst in flight.
c. The system will operate normally.
d. It cannot be used and must be shut down or the gyros will topple.

INS IRS FMS EFIS 122.
In which IRS mode does gyro-compassing take place?

a. ATT
b. ALIGN
c. ON
d. NAV

INS IRS FMS EFIS 123.
In which plane must the spin axis move to cause a gyro to drift?

a. Horizontal
b. Vertical
c. Horizontal and vertical
d. Neither, because its definition is not related to these axes

INS IRS FMS EFIS 124.
What do the sensors of an INS measure?

a. Acceleration
b. The horizontal component of the earth's rotation
c. Velocity
d. Precession

INS IRS FMS EFIS 125.
Where and when are the IRS positions updated?

a. Only on the ground during the alignment procedure .
b. Updating is normally carried out by the crew when over-flying a known position (VOR station or NDB)
c. During flight IRS positions are automatically updated by the FMC
d. IRS positions are updated by pressing the 'Take-off/ Go-around' button at the start of the take-off roll

INS IRS FMS EFIS 126
Some inertial reference systems are known as 'strapdown'. This means:

a. The system is mounted on a stabilised platform.
b. The gyros are fixed but the accelerometers are stabilised.
c. The system is mounted and fixed to the aircraft structure.
d. The accelerometers are fixed but the gyros are stabilised.

INS IRS FMS EFIS 127.
What output is calculated by double integration of the output from the east/west accelerometer of an inertial navigation system (INS) when the system is engaged in the Nav mode?

a. Vehicle longitude.
b. Distance east/west.
c. Distance north/south.
d. Velocity east/west.

INS IRS FMS EFIS 128.
The principle of 'Schuler Tuning' as applied to the operation of Inertial Navigation Systems/Inertial Reference Systems is applicable to:

a. Only gyro-stabilised systems.
b. Both gyro-stabilised platform and strapdown systems.
c. Both gyro-stabilised and laser gyro systems but only when operating in the non 'strapdown' mode.
d. Only to 'strapdown' laser gyro systems.

INS IRS FMS EFIS 129.
In an Inertial Navigation System (INS), the output of the first stage North/South integrator is?

a. Velocity along the local meridian.
b. Groundspeed.
c. Latitude.
d. Change of latitude.

INS IRS FMS EFIS 130.
Alignment of INS and IRS equipments can take place in which of the following modes?

a. ALIGN only.
b. NAV and ALIGN.
c. ALIGN and ATT.
d. ATT and ALIGN.

INS IRS FMS EFIS 131.
When a triple-fit IRS system is employed, the present positions on the CDU?

a. Will only differ if one IRS has been decoupled due to a detected malfunction.
b. Will only differ if an initial input error of aircraft position has been made.
c. Will not differ as the information is averaged
d. Are likely to differ as the information comes from different sources.

INS IRS FMS EFIS 132.
What are the positions (in the order left to right) on the Boeing 737-400 IRS Mode Selector Unit (MSU)?

a.	OFF	ALIGN	NAV	ATT.
b.	OFF	STBY	ATT	NAV.
c.	OFF	STBY	NAV	ATT.
d.	OFF	STBY	ALIGN	NAV.

INS IRS FMS EFIS 133.
In an INS the process of gyro-compassing?

a. Is possible in flight as the gyros can differentiate between acceleration due to aircraft movement and initial alignment errors.
b. Is not possible in flight as the gyros can differentiate between acceleration due to aircraft movement and initial alignment errors.
c. It is not possible in flight because the gyros cannot differentiate between acceleration due to aircraft movement and initial alignment errors
d. Is possible in flight as the gyros cannot differentiate between acceleration due to aircraft movement and initial alignment errors.

INS IRS FMS EFIS 134.
If an INS/IRS, an azimuth gyro is found to be drifting in flight, and if *t* is the time since selecting the system from ALIGN to NAV, the azimuth gyro heading error will be?

a. Proportional to the square root of t.
b. Proportional to t/2.

c. Sinusoidal.
d. Proportional to t.

INS IRS FMS EFIS 135.
On the IRS, selection of ATT mode gives attitude?

a. Altitude, and heading.
b. Only.
c. Heading, and groundspeed.
d. And heading.

INS IRS FMS EFIS 136.
How much time is required to align an Inertial Reference System?

a. 1 minute.
b. 5 minutes.
c. 10 minutes.
d. 15 minutes.

INS IRS FMS EFIS 137.
What principle is utilized by employing a piezo-electric motor to overcome laser lock in an IRS system?

a. Shake.
b. Shudder.
c. Dither.
d. Vibrate.

INS IRS FMS EFIS 138
In order to maintain an accurate vertical using a pendulous system, an aircraft inertial platform incorporates a device?

a. Without damping and a period of 84.4 MIN.
b. Without damping and a period of 84.4 SEC.
c. With damping and a period of 84.4 MIN.
d. With damping and a period of 84.4 SEC.

INS IRS FMS EFIS 139.
In order to keep the platform of an inertial navigation system (INS) at right angles to the local vertical in flight, corrections must be applied to compensate for?

a. Aircraft manoeuvres, earth rotation, transport wander and coriolis.
b. Vertical velocities, earth precession, centrifugal forces and transport drift.

c. Movement in the yawing plane, secondary precession and pendulous oscillation.
d. Gyroscopic inertia, earth rotation and real drift.

INS IRS FMS EFIS 140.
An Inertial Navigation System (INS), calculates Ground Speed (GS)?

a. From TAS and WN from Air Data Computer (ADC).
b. By integrating gyro precession in N/S and E/W directions respectively.
c. By integrating measured acceleration.
d. From TAS and WN from RNAV data.

INS IRS FMS EFIS 141.
An aircraft equipped with an Inertial Navigation System (INS) flies with INS 1 coupled with autopilot 1. Both inertial navigation systems are navigating from waypoint A to B. The inertial systems' Central Display Units (CDU) show:

XTK on INS 1 = 12L XTK on INS 2 = 0 (XTK = cross track)

What can be deduced from this information?

a. Only inertial navigation system No.1 is drifting.
b. At least one of the inertial navigation systems is drifting.
c. Only inertial navigation system No.2 is drifting.
d. The autopilot is unserviceable in NAV mode.

INS IRS FMS EFIS 142.
After an IRS has lost its position mid-flight it must?

a. Not be used in NAV mode.
b. Be turned OFF.
c. Have a new position inserted.
d. Be selected to ALIGN and then to NAV.

INS IRS FMS EFIS 143.
What does INS need for wind calculations?

a. EAS.
b. TAS.
c. Mach Number.
d. Heading.

INS IRS FMS EFIS 144.
What do you call a system of gyros and accelerometers that is fixed to the aircraft?

a. Laser.
b. Stabilised.
c. Fixed.
d. Strapdown.

INS IRS FMS EFIS 145.
What is the latest time at which the INS/IRS may be selected to NAV mode?

a. After passengers and freight are aboard.
b. Immediately prior to push back or taxi from the gate.
c. On operation of the TOGA switch when opening the throttles for the take-off.
d. At the holding point.

INS IRS FMS EFIS 146.
What can be used to enter positions on all INS systems?

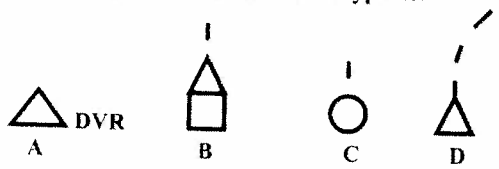
a. Waypoint names.
b. Hexadecimals.
c. Geographic coordinates.
d. Ranges and bearings.

INS IRS FMS EFIS 147.
The INS CDU mode selection required to display initial Great Circle track is?

a. HDG\DA.
b. TK\GS.
c. XTK\TKE.
d. DSRTK\STS.

INS IRS FMS EFIS 148.
Which Cyan symbol below represents an off-route waypoint?

a. A.
b. B.
c. C.
d. D.



INS IRS FMS EFIS 149.
Which of the following lists all of the methods that can be used to enter 'Created Waypoints' into the CDU of a B737-400 Electronic Flight Instrument System?

a. Identifier name and range; location name; Height above MSL; latitude and longitude.
b. Identifier grid reference, location name, Height above MSL, latitude and Rhumb line position.
c. Identifier range, location name; Height above MSL; latitude and longitude.
d. Identifier bearing/distance; place bearing/place bearing; along-track displacement; latitude and longitude.

INS IRS FMS EFIS 150.
Some inertial reference and navigation systems are known as "strapdown". This means that?

a. The gyroscopes and accelerometers become part of the unit's fixture to the aircraft structure.
b. The indicator units are strapped to the aircraft structure.
c. The accelerometers are fixed to the aircraft structure but the gyros are stabillsed.
d. The gyros are stabilised but the accelerometers are fixed to the aircraft structure.

PLOTTING 1.
What facilities are located at position N52 10.9 W009 31.4 on the Jeppesen chart E(LO)1?

a. Civil airport: ILS: NDB.
b. Military airport: ILS: NDB.
c. Civil airport: VOR: ILS.
d. Military airport: VOR; ILS.

PLOTTING 2.
What is the radial and distance from CRK VOR (N51 50.4 W008 29.7) to position N52 20.0 W009 10.0 on the Jeppesen chart E(LO)1?

a. 322°M 39 nm.
b. 322°M 41 nm.
c. 330°M 41 nm.
d. 330°M 39 nm.

PLOTTING 3.
What is the radial and distance from SHA (N52 43.3 W008 53.1) to Birr (N53 04.0 W007 54.0) on the Jeppesen chart E(LO)1?

a. 068°M 42 nm.
b. 060°M 40 nm.
c. 068°M 40 nm.

d. 060°M 42 nm.

PLOTTING 4.
What is the latitude and longitude of the point bearing 239°M at 36 NM. range from the SHA VOR (N52 43.3 W008 53.1) on the Jeppesen chart E(LO)1?

a. N52 15 W009 30.
b. N52 12 W009 15.
c. N52 20 W009 37.
d. N52 12 W009 30.

PLOTTING 5.
What is the mean true track and distance from the BAL (N53 18.0 W006 26.9) to CRN (N53 18.1 W008 56.5) on the Jeppesen chart E(LO)1?

a. 272° 89 nm.
b. 272° 88 nm.
c. 270° 89 nm.
d. 270° 86 nm.

PLOTTING 6.
Which of the following lists all the aeronautical chart symbols shown at position N51 50.4 W008 29.7 on the Jeppesen chart E(LO)1?

a. VOR: DME: NDB: compulsory reporting point.
b. Civil airport: VOR: DME: compulsory reporting point.
c. VOR: DME: NDB: ILS.
d. Civil airport: VOR: non-compulsory reporting point.

PLOTTING 7
Which of the following lists all the aeronautical chart symbols shown at position N53 18.1 W008 56.5 on the Jeppesen chart E(LO)1?

a. Civil airport: VOR: DME: non-compulsory reporting point.
b. VOR: NDB: DME: non-compulsory reporting point.
c. VOR: NDB: DME: compulsory reporting point.
d. Civil airport: NDB: DME: non-compulsory reporting point.

PLOTTING 8.
What is the aircraft position on the Jeppesen chart E(LO)1, given the following data?

SHA VOR (N52 43.3 W008 53.1) radial 205°.
CRK VOR (N51 50.4 W008 29.7) radial 317°.

a. N51 18 W009 13.
b. N52 05 W009 15.
c. N52 10 W009 10.
d. N52 15 W009 17.

PLOTTING 9.
Given the following information determine the aircraft position using the Jeppesen chart E(LO)1?

CRN (N53 18.1 W008 56.5) 18 DME
SHA VOR (N52 43.3 W008 53.1) 20 DME
Heading 270°M. Both DME ranges decreasing

a. N52 01 W009 08.
b. N53 01 W009 08.
c. N53 02 W008 43.
d. N52 03 W008 43.

PLOTTING 10.
What is the mean true track and distance from the BAL VOR (N53 18.0 W006 26.9) to CFN NDB (N55 02.6 W008 20.3) on the Jeppesen chart E(LO)1?

a. 148° 134.
b. 328° 125.
c. 148° 125.
d. 328° 134.

PLOTTING 11.
At position N53 40 W008 00 on the Jeppesen E(LO)1 chart, what is the magnetic bearing from the SHA VOR (N52 43.3 W008 53.1)?

a. 217.
b. 037.
c. 209.
d. 029.

PLOTTING 12.
What is the aircraft position on the Jeppesen E(LO)1 chart, given the following data?

The radial from the SHA VOR (N52 43.3 W008 53.1) is 120°M.
The radial from the CRK VOR (N51 50.4 W008 29.7) is 033°M.

a. N53 20 W008 00.
b. N52 20 W008 21.
c. N52 30 W008 00.

d. N52 40 W008 21.

PLOTTING 13.
What is the aircraft position on the Jeppesen E(LO)1 chart, given the following data?

SHA VOR (N52 43.3 W008 53.1) DME 41 NM.
CRK VOR (N51 50.4 W008 29.7) DME 30 NM.
Aircraft heading 270°(M),
Both DME distances decreasing.

a. N52 05 W009 15.
b. N52 15 W009 15.
c. N52 15 W008 05.
d. N52 25 W008 10.

PLOTTING 14.
The aircraft position is at N53 30 W008 00. At that position the VOR radial from SHA (N52 43.3 W008 53.1) on the Jeppesen E(LO)1 chart, would be (1) and the radial from CON (N53 54.8 W008 49.1) would be (2). The correct combination is?

a. (1) 042° (2) 138°.
b. (1) 213° (2) 310°.
c. (1) 033° (2) 130°.
d. (1) 221° (2) 318°.

PLOTTING 15.
What is the average track (°T) and distance between WTD NDB (N5211.3 W00705.0) and FOY NDB (N5234.0 W00911.7) on the Jeppesen E(LO)1 chart?

a. 075° - 81 nm.
b. 277° - 83 nm.
c. 286° - 81 nm.
d. 294° - 80 nm.

PLOTTING 16.
What is the magnetic track and distance from Connaught VOR/DME (CON, N53 54.8 W008 49.1) to overhead Abbey Shrule aerodrome (N5336 W007 39)?

a. 124° - 47 nm.
b. 116° - 46 nm.
c. 296° - 46 nm.
d. 304° - 47 nm.

PLOTTING 17.
What is the average magnetic track and distance between KER NDB (N52 10.9 W009 31.4) and CRN NDB (N53 18.1 W008 56.5) on the Jeppesen E(LO)1 chart?

a. 017° - 70 nm.
b. 025° - 70 nm.
c. 197° - 71 nm.
d. 205° - 71 nm.

PLOTTING 18.
What is the airport at N52 11 W009 32 on the Jeppesen E(LO)1 chart?

a. Shannon.
b. Waterford.
c. Kerry.
d. Cork.

PLOTTING 19.
What is the approximate course (T) and distance between Waterford NDB (WTD N52 11.3 W007 04.9) and Sligo NDB (SLG N54 16.7 W008 36.0) on the Jeppesen E(LO)1 chart?

a. 156° - 136 nm.
b. 164° - 142 nm.
c. 336° - 137 nm.
d. 344° - 139 nm.

PLOTTING 20.
What is the radial and DME distance from CRK VOR/DME (N51 50.4 W008 29.7) to position N5140 W00730 on the Jeppesen E(LO)1 chart?

a. 104° - 76 nm.
b. 106° - 38 nm.
c. 113° - 38 nm.
d. 293° - 39 nm.

PLOTTING 21.
An aircraft is on the 025° radial from SHA VOR (N52 43.3 W008 53.1) at 49 DME on the Jeppesen E(LO)1 chart. What is its position?

a. N53 29 W008 30.
b. N53 29 W009 30.
c. N52 29 W009 30.
d. N52 39 W008 30.

PLOTTING 22.
What is the radial and DME distance from CRK VOR/DME (N5150.4 W00829.7) to position N5220 W00810 on the Jeppesen E(LO)1 chart?

a. 030° - 33 nm.
b. 130° - 33 nm.
c. 030° - 53 nm
d. 033° - 30 nm.

PLOTTING 23.
What is the radial and DME distance from CRK VOR/DME (N5150.4 W00829.7) to position N5210 W00920 on the Jeppesen E(LO)1 chart?

a. 311^0 M 58 nm.
b. 311° - 38 nm.
c. 030^0 M 38 nm.
d. 030^0 M 58 nm.

PLOTTING 24.
What is the radial and DME distance from CRK VOR/DME (N5150.4 W00829.7) to position N5230 W00750 on the Jeppesen E(LO)1 chart?

a. 039^0 M 24 nm.
b. 139^0 M 48 nm
c. 139^0 M 58 nm
d. 039° M 48 nm.

PLOTTING 25.
What is the radial and DME distance from CRK VOR/DME (N5150.4 W00829.7) to position N5140 W00730 on the Jeppesen E(LO)1 chart?

a. 113° M 38 nm.
b. 123^0 M 38 nm.
c. 013^0 M 48 nm.
d. 113^0 M 19 nm.

PLOTTING 26.
What is the radial and DME distance from SHA VOR/DME (N5243.3 W00853.1) to position N5300 W00940 on the Jeppesen E(LO)1 chart?

a. 309° M 33 nm.
b. 300^0 M 53 nm.
c. 300^0 M 39 nm.
d. 139^0 M 33 nm.

PLOTTING 27.
What is the radial and DME distance from SHA VOR/DME (N5243.3 W00853.1) to position N5310 W00830 on the Jeppesen E(LO)1 chart?

a. 045^0 M 40 nm.
b. 030^0 M 35 nm.
c. 035^0 M 35 nm.
d. 035° M 30 nm.

PLOTTING 28.
What is the radial and DME distance from SHA VOR/DME (N5243.3 W00853.1) to position N5220 W00810 on the Jeppesen E(LO)1 chart?

a. 139° M 35 nm.
b. 130^0 M 30 nm
c. 135^0 M 55 nm
d. 139^0 M 45 nm

PLOTTING 29.
What is the radial and DME distance from SHA VOR/DME (N5243.3 W00853.1) to position N5210 W00920 on the Jeppesen E(LO)1 chart?

a. 214^0 M 57 nm.
b. 210^0 M 37 nm.
c. 214° M 37 nm.
d. 210^0 M 57 nm.

PLOTTING 30.
What is the radial and DME distance from CON VOR/DME (N5354.8 W00849.1) to position N5430 W00900 on the Jeppesen E(LO)1 chart?

a. 358° M 36 nm.
b. 358^0 M 30 nm.
c. 350^0 M 46 nm.
d. 350^0 M 36 nm.

PLOTTING 31.
What is the radial and DME distance from CON VOR/DME (N5354.8 W00849.1) to position N5400 W00800 on the Jeppesen E(LO)1 chart?

a. 088° M 29 nm.
b. 088^0 M 39 nm.
c. 080^0 M 19 nm.
d. 080^0 M 29 nm.

PLOTTING 32.
What is the radial and DME distance from CON VOR/DME (N5354.8 W00849.1) to position N5340 W00820 on the Jeppesen E(LO)1 chart?

a. 140^0 M 33 nm.
b. 140° M 23 nm.
c. 145^0 M 23 nm.
d. 145^0 M 33 nm.

PLOTTING 33.
What is the radial and DME distance from CON VOR/DME (N5354.8 W00849.1) to position N5330 W00930 on the Jeppesen E(LO)1 chart?

a. 230^0 M 35 nm.
b. 230^0 M 25 nm.
c. 233^0 M 55 nm.
d. 233° M 35 nm.

PLOTTING 34.
What is the radial and DME distance from BEL VOR/DME (N5439.7 W00613.8) to position N5410 W00710 on the Jeppesen E(LO)1 chart?

a. 236° M 44 nm.
b. 236^0 M 54 nm.
c. 230^0 M 44 nm.
d. 230^0 M 54 nm.

PLOTTING 35.
What is the radial and DME distance from BEL VOR/DME (N5439.7 W00613.8) to position N5440 W00730 on the Jeppesen E(LO)1 chart?

a. 278^0 M 54 nm.
b. 270^0 M 44 nm.
c. 278° M 44 nm.
d. 270^0 M 54 nm.

PLOTTING 36.
What is the radial and DME distance from BEL VOR/DME (N5439.7 W00613.8) to position N5500 W00700 on the Jeppesen E(LO)1 chart?

a. 315° M 34 nm.
b. 315^0 M 44 nm.
c. 310^0 M 34 nm.
d. 319^0 M 44 nm.

PLOTTING 37.
What is the average track (°M) and distance between WTD NDB (N5211.3 W00705.0) and KER NDB (N5210.9 W00931.5) on the Jeppesen E(LO)1 chart?

a. 278^0 M 80 nm.
b. 278° M 90 nm.
c. 270^0 M 90 nm.
d. 270^0 M 80 nm.

PLOTTING 38.
What is the average track (°M) and distance between CRK VOR (N5150.4 W00829.7) and CRN NDB (N5318.1 W00856.5) on the Jeppesen E(LO)1 chart?

a. 357° M 89 nm.
b. 357^0 M 80 nm.
c. 350^0 M 89 nm.
d. 350^0 M 90 nm.

PLOTTING 39.
What is the average track (°M) and distance between CRN NDB (N5318.1 W00856.5) and WTD NDB (N5211.3 W00705.0) on the Jeppesen E(LO)1 chart?

a. 142^0 M 90 nm.
b. 140^0 M 95 nm.
c. 140^0 M 90 nm.
d. 142° M 95 nm.

PLOTTING 40.
What is the average track (°M) and distance between WTD NDB (N5211.3 W00705.0) and BAL VOR (N5318.0 W00626.9) on the Jeppesen E(LO)1 chart?

a. 026° M 71 nm.
b. 026^0 M 75 nm.
c. 020^0 M 71 nm.
d. 020^0 M 75 nm.

PLOTTING 41.
What is the average track (°M) and distance between KER NDB (N5210.9 W00931.5) and CRN NDB (N5318.1 W00856.5) on the Jeppesen E(LO)1 chart?

a. 035^0 M 75 nm.
b. 035^0 M 70 nm.
c. 025° M 70 nm.
d. 035^0 M 70 nm.

PLOTTING 42.
What is the average track (°M) and distance between BAL VOR (N5318.0 W00626.9) and SLG NDB (N5416.7 W00836.0) on the Jeppesen E(LO)1 chart?

a. 316° M 96 nm.
b. 316° M 90 nm.
c. 310° M 96 nm.
d. 136° M 96 nm.

PLOTTING 43.
What is the average track (°M) and distance between CRN NDB (N5318.1 W00856.5) and BEL VOR (N5439.7 W00613.8) on the Jeppesen E(LO)1 chart?

a. 057° M 120 nm.
b. 123° M 126 nm.
c. 057° M 126 nm.
d. 123° M 120 nm.

PLOTTING 44.
What is the average track (°T) and distance between CON VOR (N5354.8 W00849.1) and BEL VOR (N5439.7 W00613.8) on the Jeppesen E(LO)1 chart?

a. 063° T 101 nm.
b. 063° M 101 nm.
c. 060° T 120 nm.
d. 060° T 101 nm.

PLOTTING 45.
What is the average track (°T) and distance between SLG NDB (N5416.7 W00836.0) and CFN NDB (N5502.6 W00820.4) on the Jeppesen E(LO)1 chart?

a. 011° M 47 nm.
b. 011° T 57 nm.
c. 011° T 47 nm.
d. 111° T 57 nm.

PLOTTING 46.
What is the average track (°T) and distance between WTD NDB (N5211.3 W00705.0) and FOY NDB (N5234.0 W00911.7) on the Jeppesen E(LO)1 chart?

a. 286° T 81 nm.
b. 286° M 81 nm.
c. 280° T 61 nm.
d. 280° T 81 nm.

PLOTTING 47.
What is the average track (°T) and distance between WTD NDB (N5211.3 W00705.0) and SLG NDB (N5416.7 W00836.0) on the Jeppesen E(LO)1 chart?

a. 036° T 130 nm.
b. 030° T 137 nm.
c. 036° T 137 nm.
d. 036° T 130 nm.

PLOTTING 48.
What is the average track (°T) and distance between SHA VOR (N5243.3 W00853.1) and CON VOR (N5354.8 W00849.1) on the Jeppesen E(LO)1 chart?

a. 002° T 72 nm.
b. 002° T 62 nm.
c. 015° T 75 nm.
d. 012° T 72 nm.

PLOTTING 49.
What is the average track (°T) and distance between BAL VOR (N5318.0 W00626.9) and CRN NDB (N5318.1 W00856.5) on the Jeppesen E(LO)1 chart?

a. 270° T 45 nm.
b. 270° T 90 nm.
c. 270° T 104 nm.
d. 275° T 90 nm.

PLOTTING 50.
What is the average track (°T) and distance between BAL VOR (N5318.0 W00626.9) and CFN NDB (N5502.6 W00820.4) on the Jeppesen E(LO)1 chart?

a. 327° T 124 nm.
b. 320° T 124 nm.
c. 327° T 120 nm.
d. 232° T 124 nm.

PLOTTING 51.
What is the average track (°T) and distance between CRN NDB (N5318.1 W00856.5) and EKN NDB (N5423.6 W00738.7) on the Jeppesen E(LO)1 chart?

a. 035° T 90 nm.
b. 030° T 80 nm.
c. 030° T 90 nm.
d. 035° t 80 nm.

PLOTTING 52.
Given: SHA VOR (N5243.3 W00853.1) radial 223°, CRK VOR (N5150.4 W00829.7) radial 322° on the Jeppesen E(LO)1 chart. What is the aircraft position?

a. N5220 W00920.
b. N5520 W00920.
c. N5220 W00720.
d. N5520 W00720.

PLOTTING 53.
Given: SHA VOR (N5243.3 W00853.1) radial 205°, CRK VOR (N5150.4 W00829.7) radial 317° on the Jeppesen E(LO)1 chart. What is the aircraft position?

a. N5220 W00920.
b. N5210 W00920.
c. N5210 W00910.
d. N5220 W00910.

PLOTTING 54.
Given: SHA VOR (N5243.3 W00853.1) radial 120°, CRK VOR (N5150.4 W00829.7) radial 033° on the Jeppesen E(LO)1 chart. What is the aircraft position?

a. N5230 W00900.
b. N5230 W00810.
c. N5220 W00800.
d. N5230 W00800.

PLOTTING 55.
SHA VOR (N5243.3 W00853.1) radial 129°, CRK VOR (N5150.4 W00829.7) radial 047°. What is the aircraft position?

a. N5220 W00750.
b. N5220 W00850.
c. N5220 W00700.
d. N5210 W00750.

PLOTTING 56.
Given: SHA VOR (N5243.3 W00853.1) radial 143°, CRK VOR (N5150.4 W00829.7) radial 050° on the Jeppesen E(LO)1 chart. What is the aircraft position?

To solve this type of problem:

a. N5210 W00850.
b. N5220 W00800.
c. N5220 W00850.
d. N5210 W00800.

PLOTTING 57.
SHA VOR/DME (N5243.3 W00853.1) radial 120°/35 NM on the Jeppesen E(LO)1 chart. What is the aircraft position?

a. N5230 W00800.
b. N5230 W00850.
c. N5220 W00800.
d. N5220 W00850.

PLOTTING 58.
Given: SHA VOR/DME (N5243.3 W00853.1) radial 165°/36 NM on the Jeppesen E(LO)1 chart. What is the aircraft position?

a. N5210 W00800.
b. N5210 W00830.
c. N5220 W00830.
d. N5220 W00850.

PLOTTING 59.
Given: SHA VOR/DME (N5243.3 W00853.1) radial 232°/32 NM on the Jeppesen E(LO)1 chart. What is the aircraft position?

a. N5220 W00930.
b. N5220 W00900.
c. N5210 W00930.
d. N5210 W00900.

PLOTTING 60.
Given: SHA VOR/DME (N5243.3 W00853.1) radial 025°/49 NM on the Jeppesen E(LO)1 chart. What is the aircraft position?

a. N5330 W00800.
b. N5320 W00830.
c. N5330 W00830.
d. N5320 W00800.

PLOTTING 61.
Given: SHA VOR/DME (N5243.3 W00853.1) radial 048°/22 NM on the Jeppesen E(LO)1 chart. What is the aircraft position?

a. N5300 W00800.
b. N5300 W0830.
c. N5330 W00830.
d. N5330 W00800.

PLOTTING 62.
Given: SHA VOR N5243.3 W00853.1 CRK VOR N5150.4 W00829.7 Aircraft position N5220 W00910 on the Jeppesen E(LO)1 chart, which of the following lists two radials that are applicable to the aircraft position?

a. SHA 212° CRK 328°.
b. SHA 032° CRK 140°.
c. SHA 220° CRK 322°.
d. SHA 200° CRK 328°.

PLOTTING 63.
Given: SHA VOR N5243.3 W00853.1 CRK VOR N5150.4 W00829.7 Aircraft position N5230 W00820 on the Jeppesen E(LO)1 chart, which of the following lists two radials that are applicable to the aircraft position?

a. SHA 125° CRK 010°.
b. SHA 049° CRK 017°.
c. SHA 131° CON 017°.
d. SHA 131° CRK 017°.

PLOTTING 64.
Given: SHA VOR N5243.3 W00853.1 CRK VOR N5150.4 W00829.7 Aircraft position N5230 W00930 on the Jeppesen E(LO)1 chart, which of the following lists two radials that are applicable to the aircraft position?

a. SHA 068° CRK 145°.
b. SHA 248° CRK 325°.
c. SHA 240° CRK 315°.
d. SHA 248° CRK 315°.

PLOTTING 65.
Given: SHA VOR N5243.3 W00853.1 CON VOR N5354.8 W00849.1 Aircraft position N5330 W00800 on the Jeppesen E(LO)1 chart, which of the following lists two radials that are applicable to the aircraft position?

a. SHA 042° CON 138°
b. SHA 045° CON 130°.
c. SHA 052° CRK 138°.
d. SHA 042° CRK 130°.

PLOTTING 66.
Given: SHA VOR N5243.3 W00853.1 CON VOR N5354.8 W00849.1 Aircraft position N5320 W00950 on the Jeppesen E(LO)1 chart, which of the following lists two radials that are applicable to the aircraft position?

a. SHA 325° CRK 230°.
b. SHA 145° CON 055°.
c. SHA 325° CON 235°.
d. SHA 320° CRK 230°.

PLOTTING 67.
Given: SHA VOR (N5243.3 W00853.1) DME 50 NM, CRK VOR (N5150.4 W00829.7) DME 41 NM, Aircraft heading 270°(M), Both DME distances increasing. What is the aircraft position on the Jeppesen E(LO)1 chart?

a. N5200 W00930.
b. N5200 W00935.
c. N5210 W00935.
d. N5210 W00930.

PLOTTING 68.
Given: SHA VOR (N5243.3 W00853.1) DME 41 NM, CRK VOR (N5150.4 W00829.7) DME 30 NM, Aircraft heading 270°(M), Both DME distances decreasing. What is the aircraft position on the Jeppesen E(LO)1 chart?

a. N5210 W00800.
b. N5215 W00805.
c. N5225 W00800.
d. N5225 W00805.

PLOTTING 69.
Given: CRN VOR (N5318.1 W00856.5) DME 18 NM, SHA VOR (N5243.3 W00853.1) DME 30 NM, Aircraft heading 270°(M), Both DME distances decreasing. What is the aircraft position on the Jeppesen E(LO)1 chart?

a. N5308 W00920.
b. N5210 W00830.
c. N5310 W00830.
d. N5310 W00920.

PLOTTING 70.
Given: CRN VOR (N5318.1 W00856.5) DME 34 NM, SHA VOR (N5243.3 W00853.1) DME 26 NM, Aircraft heading 090°(M), Both DME distances increasing. What is the aircraft position on the Jeppesen E(LO)1 chart?

a. N5255 W00815.

b. N5255 W00934.
c. N5200 W00934.
d. N5200 W00815.

PLOTTING 71.
Given: CON VOR (N5354.8 W00849.1) DME 30 NM, CRN VOR (N5318.1 W00856.5) DME 25 NM, Aircraft heading 270°(M), Both DME distances decreasing. What is the aircraft position on the Jeppesen E(LO)1 chart?

a. N5330 W00820.
b. N5335 W00920.
c. N5335 W00820.
d. N5330 W00920.

PLOTTING 72.
Given: CRK VOR/DME (N5150.4 W00829.7) Kerry aerodrome (N5210.9 W00931.4) What is the CRK radial and DME distance when overhead Kerry aerodrome on the Jeppesen E(LO)1 chart?

a. 307° 43 nm.
b. 302° 43 nm.
c. 300° 45 nm.
d. 310° 43 nm.

PLOTTING 73.
Given: SHA VOR/DME (N5243.3 W00853.1) Birr aerodrome (N5304 W00754) What is the SHA radial and DME distance when overhead Birr aerodrome on the Jeppesen E(LO)1 chart?

a. 073° 41 nm.
b. 068°41 nm.
c. 068° 45 nm.
d. 065° 41 nm.

PLOTTING 74.
Given: SHA VOR/DME (N5243.3 W00853.1) Connemara aerodrome (N5314 W00928) What is the SHA radial and DME distance when overhead Connemara aerodrome on the Jeppesen E(LO)1 chart?

a. 330° 37 nm.
b. 333° 30 nm.
c. 330° 30 nm.
d. 333° 37 nm.

PLOTTING 75.
Given: CON VOR/DME (N5354.8 W00849.1) Castlebar aerodrome (N5351 W00917) What is the CON radial and DME distance when overhead Castlebar aerodrome on the Jeppesen E(LO)1 chart?

a. 265° 17 nm.
b. 262° 17 nm.
c. 260° 20 nm.
d. 260° 17 nm.

PLOTTING 76.
Given: CON VOR/DME (N5354.8 W00849.1) Abbey Shrule aerodrome (N5335 W00739) What is the CON radial and DME distance when overhead Abbey Shrule aerodrome on the Jeppesen E(LO)1 chart?

a. 124° 42 nm.
b. 122° 46 nm.
c. 124° 46 nm.
d. 122° 42 nm.

PLOTTING 77.
What feature is shown on the chart at position N5211 W00931 on the Jeppesen E(LO)1 chart?

a. KERRY/Farranfore Aerodrome.
b. CORK Aerodrome.
c. SHANNON Aerodrome.
d. LOOP HEAD.

PLOTTING 78.
What feature is shown on the chart at position N5212 W00612 on the Jeppesen E(LO)1 chart?

a. STRUMBLE VOR.
b. HAVERFORDWEST NDB.
c. WATERFORD NDB.
d. TUSKAR ROCK LT.H. NDB.

PLOTTING 79.
What feature is shown on the chart at position N5311 W00637 on the Jeppesen E(LO)1 chart?

a. BALDONNEL Casement.
b. PUNCHTOWN Aerodrome.
c. NEWCASTLE Aerodrome.

d. BALDONNEL Aerodrome.

PLOTTING 80.
What feature is shown on the chart at positlon N5351 W00917 on the Jeppesen E(LO)1 chart?

a. CONNAUGHT VOR.
b. EAGLE ISLAND LHT.H.
c. CASTLEBAR Aerodrome.
d. CONNEMARE Aerodrome.

PLOTTING 81.
What feature is shown on the chart at position N5417 W01005 on the Jeppesen E(LO)1 chart?

a. TUSKAR ROCK LT.H.
b. EAGLE ISLAND LT.H. NDB.
c. LOOP HEAD.
d. SLIGO NDB.

PLOTTING 82.
Which of the following lists all the aeronautical chart symbols shown at position N5150.4 W00829.7 on the Jeppesen E(LO)1 chart?

a. Civil Airport, VOR, DME, Compulsory reporting point.
b. Military airport, NDB, ILS.
c. Military airport, VOR, DME, Non-compulsory reporting point.
d. Civil Airport, NDB, ILS, Compulsory reporting point.

PLOTTING 83.
Which of the following lists all the aeronautical chart symbols shown at position N5318.1 W00856.5 on the Jeppesen E(LO)1 chart?

a. Civil Airport, NDB, DME, Non-compulsory reporting point.
b. Military Airport, NDB, DME, Compulsory reporting point.
c. Civil Airport, VOR/DME, Non-compulsory reporting point.
d. Civil Airport, NDB, DME, Compulsory reporting point.

PLOTTING 84.
Which of the aeronautical chart symbols on page 186 indicates a VOR/DME?

a. 1.
b. 4.
c. 7.
d. 13.

PLOTTING 85.
Which of the aeronautical chart symbols on page 186 indicates a DME?

a. 1.
b. 4.
c. 7.
d. 13.

PLOTTING 86.
Which of the aeronautical chart symbols on page 186 indicates a VOR?

a. 1.
b. 4.
c. 7.
d. 13.

PLOTTING 87.
Which of the aeronautical chart symbols on page 186 indicates an NDB?

a. 2.
b. 4.
c. 7.
c. 13.

PLOTTING 88.
Which of the aeronautical chart symbols on page 186 indicates a basic, non-specified, navigation aid?

a. 1.
b. 4.
c. 7.
d. 13.

PLOTTING 89.
Which of the aeronautical chart symbols on page 186 indicates a TACAN?

a. 5.
b. 7.
c. 13.
d. 14.

PLOTTING 90.
Which of the aeronautical chart symbols on page 186 indicates a VORTAC?

a. 5.

b. 7.
c. 13.
d. 14.

PLOTTING 91.
Which aeronautical chart symbol on page 186 indicates an unlighted obstacle?

a 15.
b. 9.
c. 10.
d. 12

PLOTTING 92.
Which aeronautical chart symbol on page 186 indicates a lighted obstacle?

a 9.
b. 10.
c. 11.
d. 12

PLOTTING 93.
Which aeronautical chart symbol on page 186 indicates a group of unlighted obstacles?

a 9.
b. 10.
c. 11.
d. 12

PLOTTING 94.
Which aeronautical chart symbol on page 186 indicates a group of lighted obstacles?

a 9.
b. 10.
c. 11.
d. 12

PLOTTING 95.
Which aeronautical chart symbol on page 186 indicates an exceptionally high lighted obstacle?

a 9.
b. 10.
c. 11.

d. 12

PLOTTING 96.
Which aeronautical chart symbol on page 186 indicates a group of obstacle?

a 9.
b. 10.
c. 11.
d. 12

PLOTTING 97.
What is the meaning of aeronautical chart symbol No 3 on page 186?

a. Aeronautical ground light.
b. An unlighted obstacle.
c. A lighted obstacle.
d. An exceptionally high lighted obstacle.

PLOTTING 98.
What is the meaning of aeronautical chart symbol No. 9 on page 186?

a. Aeronautical ground light.
b. An unlighted obstacle.
c. A lighted obstacle.
d. An exceptionally high lighted obstacle.

PLOTTING 99.
Which aeronautical chart symbol on page 186 indicates an aeronautical ground light?

a. 3.
b. 9.
c. 12.
d. 15.

PLOTTING 100.
Which aeronautical chart symbol on page 186 indicates a lightship?

a. 6.
b. 8.
c. 9.
d. 15.

ANNEX A AERONAUTICAL CHART SYMBOLS

1
2
3

4
5
6

7
8
9

10
11
12

13
14
15

PSR & PET 1.

What is the distance to the point of safe endurance if an aircraft has a TAS of 300 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 50 knots headwind?

a. 1458 nm.
b. 1505 nm.
c. 1554 nm.
d. 1625 nm.

PSR & PET 2.

What is the time to the point of safe return (PSR) if the distance from A to B is 2368 nautical miles, the outbound groundspeed in 365 knots, the homebound groundspeed is 480 knots, and safe endurance is 8 hours 30 minutes?

a. 190 min.
b. 209 min.
c. 219 Min.
d. 290 Min.

PSR & PET 3.

What is the distance from 'Q' to the Point of Safe Return (PSR) for an aircraft that was over 'Q' at 1320 hours flying direct to 'R', given the following data?

Distance 'Q' to 'R' 3016 nm, True airspeed 480 kt, Safe endurance 10 Hours, if the mean wind component 'outbound' -90 kt, and the mean wind component 'homebound' is +75 kt.

a. 1320 nm.
b. 1530 nm.
c. 2290 nm.
d. 2375 nm.

PSR & PET 4.

What is the distance to B from the equal-time-point given the following data?

Distance A to B is 360 nm **Wind component A – B is -15 kt**
TAS is 180 kt **Wind component B -A is +15 kt**

a. 165 nm.
b. 170 nm.
c. 175 nm.
d. 180 nm.

PSR & PET 5.
An aircraft is flying at a TAS of 300 knots over a stretch of water between 2 airfields 500 nm apart. What is the distance from the first airfield to the equal time point (ETP) if the wind component is 60 knots head?

a. 200 nm.
b. 250 nm.
c. 280 nm.
d. 300 nm.

PSR & PET 6.
How far can the aeroplane fly out from its base and return in one hour, when flying at TAS 180 kt on a track of 090°, if the W/V is 045°/50kt?

a. 58 nm.
b. 85 nm.
c. 88 nm.
d. 175 nm.

PSR & PET 7.
For a distance of 1860 NM between Q and R, a ground speed "out" of 385 kt, a ground speed "back" of 465 kt and an endurance of 8 HR (excluding reserves) the distance from Q to the point of safe return (PSR) is?

a. 1685 NM.
b. 1532 NM.
c. 930 NM.
d. 1865 NM.

PSR & PET 8.
Two points A and B are 1000 NM apart. TAS = 490 kt. On the flight between A and B the equivalent headwind is -20 kt. On the return leg between B and A, the equivalent headwind is +40 kt. What distance from A, along the route A to B, is the Point of Equal Time (PET)?

a. 470 NM.
b. 455 NM.
c. 500 NM.
d. 530 NM.

PSR & PET 9.
An aeroplane is flying at TAS 180 kt on a track of 090°. The W/V is 045°/50kt. How far can the aeroplane fly out from its base and return in one hour?

a. 85 NM.
b. 88 NM.

c. 56 NM.
d. 176 NM.

PSR & PET 10.
Given: Distance 'A' to 'B' 2346 NM, Groundspeed 'out' 365 kt, Groundspeed 'back' 480 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 167 MIN.
b. 219 MIN.
c. 290 MIN.
d. 197 MIN.

PSR & PET 11.
Given: Distance 'A' to 'B' 2346 NM, Groundspeed 'out' 365 kt, Groundspeed 'back' 480 kt, Safe endurance 8 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 290 MIN.
b. 219 MIN.
c. 197 MIN.
d. 209 MIN.

PSR & PET 12.
An aircraft was over 'A' at 1435 hours flying direct to 'B'. Given: Distance 'A' to 'B' 2900 NM, True airspeed 470 kt, Mean wind component 'out' +55 kt, Mean wind component 'back' -75 kt. The ETA for reaching the Point of Equal Time (PET) between 'A' and 'B' is?

a. 1744.
b. 1846.
c. 1721.
d. 1657.

PSR & PET 13.
An aircraft was over 'A' at 1435 hours flying direct to 'B'. Given: Distance 'A' to 'B' 2900 NM, True airspeed 470 kt, Mean wind component 'out' +55 kt, Mean wind component 'back' -75 kt, Safe endurance 9 HR 30 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 2844 NM.
b. 2141 NM.
c. 1611 NM.
d. 1759 NM.

PSR & PET 14.
Given: Distance 'A' to 'B' 2484 NM, Groundspeed 'out' 420 kt, Groundspeed 'back' 500 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 193 MIN.
b. 163 MIN.
c. 173 MIN.
d. 183 MIN.

PSR & PET 15.
Given: Distance 'A' to 'B' 2484 NM, Mean groundspeed 'out' 420 kt, Mean groundspeed 'back' 500 kt, Safe endurance 08 HR 30 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 1630 NM.
b. 1940 NM.
c. 1908 NM.
d. 1736 NM.

PSR & PET 16.
An aircraft was over 'Q' at 1320 hours flying direct to 'R'. Given: Distance 'Q' to 'R' 3016 NM, True airspeed 480 kt, Mean wind component 'out' -90 kt, Mean wind component 'back' +75 kt, Safe endurance 10:00 HR. The distance from 'Q' to the Point of Safe Return (PSR) 'Q' is?

a. 1510 NM.
b. 2290 NM.
c. 2370 NM.
d. 1310 NM.

PSR & PET 17.
Given: Distance 'A' to 'B' 1973 NM, Groundspeed 'out' 430 kt, Groundspeed 'back' 385 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 130 MIN.
b. 145 MIN.
c. 162 MIN.
d. 181 MIN.

PSR & PET 18.
Given: Distance 'A' to 'B' 1973 NM, Groundspeed 'out' 430 kt, Groundspeed 'back' 385 kt, Safe endurance 7 HR 20 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 1664 NM.
b. 1698 NM.
c. 1422 NM.
d. 1490 NM.

PSR & PET 19.
Given: Distance 'Q' to 'R' 1760 NM, Groundspeed 'out' 435 kt, Groundspeed 'back 385 kt, Safe endurance 9 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1467 NM.
b. 1642 NM.
c. 1838 NM.
d. 1313 NM.

PSR & PET 20.
Given: Distance 'Q' to 'R' 1760 NM, Groundspeed 'out' 435 kt, Groundspeed 'back' 385 kt. The time from 'Q' to the Point of Equal Time (PET) between 'Q' and 'R' is?

a. 110 MIN.
b. 106 MIN.
c. 102 MIN.
d. 114 MIN.

PSR & PET 21.
Given: Distance 'A' to 'B' 3623 NM, Groundspeed 'out' 370 kt, Groundspeed 'back' 300 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 238 MIN.
b. 263 MIN.
c. 288 MIN.
d. 323 MIN.

PSR & PET 22.
Given: Distance 'Q' to 'R' 1860 NM, Groundspeed 'out' 400 kt, Groundspeed 'back 370 kt, Safe endurance 7 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1345 NM.
b. 1442 NM.
c. 1538 NM.
d. 1313 NM.

PSR & PET 23.
Given: Distance 'Q' to 'R' 1970 NM, Groundspeed 'out' 475 kt, Groundspeed 'back 485 kt, Safe endurance 9 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1967 NM.
b. 2142 NM.
c. 2160 NM.
d. 2313 NM.

PSR & PET 24.
Given: Distance 'Q' to 'R' 2160 NM, Groundspeed 'out' 535 kt, Groundspeed 'back 585 kt, Safe endurance 6 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1667 NM.
b. 1677 NM.
c. 1613 NM.
d. 1775 NM.

PSR & PET 25.
Given: Distance 'Q' to 'R' 2467 NM, Groundspeed 'out' 500 kt, Groundspeed 'back 400 kt, Safe endurance 9.5 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 2111 NM.
b. 2001 NM.
c. 2175 NM.
d. 2167 NM.

PSR & PET 26.
What is the distance to the point of safe endurance if an aircraft has a TAS of 350 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 50 knots headwind?

a. 1714 nm.
b. 1750 nm.
c. 1754 nm.
d. 1725 nm.

PSR & PET 27.
What is the time to the point of safe return (PSR) if the distance from A to B is 3000 nautical miles, the outbound groundspeed in 350 knots, the homebound groundspeed is 460 knots, and safe endurance is 8 hours 30 minutes?

a. 209 min.

b. 190 min.
c. 229 Min.
d. 290 Min.

PSR & PET 28.
What is the distance from 'Q' to the Point of Safe Return (PSR) for an aircraft that was over 'Q' at 1400 hours flying direct to 'R', given the following data?

Distance 'Q' to 'R' 3050 nm, True airspeed 480 kt, Safe endurance 10 Hours, if the mean wind component 'outbound' -90 kt, and the mean wind component 'homebound' is +75 kt.

a. 2290 nm.
b. 1530 nm.
c. 2190 nm.
d. 2375 nm.

PSR & PET 29.
What is the distance to B from the equal-time-point given the following data?

Distance A to B is 560 nm
TAS is 280 kt
Wind component A – B is -15 kt
Wind component B -A is +15 kt

a. 265 nm.
b. 270 nm.
c. 275 nm.
d. 280 nm.

PSR & PET 30.
An aircraft is flying at a TAS of 500 knots over a stretch of water between 2 airfields 700 nm apart. What is the distance from the first airfield to the equal time point (ETP) if the wind component is 60 knots head?

a. 300 nm.
b. 350 nm.
c. 380 nm.
d. 392 nm.

PSR & PET 31.
How far can the aeroplane fly out from its base and return in one hour, when flying at TAS 260 kt on a track of 090°, if the W/V is 045°/50kt?

a. 158 nm.
c. 128 nm.
b. 188 nm.
d. 175 nm.

PSR & PET 32.
For a distance of 1900 NM between Q and R, a ground speed "out" of 390 kt, a ground speed "back" of 450 kt and an endurance of 8 HR (excluding reserves) the distance from Q to the point of safe return (PSR) is?

a. 1671 NM.
b. 1632 NM.
c. 1930 NM.
d. 1655 NM.

PSR & PET 33.
Two points A and B are 1200 NM apart. TAS = 480 kt. On the flight between A and B the equivalent headwind is -20 kt. On the return leg between B and A, the equivalent headwind is +40 kt. What distance from A, along the route A to B, is the Point of Equal Time (PET)?

a. 670 NM.
b. 655 NM.
c. 600 NM.
d. 624 NM.

PSR & PET 34.
An aeroplane is flying at TAS 380 kt on a track of 090°. The W/V is 045°/50kt. How far can the aeroplane fly out from its base and return in one hour?

a. 188 NM.
b. 88 NM.
c. 156 NM.
d. 176 NM.

PSR & PET 35.
Given: Distance 'A' to 'B' 2400 NM, Groundspeed 'out' 365 kt, Groundspeed 'back' 480 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 267 MIN.
b. 224 MIN.
c. 190 MIN.
d. 197 MIN.

PSR & PET 36.
Given: Distance 'A' to 'B' 2500 NM, Groundspeed 'out' 400 kt, Groundspeed 'back' 480 kt, Safe endurance 8 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 278 MIN.

b. 259 MIN.
c. 297 MIN.
d. 290 MIN.

PSR & PET 37.
An aircraft was over 'A' at 1700 hours flying direct to 'B'. Given: Distance 'A' to 'B' 2900 NM, True airspeed 480 kt, Mean wind component 'out' +55 kt, Mean wind component 'back' -75 kt. The ETA for reaching the Point of Equal Time (PET) between 'A' and 'B' is?

a. 1934.
b. 1946.
c. 1821.
d. 1920.

PSR & PET 38.
An aircraft was over 'A' at 1630 hours flying direct to 'B'. Given: Distance 'A' to 'B' 3000 NM, True airspeed 490 kt, Mean wind component 'out' +55 kt, Mean wind component 'back' -75 kt, Safe endurance 9 HR 30 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 2254 NM.
b. 2238 NM.
c. 2211 NM.
d. 2259 NM.

PSR & PET 39.
Given: Distance 'A' to 'B' 2700 NM, Groundspeed 'out' 450 kt, Groundspeed 'back' 500 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 189 MIN.
b. 165 MIN.
c. 177 MIN.
d. 159 MIN.

PSR & PET 40.
Given: Distance 'A' to 'B' 2600 NM, Mean groundspeed 'out' 480 kt, Mean groundspeed 'back' 500 kt, Safe endurance 08 HR 30 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 1930 NM.
b. 2081 NM.
c. 2091 NM.
d. 1998 NM.

PSR & PET 41.
An aircraft was over 'Q' at 1545 hours flying direct to 'R'. Given: Distance 'Q' to 'R' 3016 NM, True airspeed 550 kt, Mean wind component 'out' -90 kt, Mean wind component 'back' +75 kt, Safe endurance 10:00 HR. The distance from 'Q' to the Point of Safe Return (PSR) 'Q' is?

a. 2610 NM.
b. 2650 NM.
c. 2670 NM.
d. 2710 NM.

PSR & PET 42.
Given: Distance 'A' to 'B' 2450 NM, Groundspeed 'out' 450 kt, Groundspeed 'back' 385 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 151 MIN.
b. 165 MIN.
c. 182 MIN.
d. 201 MIN.

PSR & PET 43.
Given: Distance 'A' to 'B' 2100 NM, Groundspeed 'out' 430 kt, Groundspeed 'back' 365 kt, Safe endurance 7 HR 20 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 1464 NM.
b. 1540 NM.
c. 1420 NM.
d. 1228 NM.

PSR & PET 44.
Given: Distance 'Q' to 'R' 1650 NM, Groundspeed 'out' 450 kt, Groundspeed 'back 385 kt, Safe endurance 9 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1767 NM.
b. 1742 NM.
c. 1867 NM.
d. 1813 NM.

PSR & PET 45.
Given: Distance 'Q' to 'R' 1760 NM, Groundspeed 'out' 450 kt, Groundspeed 'back' 370 kt. The time from 'Q' to the Point of Equal Time (PET) between 'Q' and 'R' is?

a. 121 MIN.
b. 116 MIN.
c. 100 MIN.
d. 106 MIN.

PSR & PET 46.
Given: Distance 'A' to 'B' 3600 NM, Groundspeed 'out' 395 kt, Groundspeed 'back' 300 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 283 MIN.
b. 236 MIN.
c. 288 MIN.
d. 323 MIN.

PSR & PET 47.
Given: Distance 'Q' to 'R' 1960 NM, Groundspeed 'out' 400 kt, Groundspeed 'back 470 kt, Safe endurance 7 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1513 NM.
b. 1542 NM.
c. 1538 NM.
d. 1353 NM.

PSR & PET 48.
Given: Distance 'Q' to 'R' 1970 NM, Groundspeed 'out' 400 kt, Groundspeed 'back 485 kt, Safe endurance 9 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1964 NM.
b. 2072 NM.
c. 1973 NM.
d. 2013 NM.

PSR & PET 49.
Given: Distance 'Q' to 'R' 2160 NM, Groundspeed 'out' 500 kt, Groundspeed 'back 585 kt, Safe endurance 6 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1767 NM.
b. 1618 NM.
c. 1803 NM.
d. 1675 NM.

PSR & PET 50.
Given: Distance 'Q' to 'R' 2550 NM, Groundspeed 'out' 500 kt, Groundspeed 'back 450 kt, Safe endurance 9.5 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 2250 NM.
b. 2201 NM.
c. 2275 NM.
d. 2267 NM.

PSR & PET 51.
What is the distance to the point of safe endurance if an aircraft has a TAS of 350 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 50 knots headwind?

a. 1713 nm.
b. 1605 nm.
c. 1754 nm.
d. 1725 nm.

PSR & PET 52.
What is the time to the point of safe return (PSR) if the distance from A to B is 2500 nautical miles, the outbound groundspeed in 375 knots, the homebound groundspeed is 480 knots, and safe endurance is 9 hours 30 minutes?

a. 390 min.
b. 309 min.
c. 319 Min.
d. 320 Min.

PSR & PET 53.
What is the distance from 'Q' to the Point of Safe Return (PSR) for an aircraft that was over 'Q' at 1520 hours flying direct to 'R', given the following data?

Distance 'Q' to 'R' 3120 nm, True airspeed 450 kt, Safe endurance 10 Hours, if the mean wind component 'outbound' -80 kt, and the mean wind component 'homebound' is +75 kt.

a. 2320 nm.
b. 2530 nm.
c. 2170 nm.
d. 2275 nm.

PSR & PET 54.
What is the distance to B from the equal-time-point given the following data?

Distance A to B is 560 nm
TAS is 200 kt
Wind component A – B is -15 kt
Wind component B -A is +15 kt

a. 259.0 nm.
b. 170.5 nm.
c. 375.5 nm.
d. 380.5 nm.

PSR & PET 55.
An aircraft is flying at a TAS of 375 knots over a stretch of water between 2 airfields 500 nm apart. What is the distance from the first airfield to the equal time point (ETP) if the wind component is 60 knots head?

a. 300 nm.
b. 350 nm.
c. 280 nm.
d. 290 nm.

PSR & PET 56.
How far can the aeroplane fly out from its base and return in one hour, when flying at TAS 280 kt on a track of 090°, if the W/V is 045°/50kt?

a. 158 nm.
b. 135 nm.
c. 188 nm.
d. 175 nm.

PSR & PET 57.
For a distance of 2000 NM between Q and R, a ground speed "out" of 375 kt, a ground speed "back" of 475 kt and an endurance of 8 HR (excluding reserves) the distance from Q to the point of safe return (PSR) is?

a. 1676 NM.
b. 1632 NM.
c. 1930 NM.
d. 1565 NM.

PSR & PET 58.
Two points A and B are 1500 NM apart. TAS = 490 kt. On the flight between A and B the equivalent headwind is -20 kt. On the return leg between B and A, the equivalent headwind is +40 kt. What distance from A, along the route A to B, is the Point of Equal Time (PET)?

a. NM.
b. NM.
c. 750 NM.
d. 795 NM.

PSR & PET 59.
An aeroplane is flying at TAS 250 kt on a track of 090°. The W/V is 045°/50kt. How far can the aeroplane fly out from its base and return in one hour?

a. 123 NM.
b. 145 NM.
c. 136 NM.
d. 116 NM.

PSR & PET 60.
Given: Distance 'A' to 'B' 2500 NM, Groundspeed 'out' 375 kt, Groundspeed 'back' 485 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 267 MIN.
b. 226 MIN.
c. 290 MIN.
d. 297 MIN.

PSR & PET 61.
Given: Distance 'A' to 'B' 2750 NM, Groundspeed 'out' 365 kt, Groundspeed 'back' 480 kt, Safe endurance 8 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 290 MIN.
b. 229 MIN.
c. 297 MIN.
d. 209 MIN.

PSR & PET 62.
An aircraft was over 'A' at 1735 hours flying direct to 'B'. Given: Distance 'A' to 'B' 2750 NM, True airspeed 470 kt, Mean wind component 'out' +55 kt, Mean wind component 'back' -75 kt. The ETA for reaching the Point of Equal Time (PET) between 'A' and 'B' is?

a. 1944.
b. 1846.
c. 1921.
d. 1950.

PSR & PET 63.
An aircraft was over 'A' at 1735 hours flying direct to 'B'. Given: Distance 'A' to 'B' 2950 NM, True airspeed 470 kt, Mean wind component 'out' +55 kt, Mean wind component 'back' -75 kt, Safe endurance 9 HR 30 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 2844 NM.
b. 2141 NM.
c. 1611 NM.
d. 1759 NM.

PSR & PET 64.
Given: Distance 'A' to 'B' 2750 NM, Groundspeed 'out' 420 kt, Groundspeed 'back' 500 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 213.5 MIN.
b. 163.0 MIN.
c. 173.5 MIN.
d. 183.5 MIN.

PSR & PET 65.
Given: Distance 'A' to 'B' 2950 NM, Mean groundspeed 'out' 450 kt, Mean groundspeed 'back' 500 kt, Safe endurance 08 HR 30 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 1930 NM.
b. 2012 NM.
c. 1998 NM.
d. 2036 NM.

PSR & PET 66.
An aircraft was over 'Q' at 1620 hours flying direct to 'R'. Given: Distance 'Q' to 'R' 3050 NM, True airspeed 480 kt, Mean wind component 'out' -90 kt, Mean wind component 'back' +75 kt, Safe endurance 10:00 HR. The distance from 'Q' to the Point of Safe Return (PSR) 'Q' is?

a. 1910 NM.
b. 2290 NM.
c. 2270 NM.
d. 2310 NM.

PSR & PET 67.
Given: Distance 'A' to 'B' 1950 NM, Groundspeed 'out' 450 kt, Groundspeed 'back' 385 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 120 MIN.
b. 135 MIN.
c. 142 MIN.
d. 111 MIN.

PSR & PET 68.
Given: Distance 'A' to 'B' 1950 NM, Groundspeed 'out' 400 kt, Groundspeed 'back' 385 kt, Safe endurance 7 HR 20 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 1464 NM.
b. 1498 NM.
c. 1422 NM.
d. 1438 NM.

PSR & 6ET 69.
Given: Distance 'Q' to 'R' 1760 NM, Groundspeed 'out' 455 kt, Groundspeed 'back 385 kt, Safe endurance 9 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1867 NM.
b. 1838 NM.
c. 1877 NM.
d. 1713 NM.

PSR & PET 70.
Given: Distance 'Q' to 'R' 1760 NM, Groundspeed 'out' 475 kt, Groundspeed 'back' 365 kt. The time from 'Q' to the Point of Equal Time (PET) between 'Q' and 'R' is?

a. 91 MIN.
b. 106 MIN.
c. 92 MIN.
d. 97 MIN.

PSR & PET 71.
Given: Distance 'A' to 'B' 3623 NM, Groundspeed 'out' 390 kt, Groundspeed 'back' 330 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 238 MIN.
b. 255 MIN.
c. 288 MIN.
d. 323 MIN.

PSR & PET 72.
Given: Distance 'Q' to 'R' 1860 NM, Groundspeed 'out' 420 kt, Groundspeed 'back 350 kt, Safe endurance 7 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1336 NM.
b. 1432 NM.
c. 1538 NM.
d. 1353 NM.

PSR & PET 73.
Given: Distance 'Q' to 'R' 1970 NM, Groundspeed 'out' 495 kt, Groundspeed 'back 465 kt, Safe endurance 9 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 2267 NM.
b. 2242 NM.
c. 2157 NM.
d. 2313 NM.

PSR & PET 74.
Given: Distance 'Q' to 'R' 2160 NM, Groundspeed 'out' 535 kt, Groundspeed 'back 595 kt, Safe endurance 6 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1667 NM.
b. 1690 NM.
c. 1613 NM.
d. 1675 NM.

PSR & PET 75.
Given: Distance 'Q' to 'R' 2467 NM, Groundspeed 'out' 500 kt, Groundspeed 'back 450 kt, Safe endurance 9.5 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 2250 NM.
b. 2221 NM.
c. 2275 NM.
d. 2267 NM.

PSR & PET 76.
What is the distance to the point of safe endurance if an aircraft has a TAS of 375 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 50 knots headwind?

a. 1842 nm.

b. 1850 nm.
c. 1854 nm.
d. 1825 nm.

PSR & PET 77.
What is the time to the point of safe return (PSR) if the distance from A to B is 3000 nautical miles, the outbound groundspeed in 380 knots, the homebound groundspeed is 430 knots, and safe endurance is 8 hours 30 minutes?

a. 289 min.
b. 290 min.
c. 259 Min.
d. 271 Min.

PSR & PET 78.
What is the distance from 'Q' to the Point of Safe Return (PSR) for an aircraft that was over 'Q' at 1500 hours flying direct to 'R', given the following data?

Distance 'Q' to 'R' 3050 nm, True airspeed 435 kt, Safe endurance 10 Hours, if the mean wind component 'outbound' -90 kt, and the mean wind component 'homebound' is +75 kt.

a. 2058 nm.
b. 2530 nm.
c. 2190 nm.
d. 2075 nm.

PSR & PET 79.
What is the distance to B from the equal-time-point given the following data?

Distance A to B is 650 nm Wind component A – B is -15 kt
TAS is 320 kt Wind component B -A is +15 kt

a. 309 nm.
b. 297 nm.
c. 375 nm.
d. 280 nm.

PSR & PET 80.
An aircraft is flying at a TAS of 475 knots over a stretch of water between 2 airfields 800 nm apart. What is the distance from the first airfield to the equal time point (ETP) if the wind component is 60 knots head?

a. 398 nm.
b. 350 nm.

c. 480 nm.
d. 451 nm.

PSR & PET 81.
How far can the aeroplane fly out from its base and return in one hour, when flying at TAS 350 kt on a track of 090°, if the W/V is 045°/50kt?

a. 158 nm.
b. 173 nm.
b. 180 nm.
d. 157 nm.

PSR & PET 82.
For a distance of 2100 NM between Q and R, a ground speed "out" of 365 kt, a ground speed "back" of 435 kt and an endurance of 8 HR (excluding reserves) the distance from Q to the point of safe return (PSR) is?

a. 1588 NM.
b. 1532 NM.
c. 1630 NM.
d. 1555 NM.

PSR & PET 83.
Two points A and B are 1300 NM apart. TAS = 485 kt. On the flight between A and B the equivalent headwind is -20 kt. On the return leg between B and A, the equivalent headwind is +40 kt. What distance from A, along the route A to B, is the Point of Equal Time (PET)?

a. 647 NM.
b. 655 NM.
c. 690 NM.
d. 676 NM.

PSR & PET 84.
An aeroplane is flying at TAS 345 kt on a track of 090°. The W/V is 045°/50kt. How far can the aeroplane fly out from its base and return in one hour?

a. 171 NM.
b. 188 NM.
c. 156 NM.
d. 163 NM.

PSR & PET 85.
Given: Distance 'A' to 'B' 2600 NM, Groundspeed 'out' 395 kt, Groundspeed 'back' 480 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 267 MIN.
b. 217 MIN.
c. 190 MIN.
d. 237 MIN.

PSR & PET 86.
Given: Distance 'A' to 'B' 2900 NM, Groundspeed 'out' 420 kt, Groundspeed 'back' 480 kt, Safe endurance 8 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 272 MIN.
b. 295 MIN.
c. 249 MIN.
d. 290 MIN.

PSR & PET 87.
An aircraft was over 'A' at 1600 hours flying direct to 'B'. Given: Distance 'A' to 'B' 2900 NM, True airspeed 450 kt, Mean wind component 'out' +55 kt, Mean wind component 'back' -75 kt. The ETA for reaching the Point of Equal Time (PET) between 'A' and 'B' is?

a. 1834.
b. 1846.
c. 1835.
d. 1827.

PSR & PET 88.
An aircraft was over 'A' at 1600 hours flying direct to 'B'. Given: Distance 'A' to 'B' 3000 NM, True airspeed 390 kt, Mean wind component 'out' +55 kt, Mean wind component 'back' -75 kt, Safe endurance 9 HR 30 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 2254 NM.
b. 1752 NM.
c. 1711 NM.
d. 1795 NM.

PSR & PET 89.
Given: Distance 'A' to 'B' 2700 NM, Groundspeed 'out' 465 kt, Groundspeed 'back' 515 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 183 MIN.
b. 165 MIN.
c. 177 MIN.
d. 159 MIN.

PSR & PET 90.
Given: Distance 'A' to 'B' 2600 NM, Mean groundspeed 'out' 380 kt, Mean groundspeed 'back' 475 kt, Safe endurance 08 HR 30 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 1730 NM.
b. 1794 NM.
c. 1691 NM.
d. 1978 NM.

PSR & PET 91.
An aircraft was over 'Q' at 1545 hours flying direct to 'R'. Given: Distance 'Q' to 'R' 3016 NM, True airspeed 525 kt, Mean wind component 'out' -90 kt, Mean wind component 'back' +75 kt, Safe endurance 10:00 HR. The distance from 'Q' to the Point of Safe Return (PSR) 'Q' is?

a. 2510 NM.
b. 2522 NM.
c. 2570 NM.
d. 2610 NM.

PSR & PET 92.
Given: Distance 'A' to 'B' 2450 NM, Groundspeed 'out' 350 kt, Groundspeed 'back' 385 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 220 MIN.
b. 195 MIN.
c. 182 MIN.
d. 201 MIN.

PSR & PET 93.
Given: Distance 'A' to 'B' 2100 NM, Groundspeed 'out' 440 kt, Groundspeed 'back' 375 kt, Safe endurance 7 HR 20 MIN. The distance from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 1464 NM.
b. 1540 NM.
c. 1447 NM.
d. 1484 NM.

PSR & PET 94.
Given: Distance 'Q' to 'R' 1650 NM, Groundspeed 'out' 465 kt, Groundspeed 'back 385 kt, Safe endurance 9 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1867 NM.
b. 1842 NM.
c. 1896 NM.
d. 1853 NM.

PSR & PET 95.
Given: Distance 'Q' to 'R' 1760 NM, Groundspeed 'out' 450 kt, Groundspeed 'back' 360 kt. The time from 'Q' to the Point of Equal Time (PET) between 'Q' and 'R' is?

a. 109 MIN.
b. 116 MIN.
c. 114 MIN.
d. 104 MIN.

PSR & PET 96.
Given: Distance 'A' to 'B' 3600 NM, Groundspeed 'out' 378 kt, Groundspeed 'back' 400 kt. The time from 'A' to the Point of Equal Time (PET) between 'A' and 'B' is?

a. 283 MIN.
b. 294 MIN.
c. 288 MIN.
d. 323 MIN.

PSR & PET 97.
Given: Distance 'Q' to 'R' 1960 NM, Groundspeed 'out' 380 kt, Groundspeed 'back 470 kt, Safe endurance 7 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1471 NM.
b. 1442 NM.
c. 1538 NM.
d. 1453 NM.

PSR & PET 98.
Given: Distance 'Q' to 'R' 1970 NM, Groundspeed 'out' 436 kt, Groundspeed 'back 485 kt, Safe endurance 9 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1964 NM.
b. 2079 NM.
c. 2066 NM.
d. 2013 NM.

PSR & PET 99.
What is the time to the point of safe endurance if an aircraft has a TAS of 300 knots and a safe endurance of 4 hours, if the wind component on the outbound leg is 20 knots headwind?

a. 2.1 hours.
b. 2.6 hours.
c. 2.9 hours.
d. 2.4 hours.

PSR & PET 100.
Given: Distance 'Q' to 'R' 2160 NM, Groundspeed 'out' 535 kt, Groundspeed 'back 585 kt, Safe endurance 6 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 1767 NM.
b. 1677 NM.
c. 1776 NM.
d. 1567 NM.

PSR & PET 101.
Given: Distance 'A' to 'B' 2500 NM, Groundspeed 'out' 370 kt, Groundspeed 'back' 480 kt, Safe endurance 6 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 220 MIN.

b. 215 MIN.
c. 229 MIN.
d. 230 MIN.

PSR & PET 102.
What is the time to the point of safe endurance if an aircraft has a TAS of 300 knots and a safe endurance of 40 hours, if the wind component on the outbound leg is 50 knots headwind?

a. 2.1 hours.
b. 2.3 hours.
c. 1.9 hours.
d. 1.1 hours.

PSR & PET 103.
Given: Distance 'A' to 'B' 2900 NM, Groundspeed 'out' 420 kt, Groundspeed 'back' 400 kt, Safe endurance 8 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 272 MIN.
b. 249 MIN.
c. 259 MIN.
d. 290 MIN.

PSR & PET 104.
Given: Distance 'Q' to 'R' 2550 NM, Groundspeed 'out' 550 kt, Groundspeed 'back 400 kt, Safe endurance 9.5 HR. The distance from 'Q' to the Point of Safe Return (PSR) between 'Q' and 'R' is?

a. 2200 NM.
b. 2250 NM.
c. 2275 NM.
d. 2267 NM.

PSR & PET 105.
Given: Distance 'A' to 'B' 2900 NM, Groundspeed 'out' 400 kt, Groundspeed 'back' 380 kt, Safe endurance 8 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 272 MIN.
b. 295 MIN.
c. 249 MIN.
d. 290 MIN.

PSR & PET 106.
What is the time to the point of safe endurance if an aircraft has a TAS of 300 knots and a safe endurance of 5 hours, if the wind component on the outbound leg is 30 knots headwind?

a. 2.3 hours.
b. 3.6 hours.
c. 2.9 hours.
d. 2.75 hours.

PSR & PET 107.
Given: Distance 'A' to 'B' 2000 NM, Groundspeed 'out' 420 kt, Groundspeed 'back' 480 kt, Safe endurance 3 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 112 MIN.
b. 195 MIN.
c. 149 MIN.
d. 190 MIN.

PSR & PET 108.
What is the distance to the point of safe endurance if an aircraft has a TAS of 300 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 30 knots headwind?

a. 1485 nm.
b. 1505 nm.
c. 1554 nm.
d. 1625 nm.

PSR & PET 109.
Given: Distance 'A' to 'B' 2600 NM, Groundspeed 'out' 220 kt, Groundspeed 'back' 280 kt, Safe endurance 3 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 172 MIN.
b. 195 MIN.
c. 149 MIN.
d. 118 MIN.

PSR & PET 110.
What is the time to the point of safe endurance if an aircraft has a TAS of 200 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 45 knots headwind?

a. 6.1 hours.

b. 5.9 hours.
c. 6.3 hours.
d. 5.8 hours.

PSR & PET 111.
Given: Distance 'A' to 'B' 1500 NM, Groundspeed 'out' 120 kt, Groundspeed 'back' 180 kt, Safe endurance 10 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 378 MIN.
b. 395 MIN.
c. 399 MIN.
d. 390 MIN.

PSR & PET 112.
What is the distance to the point of safe endurance if an aircraft has a TAS of 350 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 50 knots headwind?

a. 1458 nm.
b. 1714 nm.
c. 1554 nm.
d. 1625 nm.

PSR & PET 113.
Given: Distance 'A' to 'B' 1000 NM, Groundspeed 'out' 190 kt, Groundspeed 'back' 180 kt, Safe endurance 8 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 248 MIN.
b. 255 MIN.
c. 239 MIN.
d. 260 MIN.

PSR & PET 114.
What is the time to the point of safe endurance if an aircraft has a TAS of 300 knots and a safe endurance of 7 hours, if the wind component on the outbound leg is 65 knots headwind?

a. 4.32 hours.
b. 4.26 hours.
c. 3.91 hours.
d. 4.11 hours.

PSR & PET 115.
Given: Distance 'A' to 'B' 500 NM, Groundspeed 'out' 120 kt, Groundspeed 'back' 130 kt, Safe endurance 6 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 203 MIN.
b. 215 MIN.
c. 209 MIN.
d. 220 MIN.

PSR & PET 116.
What is the distance to the point of safe endurance if an aircraft has a TAS of 300 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 50 knots tailwind?

a. 1548 nm.
b. 1505 nm.
c. 1458 nm.
d. 1625 nm.

PSR & PET 117.
Given: Distance 'A' to 'B' 900 NM, Groundspeed 'out' 220 kt, Groundspeed 'back' 250 kt, Safe endurance 8 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 278 MIN.
b. 295 MIN.
c. 271 MIN.
d. 290 MIN.

PSR & PET 118.
What is the time to the point of safe endurance if an aircraft has a TAS of 100 knots and a safe endurance of 5 hours, if the wind component on the outbound leg is 20 knots headwind?

a. 3.0 hours.
b. 2.0 hours.
c. 1.9 hours.
d. 3.1 hours.

PSR & PET 119.
Given: Distance 'A' to 'B' 400 NM, Groundspeed 'out' 95 kt, Groundspeed 'back' 110 kt, Safe endurance 5 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 177 MIN.

b. 195 MIN.
c. 149 MIN.
d. 169 MIN.

PSR & PET 120.
What is the distance to the point of safe endurance if an aircraft has a TAS of 200 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 15 knots headwind?

a. 994 nm.
b. 1505 nm.
c. 1554 nm.
d. 1625 nm.

PSR & PET 121.
What is the time to the point of safe endurance if an aircraft has a TAS of 300 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 20 knots headwind?

a. 5.3 hours.
b. 5.6 hours.
c. 4.9 hours.
d. 5.1 hours.

PSR & PET 122.
What is the time to the point of safe endurance if an aircraft has a TAS of 300 knots and a safe endurance of 6 hours, if the wind component on the outbound leg is 20 knots headwind?

a. 3.4 hours.
b. 2.6 hours.
c. 2.9 hours.
d. 3.2 hours.

PSR & PET 123.
Given: Distance 'A' to 'B' 275 NM, Groundspeed 'out' 82 kt, Groundspeed 'back' 80 kt, Safe endurance 3 HR 30 MIN. The time from 'A' to the Point of Safe Return (PSR) 'A' is?

a. 72 MIN.
b. 104 MIN.
c. 149 MIN.
d. 190 MIN.

PSR & PET 124.
What is the distance to the point of safe endurance if an aircraft has a TAS of 200 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 85 knots headwind?

a. 819 nm.
b. 505 nm.
c. 854 nm.
d. 865 nm.

PSR & PET 125.
What is the distance to the point of safe endurance if an aircraft has a TAS of 400 knots and a safe endurance of 10 hours, if the wind component on the outbound leg is 75 knots headwind?

a. 1994 nm.
b. 1805 nm.
c. 1654 nm.
d. 1930 nm.

SCALE 1.
On a direct Mercator projection, the distance measured between two meridians spaced 5° apart at latitude 60°N is 8 cm. The scale of this chart at latitude 60°N is approximately?

a. 1 : 3 500 000.
b. 1 : 5 000 000.
c. 1 : 2 000 000.
d. 1 : 4 500 000.

SCALE 2.
On a Lambert Conformal chart the distance between meridians 5° apart along latitude 37° North is 9 cm. The scale of the chart at that parallel approximates?

a. 1 : 3 500 000.
b. 1 : 5 000 000.
c. 1 : 4 000 000.
d. 1 : 4 500 000.

SCALE 3.
A Mercator chart has a scale at the equator = 1 : 3 704 000. What is the scale at latitude 60° S?

a. 1 : 1 500 000.
b. 1 : 2 000 000.
c. 1 : 1 852 000.
d. 1 : 7 408 000.

SCALE 4.
A straight line drawn on a chart measures 4.63 cm and represents 150 NM. The chart scale is?

a. 1 : 6 000 000.
b. 1 : 5 000 000.
c. 1 : 4 500 000.
d. 1 : 6 500 000.

SCALE 5.
In a navigation chart a distance of 49 NM is equal to 7 cm. The scale of the chart is approximately?

a. 1 : 2 000 000.
b. 1 : 2 300 000.
c. 1 : 1 600 000.
d. 1 : 1 300 000.

SCALE 6.
On a direct Mercator projection, at latitude 45° North, a certain length represents 70 NM. At latitude 30° North, the same length represents approximately?

a. 86 nm.
b. 75 nm.
c. 45 nm.
d. 90 nm.

SCALE 7.
At 60° N the scale of a direct Mercator chart is 1 : 3 000 000. What is the scale at the equator?

a. 1 : 5 000 000.
b. 1 : 4 500 000.
c. 1 : 12 000 000.
d. 1 : 6 000 000.

SCALE 8.
What is the chart distance between longitudes 179°E and 175°W on a direct Mercator chart with a scale of 1 : 5 000 000 at the equator?

a. 133 mm.
b. 100 mm.
c. 113 cm.
d. 125 mm.

SCALE 9.
At 47° North the chart distance between meridians 10° apart is 5 inches. The scale of the chart at 47° North approximates?

a. 1 : 600 000.
b. 1 : 6 000 000.
c. 1 : 12 000 000.
d. 1 : 5 000 000.

SCALE 10.
Approximately how many nautical miles correspond to 12 cm on a map with a scale of 1 : 2 000 000?

a. 130 nm.
b. 130 cm.
c. 200 nm.
d. 240 nm.

SCALE 11.
The total length of the 53°N parallel of latitude on a direct Mercator chart is 133 cm. What is the approximate scale of the chart at latitude 30°S?

a. 1 : 26 000 000.
b. 1 : 2 600 000.
c. 1:125000.
d. 1 : 6 000 000.

SCALE 12.
A straight line on a chart 4.89 cm long represents 185 NM. The scale of this chart is approximately?

a. 1 : 6 000 000.
b. 1 : 5 500 000.
c. 1 : 6 500 000.
d. 1 : 7 000 000.

SCALE 13.
On a Direct Mercator chart at latitude 15°S, a certain length represents a distance of 120 NM on the earth. The same length on the chart will represent on the earth, at latitude 10°N, a distance of?

a. 122.3 nm.
b. 135.4 nm.
c. 156.5 nm.
d. 100.2 nm.

SCALE 14.

On a Direct Mercator chart at latitude of 45°N, a certain length represents a distance of 90 NM on the earth. The same length on the chart will represent on the earth, at latitude 30°N, a distance of?

a. 100 nm.
b. 110 nm.
c. 120 nm.
d. 125 nm.

SCALE 15.

On a chart, the distance along a meridian between latitudes 45°N and 46°N is 6 cm. The scale of the chart is approximately?

a. 1 : 1 850 000.
b. 1 : 2 000 000.
c. 1 : 1 500 000.
d. 1 : 1 650 000.

SCALE 16.

Given: Chart scale is 1 : 1 850 000. The chart distance between two points is 4 centimetres. Earth distance is approximately?

a. 40 nm.
b. 35 nm.
c. 55 nm.
d. 50 nm.

SCALE 17.

On a Mercator chart, at latitude 60°N, the distance measured between W002° and E008° is 20 cm. The scale of this chart at latitude 60°N is approximately?

a. 1 : 2 780 000.
b. 1 : 278 000.
c. 1 : 27 800 000.
d. 1 : 788 000.

SCALE 18.

Assume a Mercator chart. The distance between positions A and B, located on the same parallel and 10° longitude apart, is 6 cm. The scale at the parallel is 1 : 9 260 000. What is the latitude of A and B?

a. 30^0 N or S.
b. 60° N or S.
c. 45^0 N or S.
d. 75^0 N or S.

SCALE 19.

A course of 120°(T) is drawn between 'X' (61°30'N) and 'Y' (58°30'N) on a Lambert Conformal conic chart with a scale of 1 : 1 000 000 at 60°N. The chart distance between 'X' and 'Y' is?

a. 600 cm.
b. 6.7 cm.
c. 66.7 cm.
d. 76.6 cm.

SCALE 20.

Given: Direct Mercator chart with a scale of 1 : 200 000 at equator; Chart length from 'A' to 'B', in the vicinity of the equator, 11 cm. What is the approximate distance from 'A' to 'B'?

a. 12 nm.
b. 10 nm.
c. 15 nm.
d. 22 nm.

SCALE 21.

Approximately how many nautical miles correspond to 15 cm on a map with a scale of 1 : 3 000 000?

a. 130 nm.
b. 243 nm.
c. 200 nm.
d. 250 nm.

SCALE 22.

Approximately how many nautical miles correspond to 20 cm on a map with a scale of 1 : 2 000 000?

a. 216 nm.
b. 130 nm.
c. 200 nm.
d. 240 nm.

SCALE 23.

Approximately how many nautical miles correspond to 10 cm on a map with a scale of 1 : 5 000 000?

a. 256 nm.
b. 270 nm.
c. 240 nm.
d. 290 nm.

SCALE 24.
Approximately how many nautical miles correspond to 35 cm on a map with a scale of 1 : 500 000?

a. 80 nm.
b. 85.5 nm.
c. 90 nm.
d. 94.5 nm.

SCALE 25.
The total length of the 75°N parallel of latitude on a direct Mercator chart is 140 cm. What is the approximate scale of the chart at latitude 30°S?

a. 1 : 25 000 000.
b. 1 : 2 900 000.
c. 1:125000.
d. 1 : 6 000 000.

SCALE 26.
The total length of the 70°N parallel of latitude on a direct Mercator chart is 120 cm. What is the approximate scale of the chart at latitude 40°S?

a. 1 : 16 050 000.
b. 1 : 2 600 000.
c. 1:7 250 000.
d. 1 : 25 500 000.

SCALE 27.
The total length of the 45°N parallel of latitude on a direct Mercator chart is 200 cm. What is the approximate scale of the chart at latitude 60°N?

a. 1 : 26 050 000.
b. 1 : 10 000 000.
c. 1:125000.
d. 1 : 6 000 000.

SCALE 28.
What is the chart distance between longitudes 179°E and 175°W on a direct Mercator chart with a scale of 1 : 15 000 000 at the equator?

a. 44 mm.
b. 10 mm.
c. 33 cm.
d. 25 mm.

SCALE 29.
What is the chart distance between longitudes 165°E and 175°W on a direct Mercator chart with a scale of 1 : 25 000 000 at the equator?

a. 33 mm.
b. 100 mm.
c. 133 cm.
d. 89 mm.

SCALE 30.
What is the chart distance between longitudes 170°E and 170°W on a direct Mercator chart with a scale of 1 : 20 000 000 at the equator?

a. 133 mm.
b. 111 mm.
c. 125 cm.
d. 100 mm.

SCALE 31.
What is the chart distance between longitudes 175°E and 175°W on a direct Mercator chart with a scale of 1 : 7 000 000 at the equator?

a. 159 mm.
b. 176 mm.
c. 163 cm.
d. 145 mm.

SCALE 32.
What is the chart distance between longitudes 179°E and 179°W on a direct Mercator chart with a scale of 1 : 500 000 at the equator?

a. 159 mm.
b. 333 mm.
c. 444 cm.
d. 467 mm.

SCALE 33.
What is the chart distance between longitudes 176°E and 176°W on a direct Mercator chart with a scale of 1 : 4 000 000 at the equator?

a. 222 mm.
b. 276 mm.
c. 263 cm.
d. 245 mm.

SCALE 34.
Given: Chart scale is 1 : 2 000 000. The chart distance between two points is 4 centimetres. Earth distance is approximately?

a. 30 nm.
b. 43 nm.
c. 55 nm.
d. 50 nm.

SCALE 35.
Given: Chart scale is 1 : 3 000 000. The chart distance between two points is 24 centimetres. Earth distance is approximately?

a. 38.9 nm.
b. 389 nm.
c. 3.89 nm.
d. 839 nm.

SCALE 36.
Given: Chart scale is 1 : 5 000 000. The chart distance between two points is 10 centimetres. Earth distance is approximately?

a. 230 nm.
b. 243 nm.
c. 255 nm.
d. 270 nm.

SCALE 37.
Given: Chart scale is 1 : 250 000. The chart distance between two points is 4 centimetres. Earth distance is approximately?

a. 3.0 nm.
b. 5.4 nm.
c. 6.5 nm.
d. 5.0 nm.

SCALE 38.
Given: Chart scale is 1 : 200 000. The chart distance between two points is 12 centimetres. Earth distance is approximately?

a. 20 nm.
b. 13 nm.
c. 25 nm.
d. 10 nm.

SCALE 39.
On a Direct Mercator chart at latitude of 40°N, a certain length represents a distance of 90 NM on the earth. The same length on the chart will represent on the earth, at latitude 20°N, a distance of?

a. 100 nm.
b. 110 nm.
c. 120 nm.
d. 125 nm.

SCALE 40.
On a Direct Mercator chart at latitude of 70°N, a certain length represents a distance of 90 NM on the earth. The same length on the chart will represent on the earth, at latitude 10°N, a distance of?

a. 259 nm.
b. 210 nm.
c. 220 nm.
d. 265 nm.

SCALE 41.
On a Direct Mercator chart at latitude of 85°N, a certain length represents a distance of 60 NM on the earth. The same length on the chart will represent on the earth, at latitude 30°N, a distance of?

a. 605 nm.
b. 580 nm.
c. 620 nm.
d. 596 nm.

SCALE 42.
On a Direct Mercator chart at latitude of 45°N, a certain length represents a distance of 90 NM on the earth. The same length on the chart will represent on the earth, at latitude 60°N, a distance of?

a. 100 nm.
b. 65 nm.
c. 78 nm.
d. 68 nm.

SCALE 43.
On a Direct Mercator chart at latitude of 45°N, a certain length represents a distance of 25 NM on the earth. The same length on the chart will represent on the earth, at latitude 30°N, a distance of?

a. 45 nm.
b. 31 nm.
c. 20 nm.
d. 25 nm.

SCALE 44.
On a Direct Mercator chart at latitude of 75°N, a certain length represents a distance of 75 NM on the earth. The same length on the chart will represent on the earth, at latitude 30°N, a distance of?

a. 200 nm.
b. 210 nm.
c. 125 nm.
d. 251 nm.

SCALE 45.
The scale on a Lambert's conformal conic chart?

a. Is constant.
b. Is constant along a parallel of latitude.
c. Is constant along a meridian of longitude.
d. Varies slightly as a function of longitude and latitude.

SCALE 46.
The scale is correct on a Transverse Mercator chart?

a. Along the datum meridian and meridians at 90° to it.
b. At the prime meridian.
c. Along the great circle of tangency.
d. At the poles and the equator.

SCALE 47.
The nominal scale of a Lambert conformal conic chart is the?

a. Scale at the standard parallels.
b. Scale at the parallel of origin.
c. Scale at the poles.
d. Constant at all points on the chart.

SCALE 48.
On a direct Mercator projection, at latitude 45° North, a certain length represents 70 NM. At latitude 40° North, the same length represents approximately?

a. 86 nm.

b. 76 nm.
c. 45 nm.
d. 90 nm.

SCALE 49.
At 60° N the scale of a direct Mercator chart is 1 : 4 000 000. What is the scale at the equator?

a. 1 : 6 000 000.
b. 1 : 4 500 000.
c. 1 : 12 000 000.
d. 1 : 8 000 000.

SCALE 50.
What is the chart distance between longitudes 179°E and 175°W on a direct Mercator chart with a scale of 1 : 2 000 000 at the equator?

a. 333 mm.
b. 300 mm.
c. 313 cm.
d. 325 mm.

SCALE 51.
At 47° North the chart distance between meridians 10° apart is 6 inches. The scale of the chart at 47° North approximates?

a. 1 : 600 000.
b. 1 : 6 000 000.
c. 1 : 12 000 000.
d. 1 : 5 000 000.

SCALE 52.
Approximately how many nautical miles correspond to 15 cm on a map with a scale of 1 : 2 000 000?

a. 162 nm.
b. 130 nm.
c. 156 nm.
d. 140 nm.

SCALE 53.
The total length of the 53°N parallel of latitude on a direct Mercator chart is 127 cm. What is the approximate scale of the chart at latitude 30°S?

a. 1 : 27 300 000.

b. 1 : 2 600 000.
c. 1:12 500 000.
d. 1 : 6 000 000.

SCALE 54.
A straight line on a chart 4.89 cm long represents 100 NM. The scale of this chart is approximately?

a. 1 : 2 000 000.
b. 1 : 3 500 000.
c. 1 : 5 500 000.
d. 1 : 4 000 000.

SCALE 55.
On a Direct Mercator chart at latitude 15°S, a certain length represents a distance of 130 NM on the earth. The same length on the chart will represent on the earth, at latitude 10°N, a distance of?

a. 132.5 nm.
b. 135.4 nm.
c. 146.5 nm.
d. 125.2 nm.

SCALE 56.
Given: Direct Mercator chart with a scale of 1 : 200 000 at equator; Chart length from 'A' to 'B', in the vicinity of the equator, 27 cm. What is the approximate distance from 'A' to 'B'?

a. 29 nm.
b. 20 nm.
c. 25 nm.
d. 22 nm.

SCALE 57.
Approximately how many nautical miles correspond to 25 cm on a map with a scale of 1 : 3 000 000?

a. 430 nm.
b. 405 nm.
c. 400 nm.
d. 450 nm.

SCALE 58.
Approximately how many nautical miles correspond to 13 cm on a map with a scale of 1 : 2 000 000?

a. 140 nm.
b. 130 nm.
c. 100 nm.
d. 150 nm.

SCALE 59.
Approximately how many nautical miles correspond to 9 cm on a map with a scale of 1 : 5 000 000?

a. 256 nm.
b. 243 nm.
c. 240 nm.
d. 256 nm.

SCALE 60.
Approximately how many nautical miles correspond to 7 cm on a map with a scale of 1 : 500 000?

a. 19 nm.
b. 17 nm.
c. 29 nm.
d. 22 nm.

SCALE 61.
The total length of the 75°N parallel of latitude on a direct Mercator chart is 115 cm. What is the approximate scale of the chart at latitude 30°S?

a. 1 : 30 000 000.
b. 1 : 28 000 000.
c. 1 : 12 500 000.
d. 1 : 6 000 000.

SCALE 62.
The total length of the 70°N parallel of latitude on a direct Mercator chart is 95 cm. What is the approximate scale of the chart at latitude 40°S?

a. 1 : 32 250 000.
b. 1 : 26 000 000.
c. 1 : 17 250 000.
d. 1 : 25 500 000.

SCALE 63.
The total length of the 45°N parallel of latitude on a direct Mercator chart is 85 cm. What is the approximate scale of the chart at latitude 60°N?

a. 1 : 26 500 000.
b. 1 : 23 500 000.
c. 1 : 12 500 000.
d. 1 : 16 500 000.

SCALE 64.
On a direct Mercator projection, the distance measured between two meridians spaced 5° apart at latitude 60°N is 12 cm. The scale of this chart at latitude 60°N is approximately?

a. 1 : 2 300 000.
b. 1 : 3 200 000.
c. 1 : 2 000 000.
d. 1 : 1 500 000.

SCALE 65
On a Lambert Conformal chart the distance between meridians 5° apart along latitude 37° North is 11cm. The scale of the chart at that parallel approximates?

a. 1 : 3 500 000.
b. 1 : 4 000 000.
c. 1 : 5 000 000.
d. 1 : 4 500 000.

SCALE 66.
A Mercator chart has a scale at the equator = 1 : 3 000 000. What is the scale at latitude 60° S?

a. 1 : 1 700 000.
b. 1 : 2 000 000.
c. 1 : 1 500 000.
d. 1 : 3 400 000.

SCALE 67.
A straight line drawn on a chart measures 4.63 cm and represents 125 NM. The chart scale is?

a. 1 : 5 000 000.
b. 1 : 6 000 000.
c. 1 : 4 500 000.
d. 1 : 6 500 000.

SCALE 68.
In a navigation chart a distance of 55 NM is equal to 7 cm. The scale of the chart is approximately?

a. 1 : 2 300 000.
b. 1 : 2 700 000.
c. 1 : 1 600 000.
d. 1 : 1 500 000.

SCALE 69.
On a direct Mercator projection, at latitude 45° North, a certain length represents 79 NM. At latitude 30° North, the same length represents approximately?

a. 97 nm.
b. 78 nm.
c. 65 nm.
d. 93 nm.

SCALE 70.
At 60° N the scale of a direct Mercator chart is 1 : 3 500 000. What is the scale at the equator?

a. 1 : 3 500 000.
b. 1 : 4 500 000.
c. 1 : 500 000.
d. 1 : 7 000 000.

SCALE 71.
A Mercator chart has a scale at the equator = 1 : 2 400 000. What is the scale at latitude 60° S?

a. 1 : 1 500 000.
b. 1 : 2 300 000.
c. 1 : 1 200 000.
d. 1 : 3 600 000.

SCALE 72.
A straight line drawn on a chart measures 4.5 cm and represents 125 NM. The chart scale is?

a. 1 : 5 100 000.
b. 1 : 6 200 000.
c. 1 : 4 400 000.
d. 1 : 6 200 000.

SCALE 73.
In a navigation chart a distance of 55 NM is equal to 14 cm. The scale of the chart is approximately?

a. 1 : 300 000.
b. 1 : 700 000.
c. 1 : 600 000.
d. 1 : 725 000.

SCALE 74.
On a direct Mercator projection, at latitude 45° North, a certain length represents 98 NM. At latitude 30° North, the same length represents approximately?

a. 120 nm.
b. 128 nm.
c. 115 nm.
d. 99 nm.

SCALE 75.
At 60° N the scale of a direct Mercator chart is 1 : 2 750 000. What is the scale at the equator?

a. 1 : 3 500 000.
b. 1 : 2 500 000.
c. 1 : 1 500 000.
d. 1 : 5 500 000.

SCALE 76.
On a Direct Mercator chart at latitude of 70°N, a certain length represents a distance of 120 NM on the earth. The same length on the chart will represent on the earth, at latitude 10°N, a distance of?

a. 259 nm.
b. 346 nm.
c. 320 nm.
d. 365 nm.

SCALE 77.
On a Direct Mercator chart at latitude of 85°N, a certain length represents a distance of 98 NM on the earth. The same length on the chart will represent on the earth, at latitude 30°N, a distance of?

a. 905 nm.
b. 880 nm.
c. 920 nm.

d. 974 nm.

SCALE 78.
On a Direct Mercator chart at latitude of 45°N, a certain length represents a distance of 96 NM on the earth. The same length on the chart will represent on the earth, at latitude 60°N, a distance of?

a. 97 nm.
b. 68 nm.
c. 64 nm.
d. 78 nm.

SCALE 79.
On a Direct Mercator chart at latitude of 45°N, a certain length represents a distance of 39 NM on the earth. The same length on the chart will represent on the earth, at latitude 30°N, a distance of?

a. 45 nm.
b. 48 nm.
c. 40 nm.
d. 37 nm.

SCALE 80.
On a Direct Mercator chart at latitude of 75°N, a certain length represents a distance of 55 NM on the earth. The same length on the chart will represent on the earth, at latitude 30°N, a distance of?

a. 200 nm.
b. 210 nm.
c. 195 nm.
d. 184 nm.

SOLAR SYSTEM &TIME 1.
In which months is the difference between apparent noon and mean noon the greatest?

a. March and September.
b. June and December.
c. November and February.
d. January and July.

SOLAR SYSTEM &TIME 2.
What is the reason for seasonal changes in climate?

a. Because the Earth's spin axis is inclined to the plane of its orbit round the Sun.
b. Because the distance between the Earth and the Sun varies over a year.
c. Because the Earth's orbital speed round the Sun varies according to the time of the year.
d. Because of the difference between the Tropical Year and the Calendar year.

SOLAR SYSTEM &TIME 3.
How would you define standard time in relation to UTC?

a. It is local time.
b. It is local time adjusted to whole or half hours difference from UTC.
c. It is based on local sunrise and sunset.
d. It is another term for UTC.

SOLAR SYSTEM &TIME 4.
A time difference of 5 hours 20 minutes and 20 seconds is equivalent to which change of longitude?

a. 81°30'.
b. 78° 15'.
c. 79° 10'.
d. 80° 05'.

SOLAR SYSTEM &TIME 5.
The main reason that day and night, throughout the year, have different duration, is due to the?

a. Relative speed of the sun along the ecliptic.
b. Inclination of the ecliptic to the equator.
c. Earth's rotation.
d. Gravitational effect of the sun and moon on the speed of rotation of the Earth.

SOLAR SYSTEM &TIME 6.
The sun rises at 50 ° N and 025°E on the 25th January at 0254 UTC. On the same day what time does it rise at 50 ° N and 040°W?

a. 0254 UTC.
b. 2154 UTC.
c. 0714 UTC.
d. 0514 UTC.

SOLAR SYSTEM &TIME 7.
On the 27th of February, at 52°S and 040°E. the sunrise is at 0243UTC. On the same day, at 52°S and 035°W, the sunrise is at?

a. 2143 UTC.
b. 0243 UTC.
c. 0743 UTC.
d. 0523 UTC.

SOLAR SYSTEM &TIME 8.
On the 27th of February, at 55°S and 020°W. The sunrise is at 0250 UTC. On the same day, at 55°S and 075°W, the sunrise is at?

a. 0630 UTC.
b. 0243 UTC.
c. 0743 UTC.
d. 0523 UTC.

SOLAR SYSTEM &TIME 9.
The angle between the plane of the ecliptic and the plane of equator is approximately?

a. 27.5°.
b. 66.5°.
c. 23.5°.
d. 25.3°.

SOLAR SYSTEM &TIME 10.
At what approximate date is the earth furthest from the sun (aphelion)?

a. Beginning of July.
b. End of September.
c. Beginning of January.
d. End of December.

SOLAR SYSTEM &TIME 11.
At what times of the year does the length of the hours of daylight change most rapidly?

a. Autumn Equinox and Winter Solstice.
b. Spring (Vernal) Equinox and Autumn Equinox.
c. Summer Solstice and Winter Solstice.
d. Spring (Vernal) Equinox and Summer Solstice.

SOLAR SYSTEM &TIME 12.
Civil Twilight occurs between?

a. Sunrise and sunset.
b. Sunset and when the sun is 6° below the horizon.
c. The times when the sun is between 6° and 12° below the horizon.
d. The times when the sun is between 12° and 18° below the horizon.

SOLAR SYSTEM &TIME 13.
What is the highest latitude on the Earth at which the sun can be vertically overhead?

a. 23.2°.
b. 66.2°.
c. 45.0°.
d. 90.0°.

SOLAR SYSTEM &TIME 14.
The UTC of the end of evening civil twilight in position 51°N 008°W on 15 August is?

a. 1942.
b. 1958.
c. 2031.
d. 1926.

SOLAR SYSTEM &TIME 15.
What is the Standard Time in Hawaii when it is 0600 ST on the 16 July in Queensland, Australia?

a. 1000 on the 15 th.
b. 2000 on the 15 th.
c. 1000 on the 16 th.
d. 1000 on the 17 th.

SOLAR SYSTEM &TIME 16.
If it is 0700 hours Standard Time in Kuwait, what is the Standard Time in Algeria?

a. 0300 hours.
b. 0500 hours.
c. 0900 hours.
d. 1200 hours.

SOLAR SYSTEM &TIME 17.
At 1200 Standard Time on the 10th July in Queensland, Australia, what is the Standard Time in Hawaii, USA?

a. 1600 09 th July.
b. 0200 10 th July.
c. 1200 10 th July.
d. 1000 10 th July.

SOLAR SYSTEM &TIME 18.
What is the time of sunrise in Vancouver, British Columbia, Canada (49N 123° 30'W) on the 6th January expressed in UTC?

a. 0754 UTC.
b. 0717 UTC.
c. 1608 UTC.
d. 2340 UTC.

SOLAR SYSTEM &TIME 19.
The angle between the plane of the ecliptic and the plane of equator is approximately?

a. 66.5°.
b. 90.0°.
c. 23.5°.
d. 32.5°.

SOLAR SYSTEM &TIME 20.
The duration of civil twilight is the.time?

a. Between Sunset and when the centre of the sun is 6° below the true horizon.
b. Between Sunset and when the top of the Sun is 6° below the visual horizon.
c. Between sunset and when the centre of the Sun is 6° below the visual horizon.
d. When the Sunset and Sunrise.

SOLAR SYSTEM &TIME 21.
On the 27th of February, at 52°S and 034°W, the sunrise is at 0743 UTC. On the same day, at 52°S and 040°E, the sunrise is at?

a. 0243 UTC.
b. 0543 UTC.
c. 1243 UTC.
d 0743 UTC.

SOLAR SYSTEM &TIME 22.
Which is the highest latitude listed below at which the sun will rise above the horizon and set every day?

a. 66°.
b. 23.5^0.
c. 32.5^0.
d. The tropics of Cancer and Capricorn.

SOLAR SYSTEM &TIME 23
The UTC of sunrise on 6 December at WINNIPEG (Canada) (49°50'N 097°30'W) is?

a. 1215.
b. 0730.
c. 1411.
d. 1900.

SOLAR SYSTEM &TIME 24.
When it is 1000 Standard Time in Kuwait, the Standard Time in Angola is?

a. 1200.
b. 0800.
c. 0700.
d. 1400.

SOLAR SYSTEM &TIME 25.
An aircraft takes off from Guam at 2300 Standard Time on 30 April local date. After a flight of 11 HR 15 MIN it lands at Los Angeles (California). What is the Standard Time and local date of arrival (assume summer time rules apply)?

a. 1715 on 30 April.
b. 1715 on 01 May.
c. 1715 on 29 April.
d. 2415 on 30 April.

SOLAR SYSTEM &TIME 26.
When it is 1300 Standard Time in Queensland (Australia) the Standard Time in Hawaii (USA) is?

a. 1200.
b. 1500.
c. 1700.
d. 1000.

SOLAR SYSTEM &TIME 27.
What is the meaning of the term "standard time"?

a. It is the time set by the legal authorities for a country or part of a country.
b. It is just another term for UTC.
c. It is time related to the Prime meridian.
d. It is constant at all points on the earth.

SOLAR SYSTEM &TIME 28.
What is the local mean time, position 65°25'N 123°45'W at 2200 UTC?

a. 0615.
b. 1815.
c. 1345.
d. 1415.

SOLAR SYSTEM &TIME 29.
The main reason that day and night, throughout the year, have different duration, is due to the?

a. The changing distance between the Sun and the Earth.
b. The changing speed of rotation of the Earth.
c. The changing shape of the orbit of the Earth around the Sun.
d. The inclination of the ecliptic to the equator.

SOLAR SYSTEM &TIME 30.
In which two months of the year is the difference between the transit of the Apparent Sun and Mean Sun across the Greenwich Meridian the greatest?

a. February and November.
b. March and July.
c. June and December.
d. January and August.

SOLAR SYSTEM &TIME 31.
What is the highest latitude listed below at which the sun will reach an angle of 90° above the horizon at some time during the year?

a. 23°.
b. 32^0.
b. 66^0.
c. 60^0.

SOLAR SYSTEM &TIME 32.
Assuming mid-latitudes (40° to 50°N/S). At which time of year is the relationship between the length of day and night, as well as the rate of change of declination of the sun, changing at the greatest rate?

a. Winter Solstice.
b. Spring equinox and autumn equinox.
c. Summer solstice.
d. Mid July.

SOLAR SYSTEM &TIME 33.
At what approximate date is the earth closest to the sun (perihelion)?

a. 21 March.
b. 21 September.
c. Middle of June.
d. Beginning of January.

SOLAR SYSTEM &TIME 34.
At what approximate date is the earth furthest from the sun (aphelion)?

a. Beginning of July.
b. Beginning of January.
c. 21 March.
d. 21 August.

SOLAR SYSTEM &TIME 35.
The UTC of the end of civil twilight in position 051N 008W on the 15th August?

a. 1927.
b. 2030.
c. 1959.
d. 1730.

SOLAR SYSTEM &TIME 36.
What is the UTC time at sunrise in Vancouver , British COLUMBIA , Canada 49N 123 30 W on the 6th December?

a. 0736.
b. 1012.
c. 1550.
d. 0813.

SOLAR SYSTEM &TIME 37.
The ratio of the ellipticity of the earth is 1/297, if the major axis is 6956 km at the equator, what is the minor axis (poles)?

a. 6879 km.
b. 6862 km.
c. 6932 km.
d. 6952 km.

SOLAR SYSTEM &TIME 38.
At which of the following latitudes does the maximum difference between geodetic and geocentric latitude occur?

a. 00°
b. 60°
c. 45°
d. 90°

SOLAR SYSTEM &TIME 39.
When standing at the South Pole in which direction will you be facing?

a. North.
b. South.
c. East.
d. West.

SOLAR SYSTEM &TIME 40.
What is the approximate circumference of the earth?

a. 5400 nm.
b. 11800 nm.
c. 21600 nm.
d. 43400 nm.

SOLAR SYSTEM &TIME 41.
Two aircraft are flying eastwards around the earth. Aircraft A is flying along the 60N parallel of latitude and aircraft B is flying along the equator. If aircraft A is flying at a groundspeed of 240 knots, what would be the groundspeed of aircraft B both aircraft fly once round the Earth in the same journey time?

a. 120 knots.
b. 240 knots.
c. 480 knots.
d. 600 knots.

SOLAR SYSTEM &TIME 42.
The circumference of the Earth is approximately?

a. 5,600 km.
b. 13,200 km.
c. 16,400 km.
d. 40,000 km.

SOLAR SYSTEM &TIME 43.
The sun rises at 55 ° N and 050°E on the 25th January at 0254 UTC. On the same day what time does it rise at 55 ° N and 040°W?

a. 0854 UTC.
b. 2154 UTC.
c. 0714 UTC.
d. 0514 UTC.

SOLAR SYSTEM &TIME 44
The sun sets at 45 ° N and 025°E on the 21st March at 1633 UTC. On the same day what time does it rise at 45 ° N and 060°W?

a. 2254 UTC.
b. 2154 UTC.
c. 1714 UTC.
d. 2213 UTC.

SOLAR SYSTEM &TIME 45.
The sun rises at 50 ° N and 025°W on the 25th January at 0654 UTC. On the same day what time does it rise at 50 ° N and 040°E?

a. 0254 UTC.
b. 0154 UTC.
c. 0234 UTC.
d. 0514 UTC.

SOLAR SYSTEM &TIME 46.
Two aircraft are flying eastwards around the earth. Aircraft A is flying along the 50N parallel of latitude and aircraft B is flying along the equator. If aircraft A is flying at a groundspeed of 340 knots, what would be the groundspeed of aircraft B both aircraft fly once round the Earth in the same journey time?

a. 529 knots.
b. 540 knots.
c. 480 knots.
d. 600 knots.

SOLAR SYSTEM &TIME 47.
Two aircraft are flying eastwards around the earth. Aircraft A is flying along the 45N parallel of latitude and aircraft B is flying along the equator. If aircraft A is flying at a groundspeed of 300 knots, what would be the groundspeed of aircraft B both aircraft fly once round the Earth in the same journey time?

a. 420 knots.
b. 424 knots.
c. 480 knots.
d. 600 knots.

SOLAR SYSTEM &TIME 48.
Two aircraft are flying eastwards around the earth. Aircraft A is flying along the 60N parallel of latitude and aircraft B is flying along the 20^0N parallel. If aircraft A is flying at a groundspeed of 240 knots, what would be the groundspeed of aircraft B both aircraft fly once round the Earth in the same journey time?

a. 212 knots.
b. 245 knots.
c. 451 knots.
d. 560 knots.

SOLAR SYSTEM &TIME 49.
Two aircraft are flying eastwards around the earth. Aircraft A is flying along the 75N parallel of latitude and aircraft B is flying along 45S. If aircraft A is flying at a groundspeed of 300 knots, what would be the groundspeed of aircraft B both aircraft fly once round the Earth in the same journey time?

a. 920 knots.
b. 740 knots.
c. 820 knots.
d. 860 knots.

SOLAR SYSTEM &TIME 50.
Two aircraft are flying eastwards around the earth. Aircraft A is flying along the 30N parallel of latitude and aircraft B is flying along the equator. If aircraft A is flying at a groundspeed of 400 knots, what would be the groundspeed of aircraft B both aircraft fly once round the Earth in the same journey time?

a. 320 knots.
b. 462 knots.
c. 480 knots.
d. 560 knots.

SECTION 3

ANSWERS AND EXPLANATIONS

Subject	Pages		
CRP5.	245	to	369
Chart Theory.	369	to	388
Circles.	389	to	448
Magnetic Compasses.	448	to	487
Descents.	488	to	524
INS/IRS/FMS.	525	to	560
Plotting.	560	to	589
PSR/PET.	589	to	639
Scale.	639	to	674
Solar System & Time.	674	to	695

CRP5 1 c.

To solve this type of problem using the CRP5:

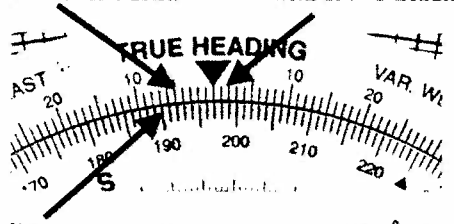
a. **Flight time between X and Y = 1250 – 1232 = 18 min.**
b. **To find the ground speed divide the distance between X and Y, (42 nm) by time (18 min) by setting 18 on the inner scale against 42 0n the outer scale. The 60 min index on the Inner scale will now align with 139.5 on the outer. This means that the ground speed is 139.5 kts.**
c. **To find the time taken to fly from Y to Z divide the distance (70 nm) by the ground speed (139.5). To do this, align 139.5 on the inner scale with 70 on the outer scale. The 60 min index on the inner will now align with 30 on the outer. This means that the time between Y and Z will be 30 min.**
d. **Adding this to the ATA at Y gives 1250 + 30 min = 1320 UTC (option c).**

CRP5 2 a.

To solve this type of problem on the CRP5:

a. **Rotate the window to align required track 192T on the inner scale with 5 left drift on the outer scale.**
b. **The true heading index mark will now align with 197T.**
c. **Without moving the window any further, read the required magnetic heading on the window scale where it aligns with variation 7 E on the outer scale. This gives 190 M (option a). This situation is illustrated below.**

1. **Rotate window to align required heading 192^0 T with 5^0 left drift.**
2. **True heading index mark aligns with 197^0 T heading.**



3. **7^0 E variation aligns with the required heading of 190^0 M.**

CRP5 3 d.

To solve this type of problem on the CRP5:

a. **Rotate the window to align required magnetic heading 060^0 M on the inner scale with 8^{0}W variation on the outer scale.**
b. **Without moving the window any further, read the true track on the window scale where it aligns with 4^0 right drift. This gives 056^0 T (option d). This situation is illustrated below.**

1. Rotate window to align magnetic heading 060° M with 8° W variation

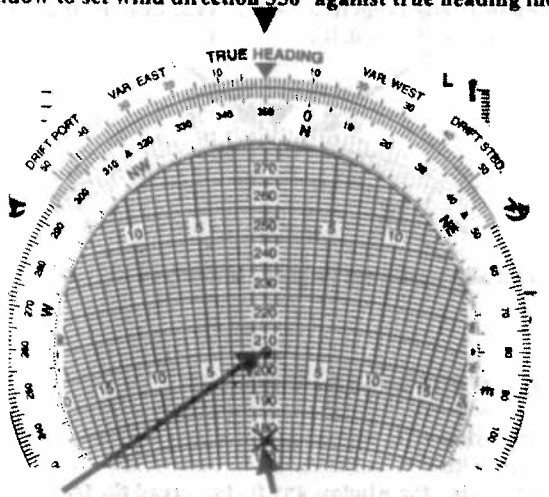
2. 4° right drift aligns with track 056° T.

CRP5 4 a,

To solve this type of problem using the CRP5:

a. Insert the slide so that the low speed side is visible in the window disc on the back of the CRP5.
b. Rotate the inner scale until the wind direction (350) aligns with the index on the outer scale.
c. Move the slide until the centre dot on the window disc aligns with the TAS (210 Kts).
d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 30 Kts so with the centre dot at 210 Kts the cross for wind speed should be at 180 Kts. This situation is illustrated below.

1. Rotate window to set wind direction 350° against true heading index mark



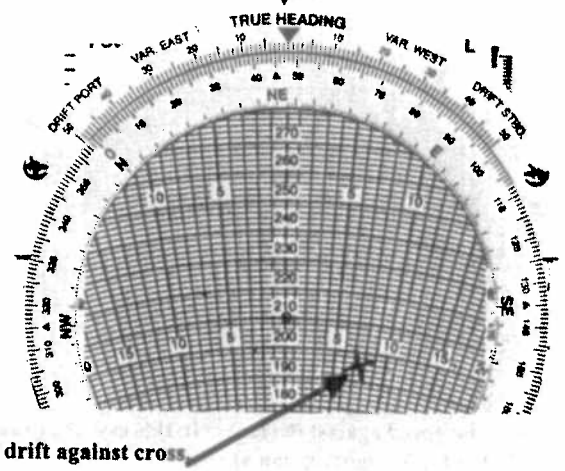
2. Set slide so that 210 kts TAS is under centre dot

3. Draw a cross 30 kts below the centre dot to show wind speed

e. Rotate the inner scale to align the track (048) on the inner scale with the index mark on the outer scale.

f. Read off the drift using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

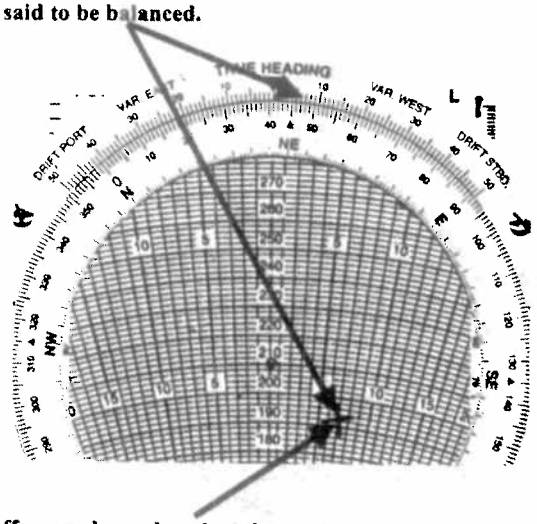
1. Rotate window to align aircraft course 048° with true heading index mark



2. Read off drift against cro

g. In this case the drift is approximately 7.5 degrees right.
h. But the question specified a course rather than a heading, so it is necessary to balance the drift. To do this, rotate the inner scale until the course (048) on the inner scale aligns with 7.5 on the outer scale.
i. Using the cross, estimate the new drift. In this case this is now approximately 7 degrees right.
j. Rotate the inner scale left until the course (048) on the inner scale aligns with 7 degrees right on the outer scale.
k. Using the cross estimate the drift. In this case it is approximately 7 degrees. The drift indicated by the cross is now the same as that on the outer scale, so the drift is said to be correctly balanced.
l. Using the cross read off the groundspeed from the slide. This situation is illustrated below.

1. Course 048^0 is set against 7^0 right drift and the cross indicates 7^0 right drift, so the drift is said to be balanced.



1. Read off ground speed against the cross. In this case the ground speed is approximately 192 kt, 7° right (option a).

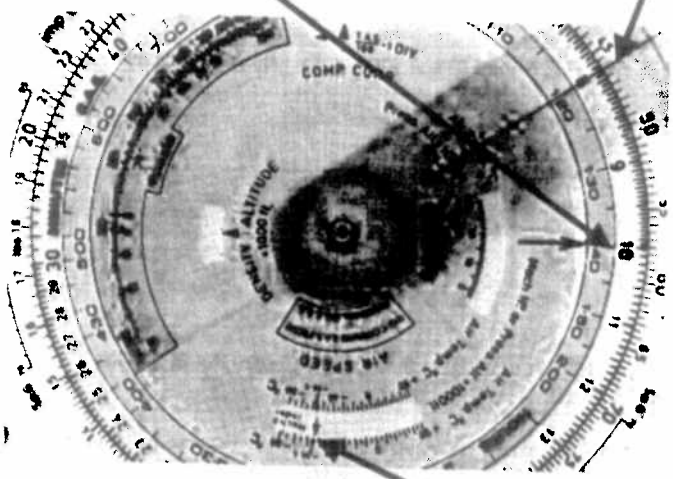
CRP5 5 a.

To solve this type of problem on the CRP5:

a. Set Mach index mark in Airspeed window opposite the OAT (-55^{0}C).
b. Position the cursor on Mach 0.8 on the inner scale.
c. Read off the TAS 460 kts TAS. And against mach 1 read LSS = 575 kts (option a). This situation is illustrated below.

2. Mach 1 on inner scale aligns with TAS 575 Kts LSS on outer scale.

3. Cursor set at mach 0.8 on inner scale aligns with TAS 460 Kts on outer scale.



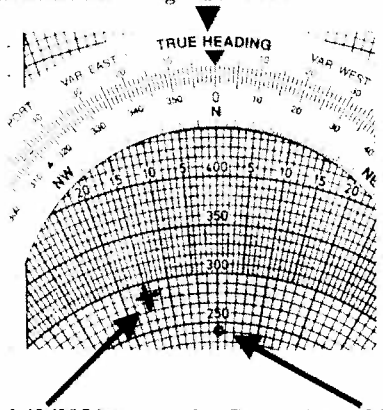
1. Mach index pointer set against –55^{0}C OAT in Airspeed window.

CRP5 6 b.

To solve this type of problem using the CRP5:

a. No heading is specified so select one at random, 000^0 for example.
b. Set the high speed slide with the centre dot at 240 kts.
c. The question specifies a +45 wind component. This means a 45 kt tailwind component. This means that the ground speed is 240 TAS + 45 kts = 285 kts.
d. The question also specifies 15^0 left drift. So draw a cross where the 15^0 left drift line crosses the 285 kt arc. This situation is illustrated below.

1. 000^0 set against true heading index mark.



3. Cross at 15^0 left drift/285 kts ground speed.

2. Centre dot at 240 kts TAS.

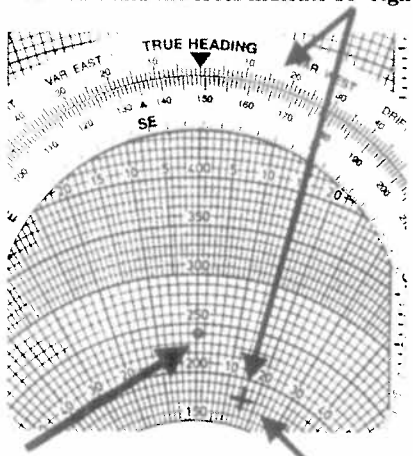
e. With 15^0 left drift the track is 345^0. So the reverse track is 165^0.

f. Rotate window to align 165^0 with true heading index.

g. The cross now indicates 19^0 right drift. Align the 165^0 track with 19^0 right drift. The cross now indicates 15^0 right drift. Align 165^0 with 15^0 right drift. The cross now indicates 16^0 right drift. Align 165^0 with 16^0 right drift. Both the cross now indicates Move and the outer scale now indicate 16^0 right drift, so the drift is balanced.

h. The cross is now on an arc 65 kts below the centre dot. This means that the wind speed is -65 kts (option b). This situation is illustrated below.

1. Both the outer scale and the cross indicate 16^0 right drift



2. Centre dot is at 240 kts TAS.

3. Cross is at –65 kts wind speed.

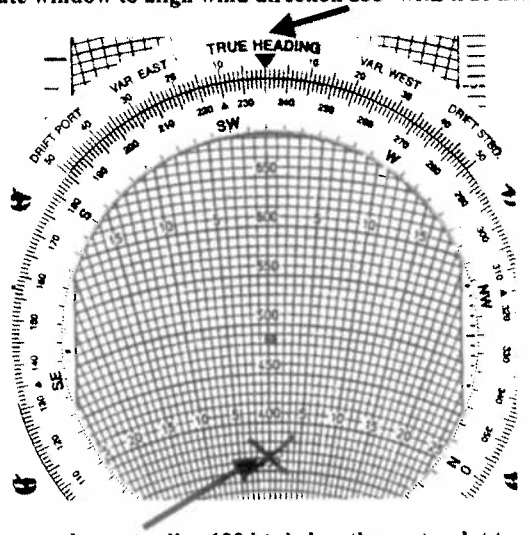
CRP5 7 c.

To solve this type of problem on the CRP5:

a. Insert the slide so that the high sped side is visible in the window and rotate window to allgn wind direction 235^0 T with true heading index.

b. Draw a cross on the centre line below the centre dot to represent the wind speed 120 kts. This situation is illustrated below.

1. Rotate window to align wind direction 235^0 with true heading index.



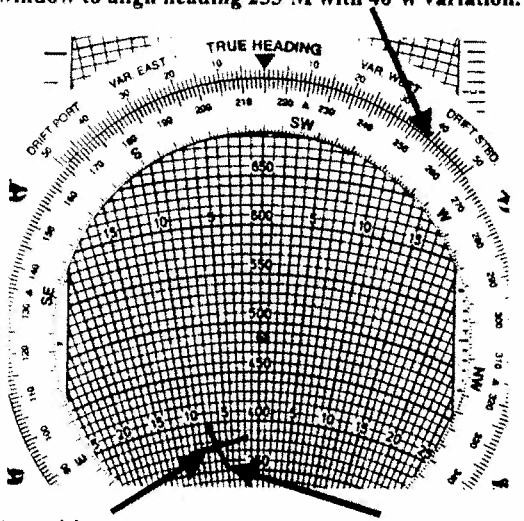
2. Draw a cross on the centre line 120 kts below the centre dot to represent wind speed. The position of the slide is unimportant at this stage but high speed side must be visible.

c. Rotate the window to align heading of 255^0M on the window with 40^0 W variation on the outer scale.

d. Move the slide to align the cross with the ground speed 120 kts.

e. Read the drift indicated by the position of the cross (6.5^0 left). This is closest to 7^0 left (option c). This situation is illustrated below.

1. Rotate window to align heading 255°M with 40°w variation.



2. Move slide to position cross on ground speed 375 kts radial.

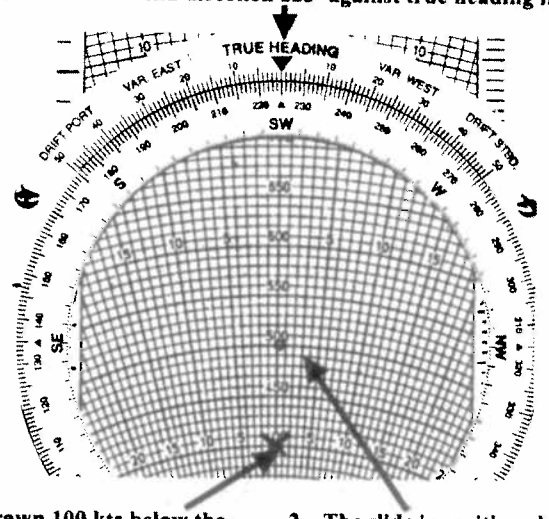
3. 6.5 left drift is indicated by position of cross.

CRP5 8 a.

To solve this type of problem using the CRP5:

a. Insert the slide so that the high speed side is visible in the window disc on the back of the CRP5.
b. Rotate the inner scale until the wind direction (225) allgns with the index on the outer scale.
c. Move the slide until the centre dot on the window disc allgns with the TAS (500 Kts).
d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 100 Kts so with the centre dot at 500 Kts the cross for wind speed should be at 400 Kts. This situation is illustrated below.

1. Rotate window to set wind direction 225° against true heading index mark

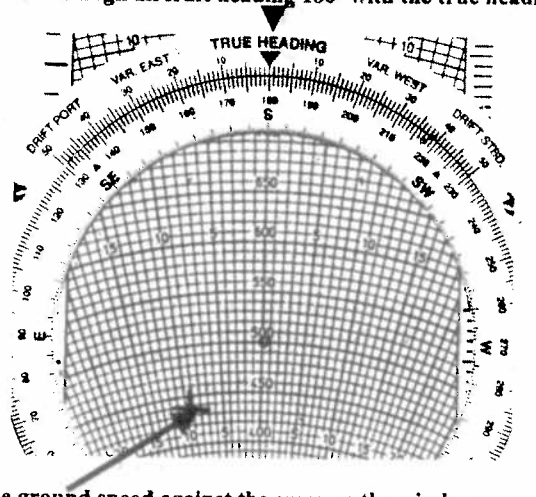


3. A cross drawn 100 kts below the center dot to indicate 100 kt wind

2. The slide is positioned so that the center dot is on 500 kts TAS

e. Rotate the inner scale to allgn the heading (180) on the inner scale with the index mark on the outer scale.
f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to allgn aircraft heading 180° with the true heading index



2. Read off the ground speed against the cross on the window

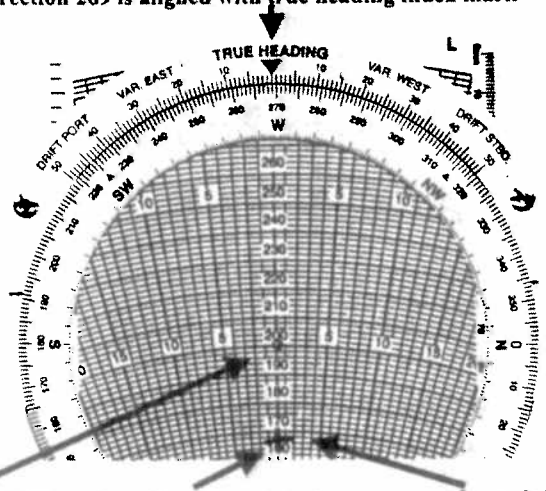
In this case the ground speed is approximately 435 Kts (option a).

CRP5 9 b.

To solve this type of problem on the CRP5:

a. On low speed side of slide set 200 Kts TAS at the centre dot.
b. Rotate the window to align heading 310 with true heading index mark.
c. Draw a cross to represent the wind where the 7 right drift radial intersects the 176 Kts ground speed radial.
d. Rotate the window to align the cross with the centre line of the slide below the centre dot.
e. Read off the wind direction 269° at the true heading index mark and the wind speed (33 kts) at the cross. These values are closest to 270°/33 kts (option b). This situation is illustrated below.

1. Wind direction 269 is aligned with true heading index mark



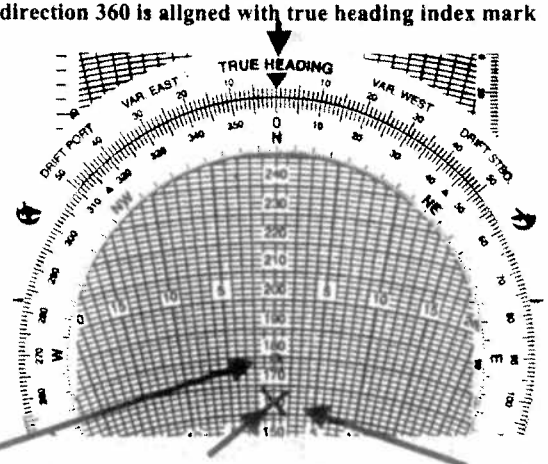
2. 200 kts TAS is aligned with centre dot.
3. Window is rotated align cross below centre dot
4. wind speed 33 kts indicated by distance from centre dot to cross

CRP5 10 a.

To solve this type of problem on the CRP5:

a. On low speed side of slide set 180 Kts TAS at the centre dot.
b. Rotate the window to align heading 090 with true heading index mark.
c. Draw a cross to represent the wind where the 5 right drift radial intersects the 180 Kts ground speed radial.
d. Rotate the window to align the cross with the centre line of the slide below the centre dot.
e. Read off the wind direction of 360° at the true heading index mark and the wind speed (15 kts) at the cross (option b). This situation is illustrated below.

1. Wind direction 360 is aligned with true heading index mark



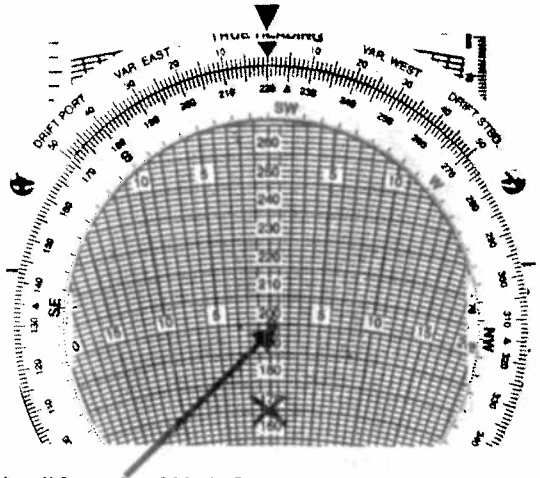
2. 180 kts TAS is aligned with centre dot.
3. Window is rotated align cross below centre dot
4. wind speed 15 kts indicated by distance from centre dot to cross

CRP5 11 d.

To solve this type of problem using the CRP5:

a. Insert the slide so that the low speed side is visible in the window disc on the back of the CRP5.
b. Rotate the inner scale until the wind direction (220) aligns with the index on the outer scale.
c. Move the slide until the centre dot on the window disc aligns with the TAS (200 Kts).
d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 30 Kts so with the centre dot at 200 Kts the cross for wind speed should be at 170 Kts. This situation is illustrated below.

1. Rotate window to set wind direction 220° against true heading index mark



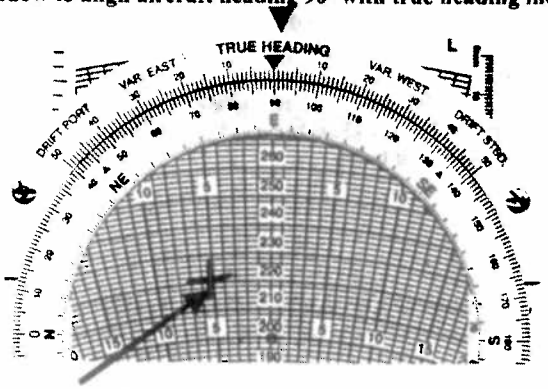
2. Set the slide so that 200 TAS is under the centre dot

3. Draw a cross 30 kts below the centre dot to show 30 kt wind

e. Rotate the inner scale to align the heading (090) on the inner scale with the index mark on the outer scale.

f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 90° with true heading index mark



2. Read off ground speed against cross on window.

In this case the ground speed is approximately 220 Kts (option d).

CRP5 12 a.

To solve this type of problem using the CRP5:

a. Set the low speed slide with 180 kts TAS at the centre dot.
b. Set wind direction 045° against the true heading index.
c. Draw a cross on the centre line 50 kts below the centre dot.
d. Align the track 090° on the window scale with the true heading index mark, then read off 13.5 right drift the cross.
e. Align track 090° on the window scale with 13.5 right drift on the outer scale. Read off 10.5 right drift at the cross.
f. Align track 090° on the window scale with 10.5 right drift on the outer scale. Read off 11.5 right drift at the cross.
g. Align track 090° on the window scale with 11.5 right drift on the outer scale. Read off 11.5 right drift at the cross. Both the outer scale and the cross indicate 11.5 right drift, so the drift is now balanced.
h. Read off 141 kts ground speed at the cross. This is the ground sped out from the start of the flight.
i. To get the ground speed on the homebound leg of the flight align the reverse track 270° with 11.5 right drift and read of 225 ground speed.

j. These ground speeds can now be used to calculate the time to the point of safe return using the standard equation:

$$\text{Time to PSR} = \frac{\text{Endurance x homeward speed}}{\text{Outward sped + homeward speed}}$$

Inserting the 1 hour time specified in the questions and the speeds calculated above gives:

Time to PSR = (1 hour x 225 kts) / (141 kts + 225 kts) = 0.61475 hours.

Multiplying this by the outward speed gives a maximum outward distance of

Maximum outward distance = 0.61475 hr x 141 kts = 86.7 nm.

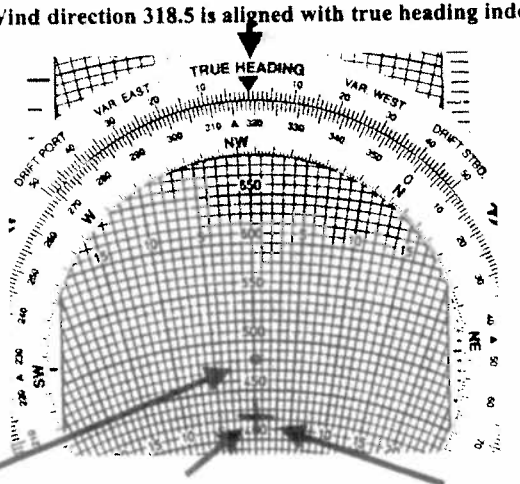
This is closest to 85 nm (option a).

CRP5 13 b.

To solve this type of problem on the CRP5:

a. On high speed side of slide set 480 Kts TAS at the centre dot.
b. Rotate the window to align heading 090 with true heading index mark.
c. Draw a cross to represent the wind where the 5 right drift radial intersects the 520 Kts ground speed radial.
d. Rotate the window to align the cross with the centre line of the slide below the centre dot.
e. Read off the wind direction of 318.5° at the true heading index mark and the wind speed (60 kts) at the cross. This is closest to 320°/60 kts (option b). This situation is illustrated below.

1. **Wind direction 318.5 is aligned with true heading index mark**



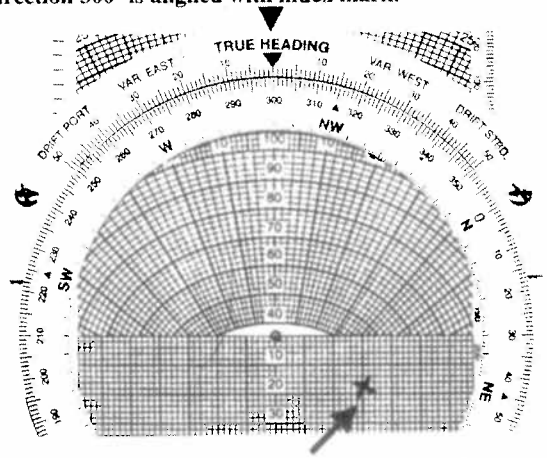
2. **480 kts TAS is aligned with centre dot.**
3. **Window is rotated align cross below centre dot**
4. **wind speed 60 kts indicated by distance from centre dot to cross**

CRP5 14 a.

To solve this type of problem using the CRP5:

a. **Set the low speed side of the slide so that the top line of the squared section aligns with the centre dot in the window.**
b. **Rotate the window to align the wind direction (240) with the true heading index mark.**
c. **Draw a cross to represent the wind speed (35 kts) on the centre line below the centre dot.**
d. **Rotate the window disc to align the runway direction (300) with the true heading index mark.**
e. **The crosswind component (30 kts) is the horizontal distance from the centre dot to the cross. This situation is illustrated below.**

1. **Runway direction 300^0 is aligned with index mark.**



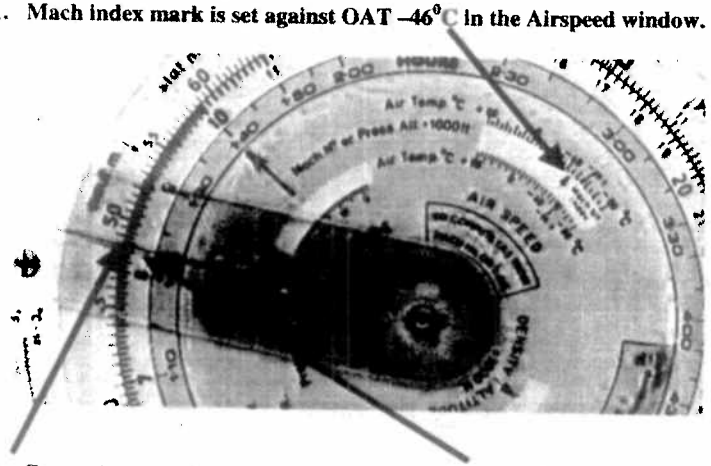
2. **Horizontal distance from dot to cross indicates crosswind component 30 kts.**

CRP5 15 c.

To solve this type of problem on the CRP5:

a. **At FL450 the pressure altitude is 45000 ft, which is above the tropopause. So ISA temperature is the same as that at the tropopause -56.5^0C. This means that ISA + 10^0C = -46.5^0C.**
b. **Set the mach index against this temperature in the airspeed window.**
c. **Set the cursor against TAS 485 kts on the outer scale.**
d. **Read off the mach number 0.825 at the cursor on the inner scale (option c). This situation is illustrated below.**

1. Mach index mark is set against OAT –46°C in the Airspeed window.



2. Cursor is set against 485 kts TAS on the outer scale.

3. Cursor indicates M0.825 on the inner scale.

CRP5 16 a.

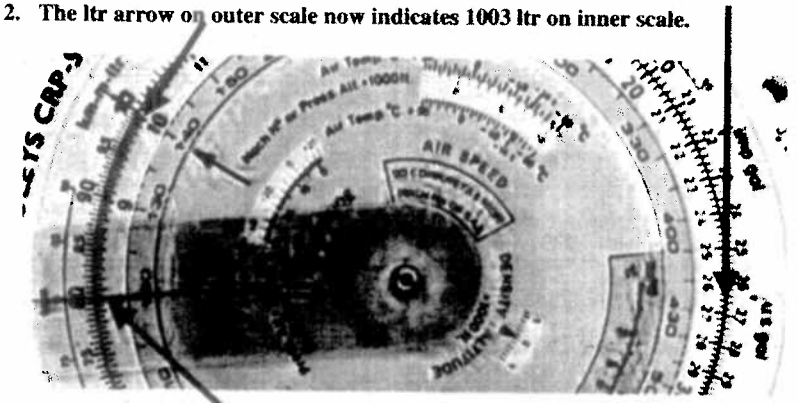
To solve this type of problem on the CRP5:

a. First convert 265 USG to litres by setting 265 on the inner scale against the U.S.Gal arrow on the outer scale. Then read off 1004 litres on the inner scale against the ltr arrow .

b. Set the cursor against 0.8 on the SG scale, then read off 803 kg (option a) where the cursor crosses the inner scale. This situation is illustrated below.

1. Set 265 on the inner scale against USGal arrow on the outer scale.

2. The ltr arrow on outer scale now indicates 1003 ltr on inner scale.



3. With cursor set against 0.8SG on SG scale, the cursor crosses the inner scale at 803 kg.

CRP5 17 c.

To solve this type of problem using the CRP5:

a. Convert 730 feet to meters by setting 730 on the inners scale against the feet arrow. Now read of 222 metres on the inner scale opposite the m arrow on the outer scale. This means that 730 feet = 222 metres.

b. The settings described above are illustrated below.

1. 730 on the inner scale is set against the feet arrow on the outer scale.

2. The m arrow on the outer scale is aligned with 222 on the inner scale indicating that 730 feet = 222 meters.

b. This in turn means that 730 ft/min = 222 m/min. This can be converted into m/sec by setting 222 on the inner scale against 60 on the outer scale. Then read off 3.71 on the inner scale against 1 on the outer scale. This is closest to 3.7 m/sec (option c). These settings are illustrated below.

1. 222 on inner scale is set against 60 on outer scale.

2. 10 on the outer scale aligns with 3.71 on the inner scale.

CRP5 18 b.
To solve this type of problem on the CRP5:

a. Align the 60 min index mark on the inner scale with 269 kts on the outer scale.
b. Align the cursor with 5 nm on then outer scale. Then read off 1.11 min on the inner scale. Multiplying the .11min by 60 gives 6.6 secs. So the total time is 1 min 6.6 sec or approximately 1 min 7 sec (option b). The above settings are illustrated below.

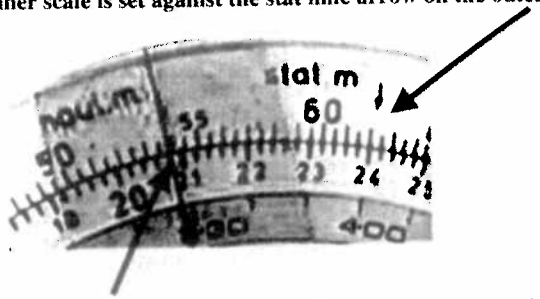
1. 60 min index mark is aligned with 269 kts.

2. Cursor aligned with 5 nm on outer scale crosses inner scale at 1.11 min.

CRP5 19 a.
To solve this type of problem using the CRP5:

a. Align 2.4 on the inner scale with the statute mile arrow on the outer scale.
b. Align the cursor with the nautical miles arrow on the outer scale and read off 2.085 nm on the inner scale. This means that 2.4 statute miles equals 2.085 nautical miles. These settings are illustrated below.

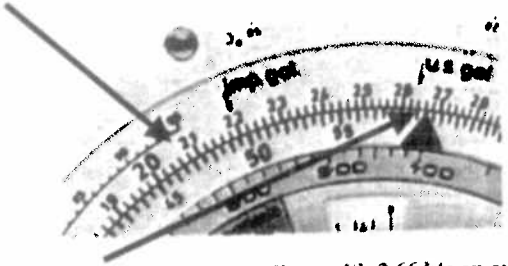
1. 2.4 on inner scale is set against the stat mile arrow on the outer scale.



2. The cursor aligned with the nautical miles arrow crosses the inner scale at 2.085. this means that 2.4 stat miles = 2.085 nm.

c. Set 2.085 on the outer scale against 47 minutes on the inner scale.
d. Against the 60 min index mark read off 2.66 kts on the outer scale. This means that a speed of 2.66 kts would be required to travel 2.085 nm in 47 minutes. So to move the same distance in 47 seconds it would take 60 times this sped, which is 159.6 kt or approximately 160 kts (option a). These settings are illustrated below.

1. 2.085 nm on outer scale is set against 47 minutes on inner scale.

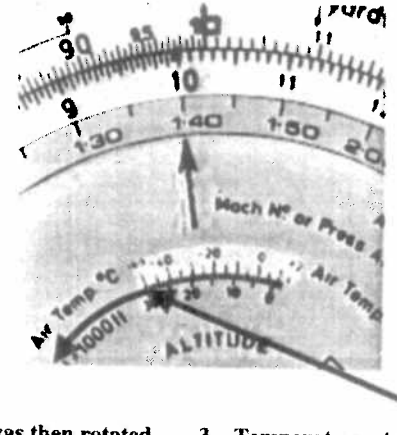


2. 60 min index on inner scale aligns with 2.66 kts on outer scale. Multplying this by 60 gives 159.9 kts

CRP5 20 c.
To solve this type of problem using the CRP5:

a. Align the 10 on the inner scale with the 10 on the outer scale. This will set the altitude window to ISA conditions. Temperatures up to 30000 ft can now be read directly from the altitude window.
b. For temperature at 33000 ft carefully rotate the inner disc anti-clockwise three division left on the altitude scale. This can be measured by using any of the markings on the temperature scale.
c. Now read of the temperature opposite the 30. This (-50^{0}C) is the approximate temperature at 33000 ft (FL330). These settings are illustrated below.

1. The 10 on the inner scale was initially set against the 10 on the outer scale. (These have now moved out of line due to action 2 below)



2. The inner scale was then rotated anti-clockwise so that the altitude scale moved 3 units to the left in the Altitude window.

3. Temperature at 33000 ft (-50^{0}C) is now indicated at the 30 on the temperature scale in line With 30 on the altitude scale.

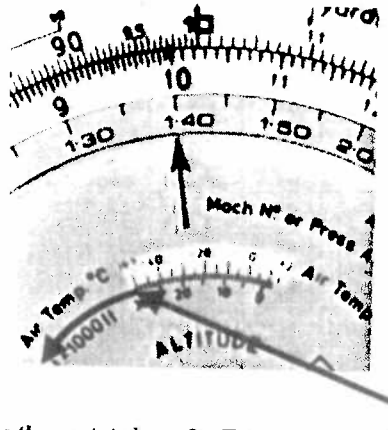
CRP5 21 a.

To solve this type of problem on the CRP5:

a. At FL330 the pressure altitude is 33000 ft. On the CRP5 set 10 on the inner scale with 10 on the outer scale.

b. Temperature would normally be read against the altitude (in thousands of feet) in the Altitude window, but the altitude scale reads only up to 30. To overcome this problem, rotate the inner scale anti-clockwise so that the pressure altitude scale in the Altitude window moves 3 divisions left as Use any one of the markers on the temperature scale to measure this movement. Now read of the temperature aligned with 30. This is approximately –51^{0}C. This situation is illustrated below.

1. The 10 on the inner scale was initially set against the 10 on the outer scale. (These have now moved out of line due to action 2 below)



2. The inner scale was then rotated anti-clockwise so that the altitude scale moved 3 units to the left in the Altitude window.

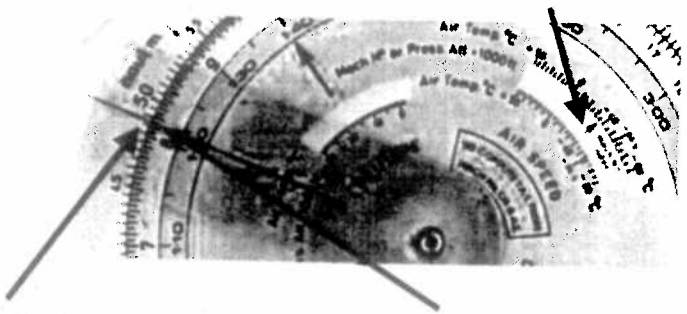
3. Temperature at 33000 ft (-51^{0}C) is now indicated at the 30 on the temperature scale in line With 30 on the altitude scale.

c. The question specifies ISA + 15^{0}C so the actual temperature at FL33 will be –51^{0}C + 15^{0}C = - 36^{0}C. Set the mach index against this temperature in the airspeed window.

d. Set the cursor against TAS 487 kts on the outer scale.

e. Read off the mach number 0.814 at the cursor on the inner scale. This is closest to M0.81 (option a). This situation is illustrated below.

1. Set Mach index against OAT –36^{0}C in Airspeed window



2. Set cursor against 487 TAS on outer scale.

3. Mach 0.814 is indicated on inner Scale.

CRP5 22 d.

To solve this type of problem using the CRP5:

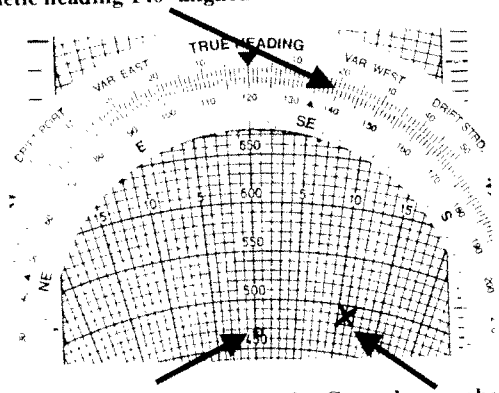
a. Convert the mach number to TAS by setting the mach index against –50°C in the Airspeed window. Align the cursor with mach 0.80 on the inner scale and read off 465 kts TAS on the outer scale.

b. Using the high speed slide set 465 TAS at the centre dot.

c. Rotate the window to align the magnetic heading (140°) with the 20° W variation on the outer scale.

d. Draw a cross where the 11° right drift radial intersects the 490 kt groud speed arc. This situation is illustrated below.

1. Magnetic heading 140° aligned with 20°W variation.



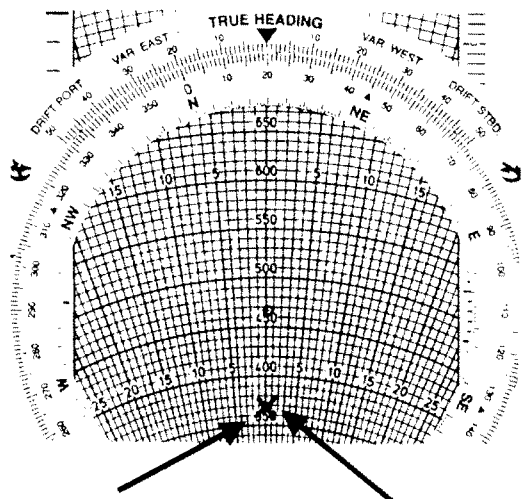
2. Centre dot set at 465 kts TAS.

3. Cross drawn where 11 R drift radial crosses 490 Kt ground speed arc.

e. Rotate the window to position the cross on the centre line below the centre dot.

f. Read off wind direction (020°) at the true heading index and wind speed (95 kts) by counting down from the centre dot to the cross. So the wind is 020°/95 kts (option d). These settings are illustrated below.

1. Wind direction 0200 indicated by true heading index mark.



2. Cross on centre line below centre dot.

3. Distance down from centre dot to cross indicates 95 kt wind speed.

CRP5 23 d.

Density altitude calculations carried out on the CRP5 are notoriously inaccurate. A more accurate estimation can be made using the standard equation:

Density Alt = Pressure Alt + (120 x temperature deviation).

Where temp deviation is actual temperature – ISA temperature

Setting 10 on the inner scale against 10 on the outer scale on the CRP5 causes the altitude window to indicate that at 29000 ft the ISA temperature is –43°C. Subtracting this from the actual temperature gives temperature deviation = -12°C

Inserting this value into the equation gives:

Density Alt = 29000 =(120 x (-12)) = 27560 feet. This is closest to 27500 ft (option c).

CRP5 24 a.

To solve this problem using the CRP5.

a. The 6 min taken to fly 14 nm s 1/10 of an hour, so its ground speed is 14 x 10 = 140 kts.

b. Compass heading is 090^0 with 12^0 E variation and 2^0 W deviation, so true heading is 100^0 , set this on the window against the true heading index.

c. Course is the 070^{0}M VOR radial. With variation 12^{0}E this is 082^{0}T.

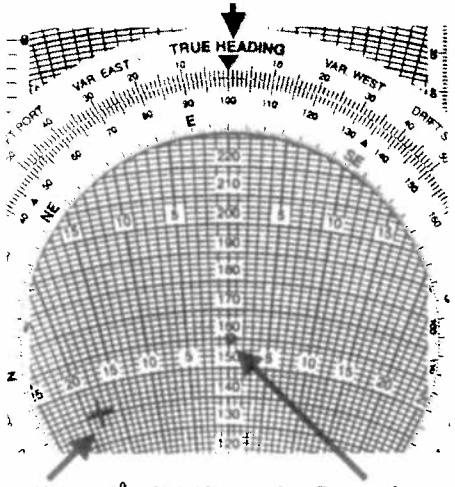
d. Set the low speed slide so that 160 kts TAS is at the centre dot.

e. Align 1000 on the inner scale with the true heading Index mark on the outer scale.

f. The aircraft is maintaining course 082^{0}T, while on true heading 100^0 so it is drifting so it is 18^0 left.

g. Draw a cross where the 140 kt arc intersects the 180 left drift radial. This represents the ground speed. This situation is illustrated below.

1. 100^0 aligned with true heading index mark.

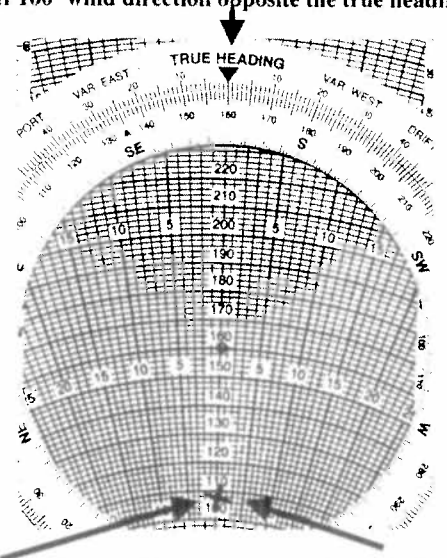


3. Cross drawn at 140 kts 18^0 left drift. 2. Centre dot on 160 kts TAS.

h. Rotate the window to align the cross with the centre line below the centre dot.

i. Read off the wind direction 160^0 opposite the true heading index and the wind speed by counting down from the centre dot to the cross. This gives 160^0/53 kts or approximately 160^0/50 kts (option a.) This situation is illustrated below.

3. Read off 160^0 wind direction opposite the true heading index mark.



1. Set cross on centre line below centre dot. 2. Cross 53 kts below centre dot.

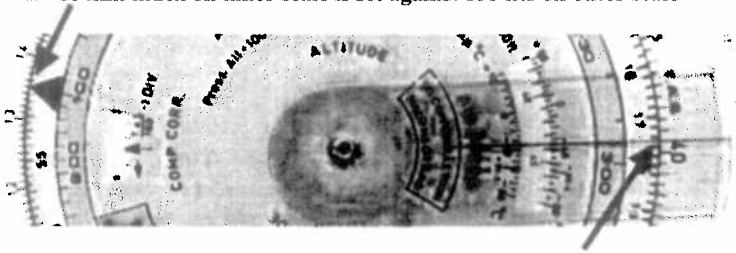
CRP5 25 c.

To solve this type of problem using the CRP5:

a. Set the 60 min index mark on the inner scale against 135 on the outer scale.

b. Position the cursor over 1.75 minutes (which is 1 min 45 sec), then read off 3.95 nm (option c). This situation is illustrated below.

1. 60 min index on inner scale is set against 135 kts on outer scale

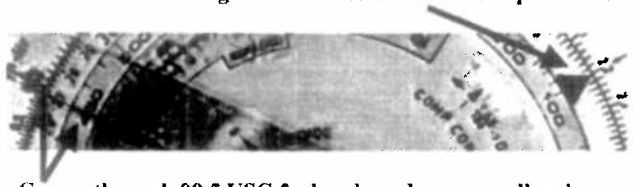


2. With cursor on 1.75 min on inner scale it crosses outer scale at 3.95 nm.

CRP5 26 a.
To solve this type of problem using the CRP5:

a. First convert Imp Gal into USG by setting 83 on the inner scale against the Imp Gal arrow on the outer scale. Now put the cursor on the USG arrow and read off 99.5 USG on the inner scale.
a. Align the 60 min index mark on the inner scale with the fuel consumption of 22 USG/Hr on the outer scale.
b. Position the cursor through the fuel available (99.5 USG) on the outer scale and read off 4 h 32 min on the yellow inner scale (option a). These settings are illustrated below.

1. 60 min index is set against 22 USG/hr fuel consumption rate.



2. Curser through 99.5 USG fuel on board crosses yellow inner scale at 4 hours 32 min.

CRP5 27 c.
To solve this type of problem on the CRP5:

a. Set 1 USG on the inner scale against the USG arrow on the outer scale.
b. Against the itr arrow on the outer scale read off 3.48 lts on the inner scale (option c). these settings are illustrated below.

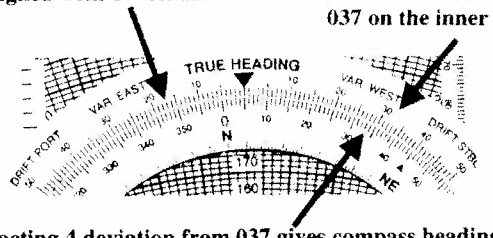
1. Set 1 USG on the inner scale against the USG arrow on the outer scale.

2. Cursor set on the ltr arrow crosses the inner scale at 3.78.

CRP5 28 d.
To solve this type of problem using the CRP5:

a. Set 348 on the inner scale against 17 left drift on the outer scale.
b. Against 32 west variation on the outer scale read 037 on the inner scale.
c. Subtract 4 deviation to give a compass heading of 033^0 (option d). These setting s are illustrated below.

1. 348 aligned with 17 left drift.
2. At 32 west variation read of 037 on the inner scale.

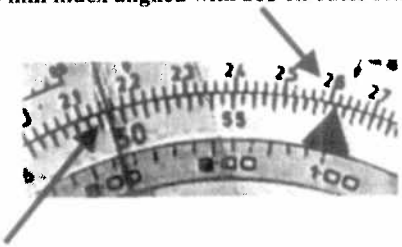


3. Subtracting 4 deviation from 037 gives compass heading 033

CRP5 29 a.
To solve this type of problem using a CRP5:

a. Set 100 on the inner scale against the statute miles arrow on the outer scale.
b. The nautical mile arrow on the outer scale will now align with 87 nm the inner scale. This means that 100 statute mile = 87 nautical miles, which the aircraft flies in 20 minutes.
c. 20 minutes is 1/3 of an hour so the aircraft speed is 87 x 3 = 261 kts.
d. Set 261 on the inner scale against 215 on the outer scale.
e. Position the cursor at 215 on the outer scale. The cursor will now cro the inner scale at 49.5 min, or approximately 50 min (option a). Thes settings are illustrated below.

1. 60 min index aligned with 261 on outer scale.



2. Cursor aligned with 215 on outer scale, crosses inner scale at 49.5

CRP5 30 b.
This problem poses two difficulties in that the directions are given as magnet and the course is given rather than the heading. Because both the course an wind direction are stated in magnetic, they can be used on the CRP5 as if the were true.

To solve this type of problem using the CRP5:

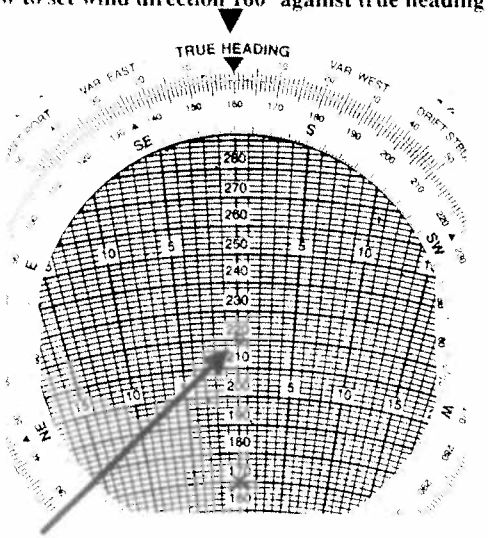
a. Insert the slide so that the low speed side is visible in the window disc the back of the CRP5.

b. Rotate the inner scale until the wind direction (160) aligns with the index on the outer scale.

c. Move the slide until the centre dot on the window disc aligns with the TAS (220 Kts).

d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 50 Kts so with the centre dot at 220 Kts the cross for wind speed should be at 170 Kts. This situation is illustrated below.

1. Rotate window to set wind direction 160^0 against true heading index mark



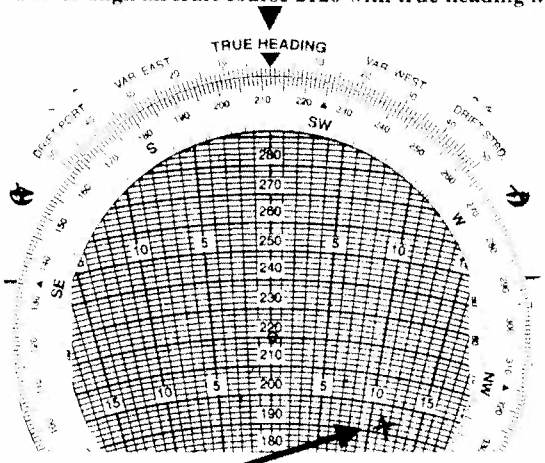
2. Set slide so that 220 kts TAS is under centre dot

3. Draw a cross 50 kts below the centre dot to show wind speed

e. Rotate the inner scale to align the course (212) on the inner scale with the index mark on the outer scale.

f. Read off the drift using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft course 2120 with true heading index mark



2. Read off drift against cross.

g. In this case the drift is approximately 11.5 degrees right.

h. But the question specified a course rather than a heading, so it is necessary to balance the drift. To do this, rotate the inner scale clockwise until the course (212) on the inner scale aligns with 11.5 on the outer scale.

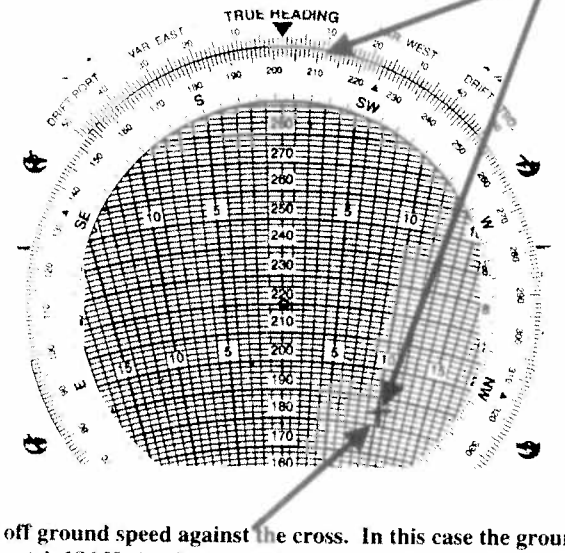
i. Using the cross, estimate the new drift. In this case this is now approximately 10 degrees right.

j. Rotate the inner scale left until the course (212) on the inner scale aligns with 10 degrees right on the outer scale.

k. Using the cross estimate the drift. In this case it is approximately 10 degrees. The drift indicated by the cross is now the same as that on the outer scale, so the drift is said to be correctly balanced.

l. Using the cross read off the groundspeed from the slide. This situation is illustrated below.

1. Course 212^0 is set against 10^0 right drift and the cross indicates 10^0 right drift, so the drift is said to be balanced.



2. Read off ground speed against the cross. In this case the ground speed is approximately186 Kt (option b).

CRP5 31 b.

To solve this type of problem using the CRP5:

a. Set mach index against the temperature -15^0C in the airspeed window.
b. Set the cursor at 250 kts TAS on the outer scale, then read off mach 0.40 (option b) where the cursor crosses the inner scale. These settings are illustrated below.

1. Mach index is set against -15^0C in airspeed window.

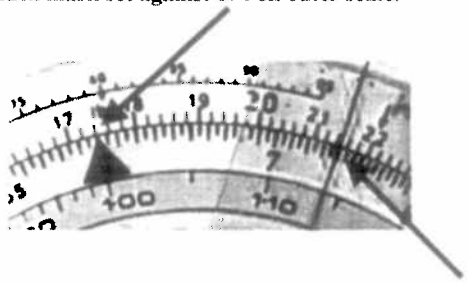
2. Cursor set at 250 kts TAS on outer scale crosses inner scale at Mach 0.40.

CRP5 32 a.

To solve this type of problem using the CRP5:

a. Set 100 on inner scale against the statute miles arrow on outer scale.
b. At the nautical miles arrow on outer scale read off 87 on inner scale. This means that 100 statute miles = 87 nautical miles. The aircraft covers this in 30 minutes so its ground speed is 87 x 2 = 174 kts.
c. Set the 60 min index mark at 174 on the outer scale.
d. With the cursor set at 215 on the outer scale it crosses the inner scale at 74 min (option a). These settings are illustrated below.

1. 60 min index mark set against 174 on outer scale.



2. Cursor set at 215 on outer scale crosses inner scale at 74 min.

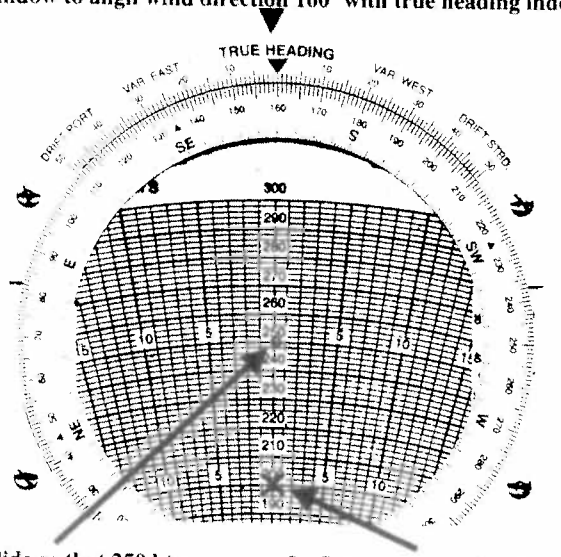
CRP5 33 c.

This problem poses two difficulties in that the directions are given as magnetic and the course is given rather than the heading. Because both the course and wind direction are stated in magnetic, they can be used on the CRP5 as if they were true.

To solve this type of problem using the CRP5:

a. Insert the slide so that the low speed side is visible in the window disc on the back of the CRP5.
b. Rotate the inner scale until the wind direction (160) aligns with the index on the outer scale.
c. Move the slide until the centre dot on the window disc aligns with the TAS (250 Kts).
d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 50 Kts so with the centre dot at 250 Kts the cross for wind speed should be at 200 Kts. This situation is illustrated below.

i. Rotate window to align wind direction 160^0 with true heading index mark



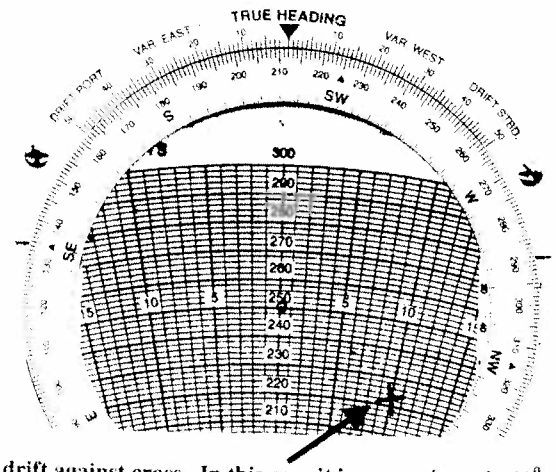
2. Position slide so that 250 kts TAS aligns with centre dot

3. Draw a cross 50 kts below centre dot to show wind speed

e. Rotate the inner scale to align the course (212) on the inner scale with the index mark on the outer scale.

f. Read off the drift using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align course 212^0 with true heading index mark

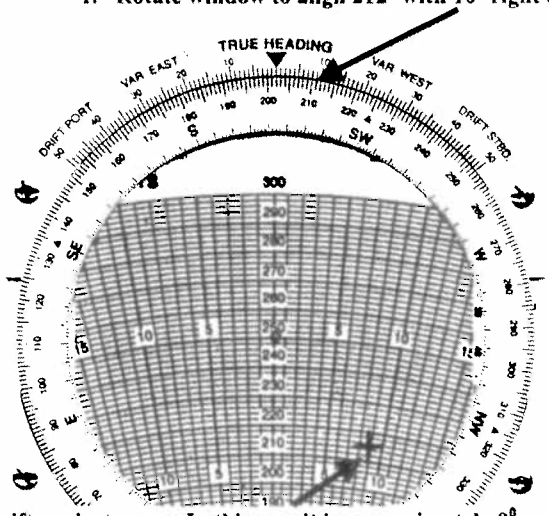


2. Read off drift against cross. In this case it is approximately 10^0

g. To balance the drift rotate the inner scale clockwise until the course (212) on the inner scale aligns with 10 on the outer scale.

h. Using the cross, estimate the new drift. In this case this is now approximately 9 degrees right. This situation is illustrated below.

1. Rotate window to align 212^0 with 10^0 right drift



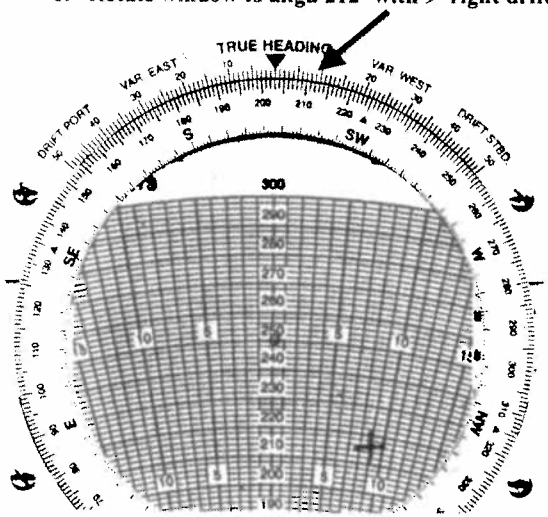
2. Read of drift against cross. In this case it is approximately 9^0

i. Rotate the inner scale left until the course (212) on the inner scale aligns with 9 degrees right on the outer scale.

j. Using the cross, estimate the new drift. In this case this is now approximately 9 degrees right.

k. The drift indicated by the cross is now the same as that on the outer scale, so the drift is said to be correctly balanced. This situation is illustrated below.

1. Rotate window to align 212^0 with 9^0 right drift



2. Read off drift against cross. In this case it is approximately 90 right

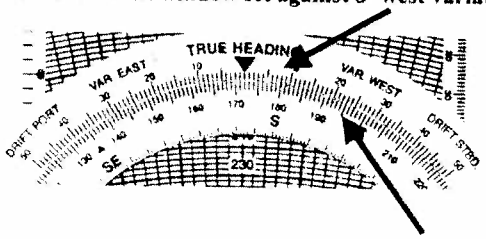
l. Using the cross read off the groundspeed from the slide.

In this case the ground speed is 215 Kt (option c).

CRP5 34 d.
To solve this type of problem using the CRP5:

a. Set track 180^0 on inner window against 8^0 right drift on the outer scale.
b. Against compass heading 195^0 on inner scale read off 23^0 west variation.
c. Subtracting 2^0 deviation gives 21^0 W variation (option d). These settings are illustrated below.

1. Track 180^0 on window set against 8^0 west variation.

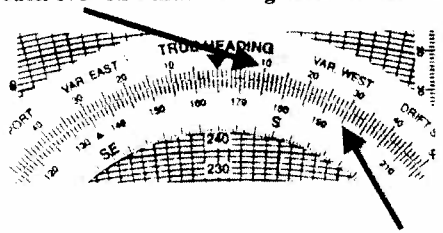


2. Compass heading 195^0 on inner scale aligns with 23^0 variation on outer scale. Subtracting 2^0 deviation gives 21^0 variation.

CRP5 35 b.
To solve this type of problem using the CRP5:

a. Set track 175^0 on inner window against 10^0 right drift on the outer scale.
b. Against compass heading 195^0 on inner scale read off 30^0 west variation.
c. Subtracting 3^0 deviation gives 27^0 W variation (option b). These settings are illustrated below.

1. Track 175^0 on window set against 10^0 west variation.

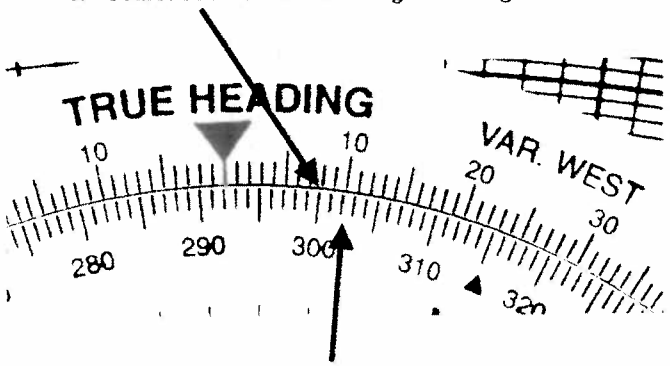


2. Compass heading 195^0 on inner scale aligns with 30^0 variation on outer scale. Subtracting 3^0 deviation gives 27^0 variation.

CRP5 36 d.
To solve this type of problem using the CRP5:

a. Set true course 300^0 on inner window against 8^0 right drift on outer scale.
b. Against 10^0 west variation read 302^0.
c. Adding 4^0 deviation gives 306^0 (option d). These settings are illustrated below.

1. Course 300^0 on window set against 8^0 right drift.



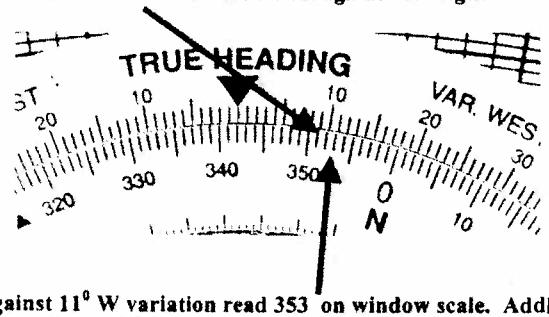
2. Against 10^0 W variation read 302 on window scale. Adding 4^0 deviation gives 306^0.

CRP5 37 b.

To solve this type of problem using the CRP5:

a. Set true track 352° on inner window against 10° right drift on outer scale.
b. Against 11° west variation read 353°.
c. Adding 5° deviation gives 358° (option b). These settings are illustrated below.

1. Course 352° on window set against 10° right drift.



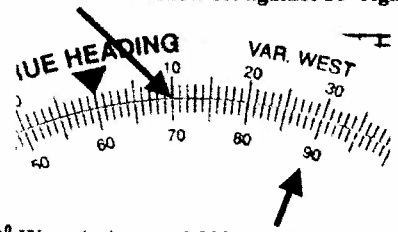
2. Against 11° W variation read 353 on window scale. Adding 5° deviation gives 358°.

CRP5 38 a.

To solve this type of problem using the CRP5:

a. Set true track 070° on inner window against 10° right drift on outer scale.
b. Against 30° west variation read 090°.
c. Subtracting 1° deviation gives 089° (option a). These settings are illustrated below.

1. Course 070° on window set against 10° right drift.



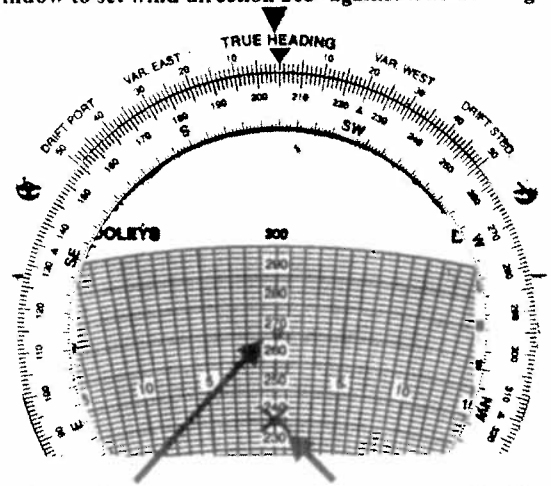
2. Against 30° W variation read 090 on window scale. Subtracting 1° deviation gives 089°.

CRP5 39 c.

To solve this type of problem using the CRP5:

a. Insert the slide so that the low speed side is visible in the window disc on the back of the CRP5.
b. Rotate the inner scale until the wind direction (205) aligns with the index on the outer scale.
c. Move the slide until the centre dot on the window disc aligns with the TAS (270 Kts).
d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 30 Kts so with the centre dot at 270 Kts the cross for wind speed should be at 240 Kts. This situation is illustrated below.

1. Rotate window to set wind direction 205° against true heading index mark

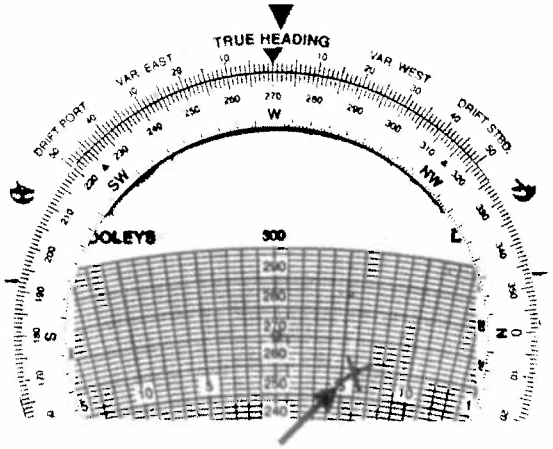


2. Set the slide so that 270 TAS is under the centre dot

3. Draw a cross 30 kts below the centre dot to show 30 kt wind

e. Rotate the inner scale to align the heading (270) on the inner scale with the index mark on the outer scale.
f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 270^0 with true heading index mark



2. Read off drift and ground speed against cross on window.

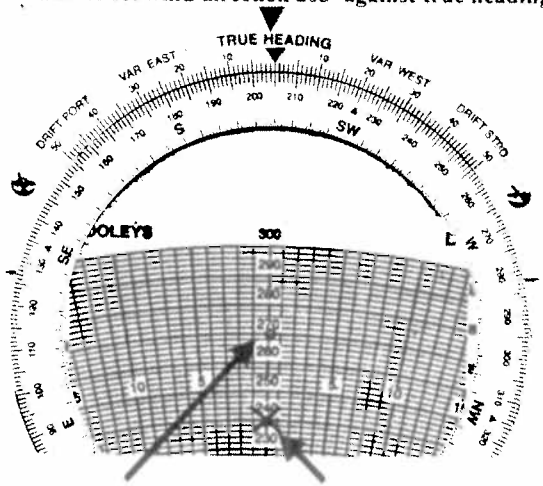
In this case the drift is approximately 6^0 right and the ground speed is approximately 259 Kts (option c).

CRP5 40 a.

To solve this type of problem using the CRP5:

a. Insert the slide so that the low speed side is visible in the window disc on the back of the CRP5.
b. Rotate the inner scale until the wind direction (205) aligns with the index on the outer scale.
c. Move the slide until the centre dot on the window disc aligns with the TAS (270 Kts).
d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 30 Kts so with the centre dot at 270 Kts the cross for wind speed should be at 240 Kts. This situation is illustrated below.

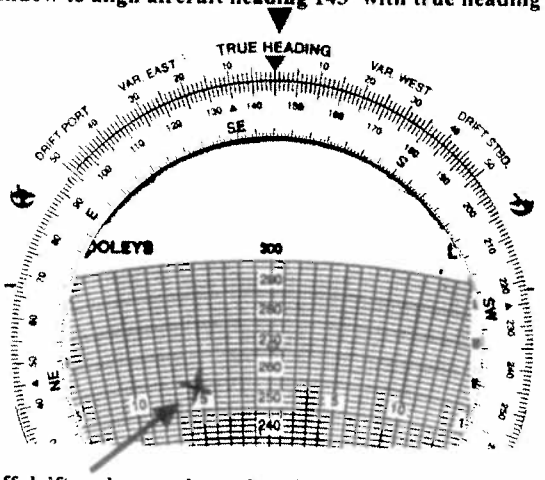
1. Rotate window to set wind direction 205^0 against true heading index mark



3. Set the slide so that 270 TAS is under the centre dot
2. Draw a cross 30 kts below the centre dot to show 30 kt wind

e. Rotate the inner scale to align the heading (145) on the inner scale with the index mark on the outer scale.
f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 145^0 with true heading index mark



2. Read off drift and ground speed against cross on window.

In this case the drift is approximately 5.5^0 left and the ground speed is approximately 257 Kts. This is closest to option a, 6°L - 256 kt.

CRP5 41 c.

To solve this type of problem using the CRP5:

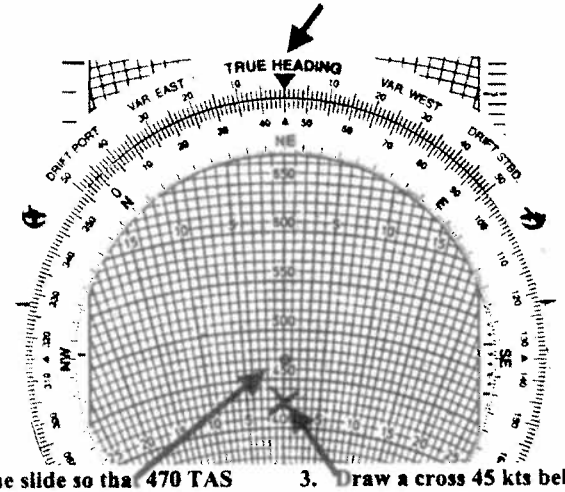
a. Insert the slide so that the high speed side is visible in the window disc on the back of the CRP5.

b. Rotate the inner scale until the wind direction (045) aligns with the index on the outer scale.

c. Move the slide until the centre dot on the window disc aligns with the TAS (470 Kts).

d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 45 Kts so with the centre dot at 270 Kts the cross for wind speed should be at 425 Kts. This situation is illustrated below.

3. Rotate window to set wind direction 045° against true heading index mark



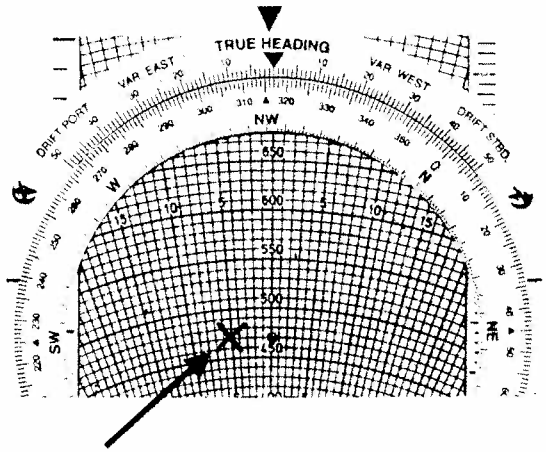
4. Set the slide so that 470 TAS is under the centre dot

3. Draw a cross 45 kts below the centre dot to show 45 kt wind

e. Rotate the inner scale to align the heading (317) on the inner scale with the index mark on the outer scale.

f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 317° with true heading index mark



2. Read off drift and ground speed against cross on window.

In this case the drift is approximately 5° left and the ground speed is approximately 470 Kts (option c).

CRP5 42 b.

To solve this type of problem using the CRP5:

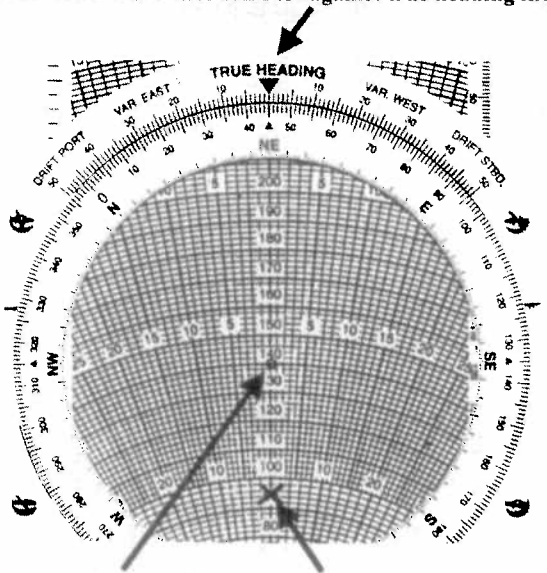
a. Insert the slide so that the low speed side is visible in the window disc on the back of the CRP5.

b. Rotate the inner scale until the wind direction (045) aligns with the index on the outer scale.

c. Move the slide until the centre dot on the window disc aligns with the TAS (140 Kts).

d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 45 Kts so with the centre dot at 140 Kts the cross for wind speed should be at 95 Kts. This situation is illustrated below.

1. Rotate window to set wind direction 045^0 against true heading index mark



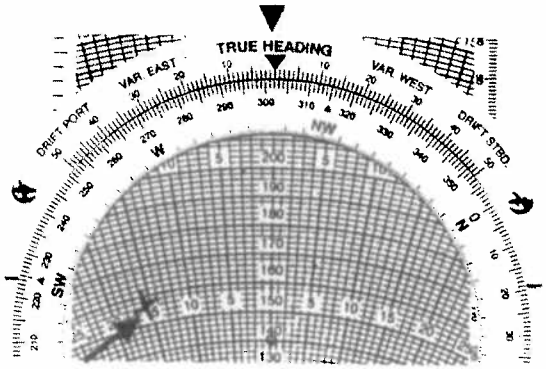
2. Set the slide so that 140 TAS is under the centre dot

3. Draw a cross 45 kts below the centre dot to show 45 kt wind

e. Rotate the inner scale to align the heading (302) on the inner scale with the index mark on the outer scale.

f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 302^0 with true heading index mark



2. Read off drift and ground speed against cross on window.

In this case the drift is approximately 16^0 left and the ground speed is approximately 156 Kts (option b).

CRP5 43 d.

To solve this type of problem using the CRP5:

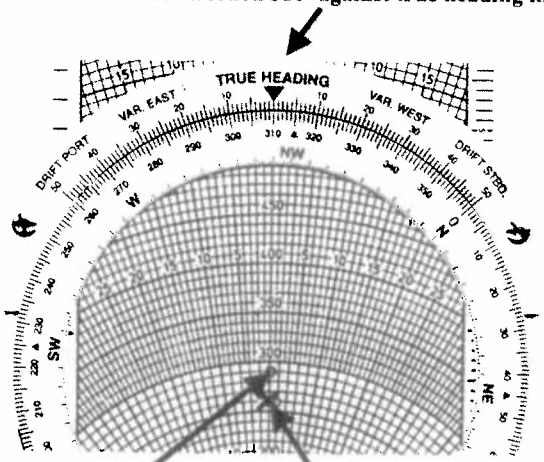
a. Insert the slide so that the high speed side is visible in the window disc on the back of the CRP5.

b. Rotate the inner scale until the wind direction (310) aligns with the index on the outer scale.

c. Move the slide until the centre dot on the window disc aligns with the TAS (290 Kts).

d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 30 Kts so with the centre dot at 290 Kts the cross for wind speed should be at 260 Kts. This situation is illustrated below.

1. Rotate window to set wind direction 310^0 against true heading index mark



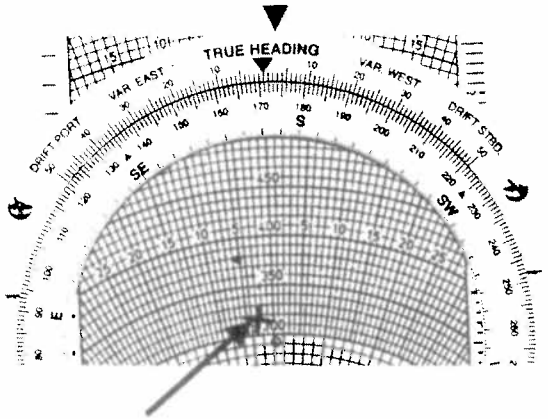
2. Set the slide so that 290 TAS is under the centre dot

3. Draw a cross 30 kts below the centre dot to show 30 kt wind

e. Rotate the inner scale to align the heading (171) on the inner scale with the index mark on the outer scale.

f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 171^0 with true heading index mark



2. Read off drift and ground speed against cross on window.

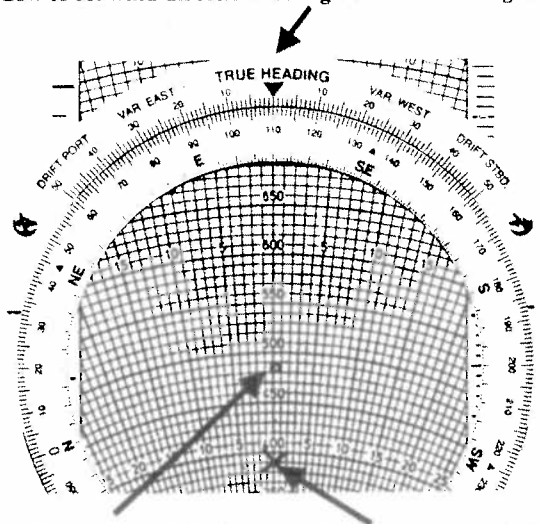
In this case the drift is approximately 3^0 left and the ground speed is approximately 315 Kts. This is closest to 4^0 Left and 314 Kts (option d).

CRP5 44 a.

To solve this type of problem using the CRP5:

a. Insert the slide so that the high speed side is visible in the window disc on the back of the CRP5.
b. Rotate the inner scale until the wind direction (110) aligns with the index on the outer scale.
c. Move the slide until the centre dot on the window disc aligns with the TAS (485 Kts).
d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 95 Kts so with the centre dot at 485 Kts the cross for wind speed should be at 390 Kts. This situation is illustrated below.

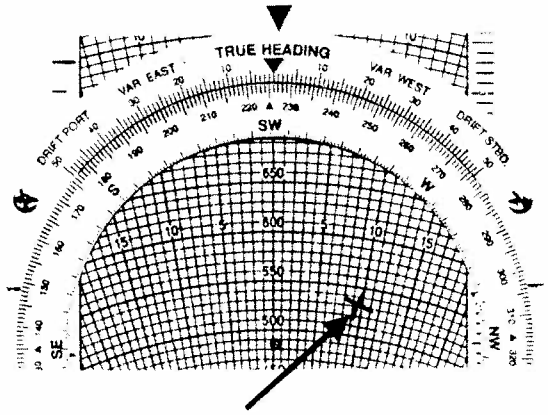
1. Rotate window to set wind direction 110^0 against true heading index mark



2. Set the slide so that 485 TAS is under the centre dot
3. Draw a cross 95 kts below the centre dot to show 95 kt wind

e. Rotate the inner scale to align the heading (226) on the inner scale with the index mark on the outer scale.
f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 226^0 with true heading index mark



2. Read off drift and ground speed against cross on window.

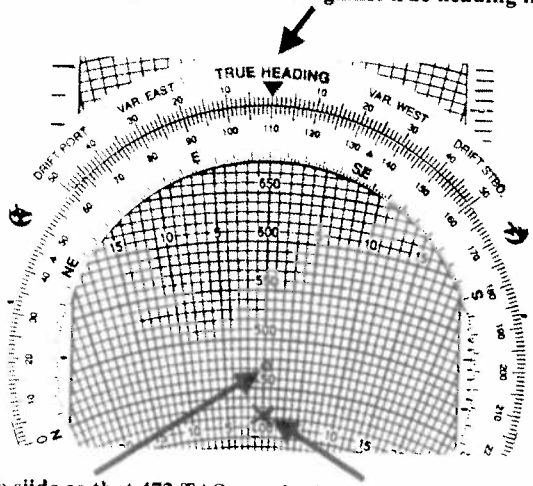
In this case the drift is approximately 9.5^0 right and the ground speed is approximately 533 Kts. This is closest to 9^0 right and 533 Kts (option a).

CRP5 45 b.

To solve this type of problem using the CRP5:

a. Insert the slide so that the high speed side is visible in the window disc on the back of the CRP5.
b. Rotate the inner scale untii the wind direction (110) aligns with the index on the outer scale.
c. Move the slide until the centre dot on the window disc aligns with the TAS (472 Kts).
d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 50 Kts so with the centre dot at 472 Kts the cross for wind speed should be at 422 Kts. This situation is illustrated below.

1. Rotate window to set wind direction 110^0 against true heading index mark

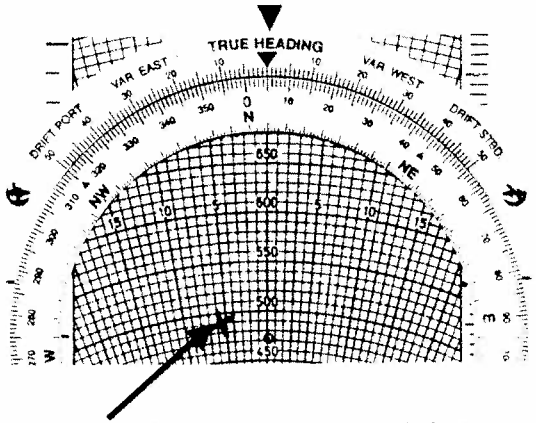


2. Set the slide so that 472 TAS is under the centre dot

3. Draw a cross 50 kts below the centre dot to show 50 kt wind

e. Rotate the inner scale to align the heading (005) on the inner scale with the index mark on the outer scale.
f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 005^0 with true heading index mark



2. Read off drift and ground speed against cross on window.

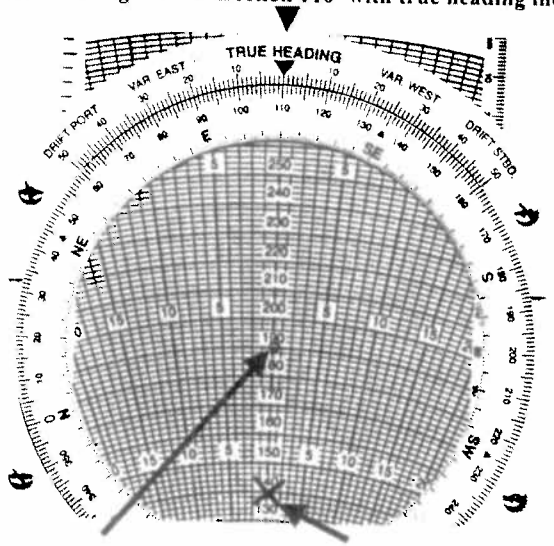
In this case the drift is approximately 5.5^0 left and the ground speed is approximately 490 Kts. This is closest to 6^0 left and 487 Kts (option b).

CRP5 46 a.

To solve this type of problem using the CRP5:

a. Insert the slide so that the low speed side is visible in the window disc on the back of the CRP5.
b. Rotate the inner scale until the wind direction (110) aligns with the index on the outer scale.
c. Move the slide until the centre dot on the window disc aligns with the TAS (190 Kts).
d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 50 Kts so with the centre dot at 190 Kts the cross for wind speed should be at 140 Kts. This situation is illustrated below.

1. Rotate window to align wind direction 110^0 with true heading index mark



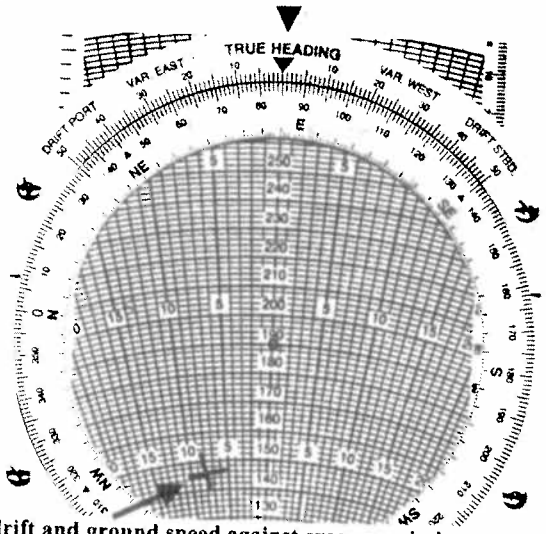
2. Position slide so that air speed 190 kts is under the centre dot

3. Draw a cross 50 kts below centre dot to indicate 50 kts wind speed

e. Rotate the inner scale to align the heading (085) on the inner scale with the index mark on the outer scale.

f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 085^0 with true heading index mark



2. Read off drift and ground speed against cross on window.

In this case the drift is approximateiy 8^0 left and the ground speed is approximately 145 Kts. This is closest to 8^0 left and 146 Kts (option a).

CRP5 47 d.

To solve this type of problem using the CRP5:

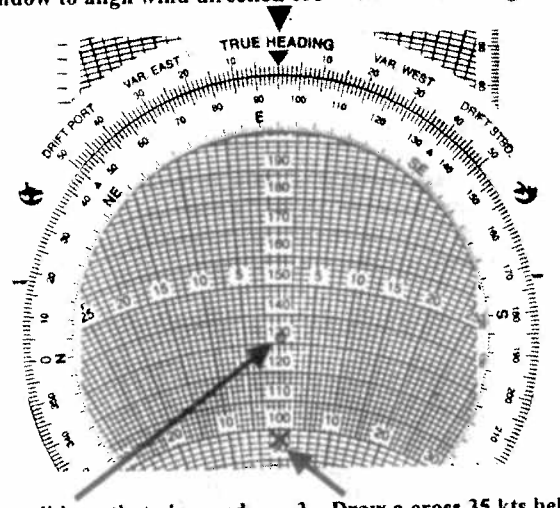
a. Insert the slide so that the low speed side is visible in the window disc on the back of the CRP5.

b. Rotate the inner scale until the wind direction (095) aligns with the index on the outer scale.

c. Move the slide until the centre dot on the window disc aligns with the TAS (132 Kts).

d. Using the scale on the slide as a guide, draw a cross below the centre dot to represent the wind speed. In this case the wind is 35 Kts so with the centre dot at 132 Kts the cross for wind speed should be at 97 Kts. This situation is illustrated below.

1. Rotate window to align wind direction 095^0 with true heading index mark



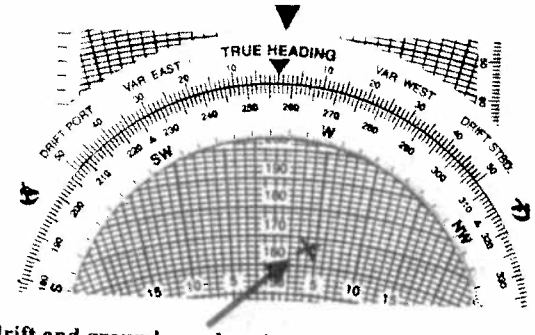
2. Position slide so that air speed 132 kts is under the centre dot

3. Draw a cross 35 kts below centre dot to indicate 35 kts wind speed

e. Rotate the inner scale to align the heading (257) on the inner scale with the index mark on the outer scale.

f. Read off the ground speed using the scale at the location of the cross that was drawn in operation d above. This situation is illustrated below.

1. Rotate window to align aircraft heading 257^0 with true heading index mark



2. Read off drift and ground speed against cross on window.

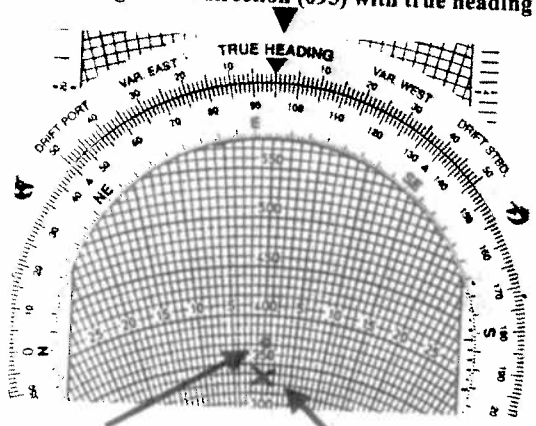
In this case the drift is approximately 4^0 right and the ground speed is approximately 166 Kts. This is closest to 4^0 right and 165 Kts (option d).

CRP5 48 a.

To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (095) aligns with the true heading Index.
b. Using the high speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (35 kts).
c. Move the slide up or down until the TAS (370 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (095) with true heading index mark

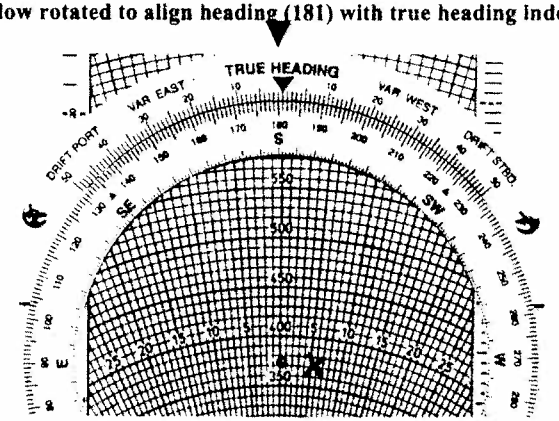


2. Set slide so that TAS (370 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (35 kts)

d. Rotate the window to align the heading direction (181) with the true heading index mark.
e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 6^0 right 370 kts. Adding this to the heading gives a track of 186^0 370 kts (option a). This situation is illustrated below.

1. Window rotated to align heading (181) with true heading index mark



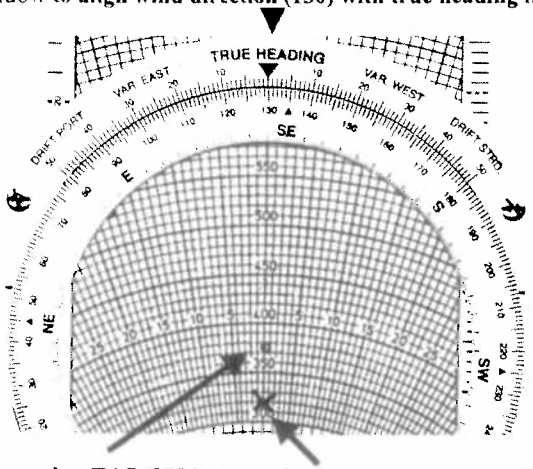
2. Cross indicates 50 right drift and 370 Kts ground speed. Adding 5^0 to heading of 181^0 gives track 186^0 and 370 kts ground speed (option a).

CRP5 49 b.

To solve this type of problem on the CRP5:

c. Rotate the window so that the wind direction (130) aligns with the true heading index.
d. Using the high speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (55 kts).
c. Move the slide up or down until the TAS (375 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (130) with true heading index mark



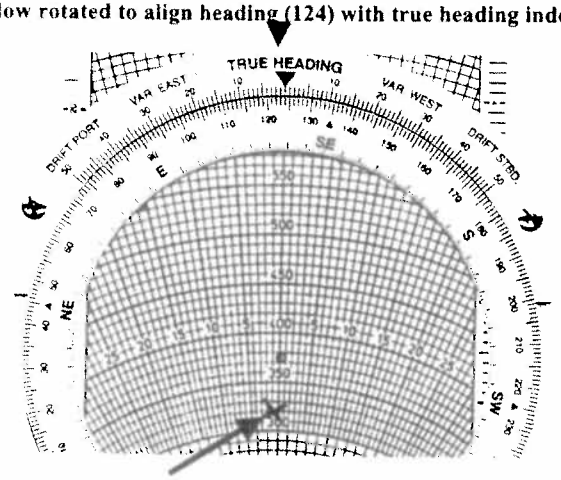
2. Set slide so that TAS (375 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (55 kts)

d. Rotate the window to align the heading direction (124) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 1^0 left 320 kts. Adding this to the heading gives a track of 123^0 320 kts (option b). This situation is illustrated below.

1. Window rotated to align heading (124) with true heading index mark



2. Cross indicates 10 left drift and 320 Kts ground speed. Adding these values to the heading of 124^0 gives track 123^0 and 320 kts ground speed (option b).

CRP5 50 a.

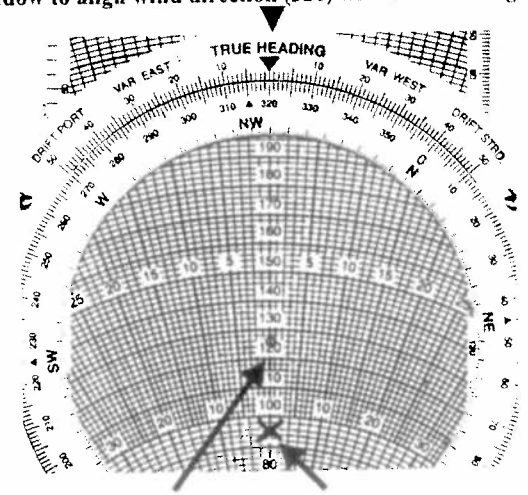
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (320) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (30 kts).

c. Move the slide up or down until the TAS (125 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (320) with true heading index mark



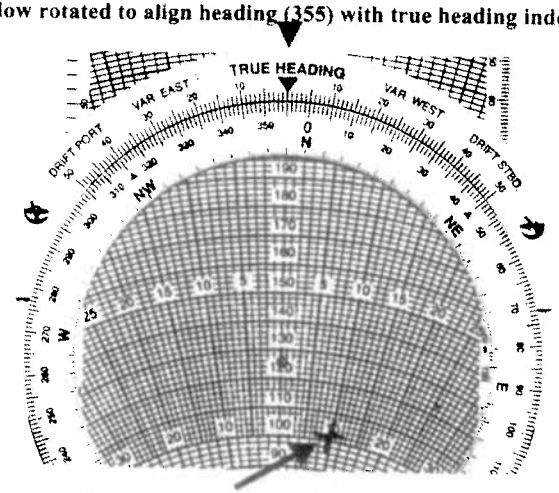
2. Set slide so that TAS (125 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (30 kts)

d. Rotate the window to align the heading direction (355) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 10^0 right 102 kts. Adding this to the heading gives a track of 005^0 102 kts (option a). This situation is illustrated below.

1. Window rotated to align heading (355) with true heading index mark



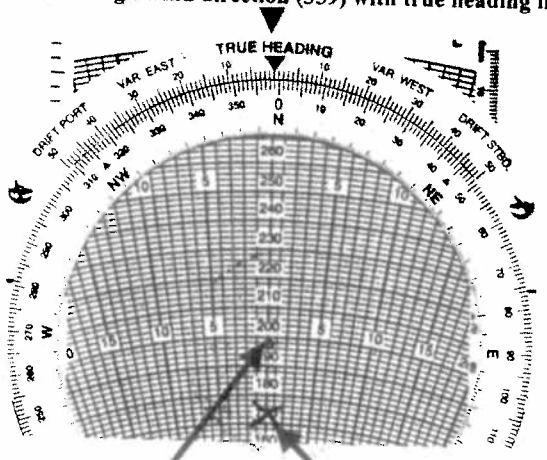
2. Cross indicates 10^0 right drift and 102 Kts ground speed. Adding these values to heading of 355^0 gives track 005^0 and 102 kts ground speed (option a).

CRP5 51 c.

To solve this type of problem on the CRP5:

a. Rotate window so the wind direction (359) aligns with true heading index.
b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (25 kts).
c. Move the slide up or down until the TAS (198 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (359) with true heading index mark

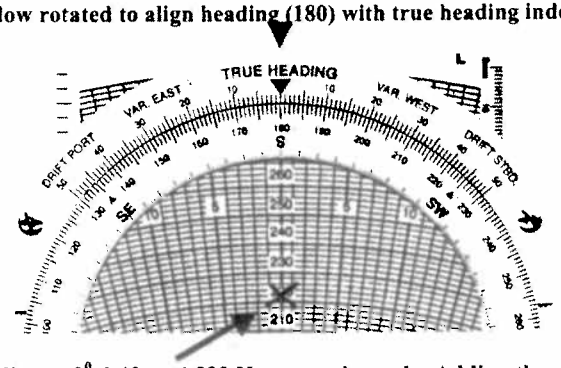


2. Set slide so that TAS (198 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (25 kts)

d. Rotate the window to align the heading direction (180) with the true heading index mark.
e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 0^0 drift 222 kts. So the track is the same as the heading (180) and the groundspeed is approximately 222 Kts. This is closest to 0 drift 223 kts groundspeed (option c). This situation is illustrated below.

1. Window rotated to align heading (180) with true heading index mark



2. Cross indicates 0^0 drift and 222 Kts ground speed. Adding these to heading of 180^0 gives track 180^0 and approximately 222 kts ground speed (option c).

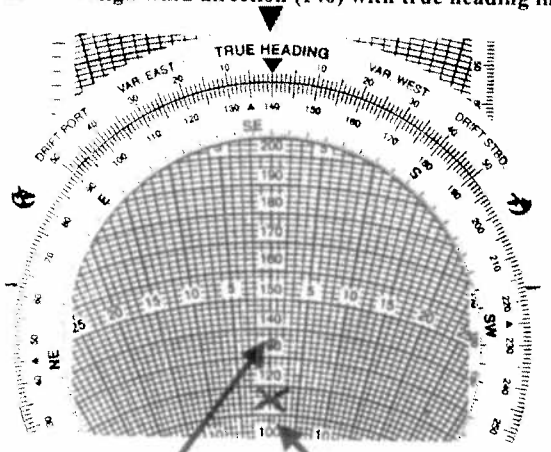
CRP5 52 a.

To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (140) aligns with the true heading index.
b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (20 kts).
c. Move the slide up or down until the TAS (135 kts) aligns with the centre dot. This situation is illustrated below.

IGRUA LIBRARY

1. Rotate window to align wind direction (140) with true heading index mark

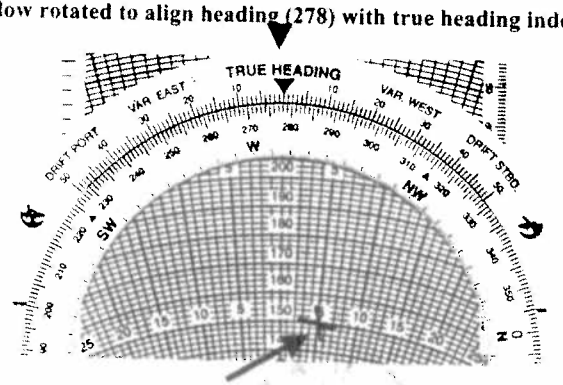


2. Set slide so that TAS (135 kts) aligns with centre dot
3. Draw a cross below the centre dot to represent wind speed (20 kts)

d. Rotate the window to align the heading direction (278) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 5^0 right drift 150 kts. Adding this to the heading gives a track of 283^0 150 kts (option a). This situation is illustrated below.

1. Window rotated to align heading (278) with true heading index mark



2. Cross indicates 5^0 right drift and 150 Kts ground speed.

CRP5 53 c.

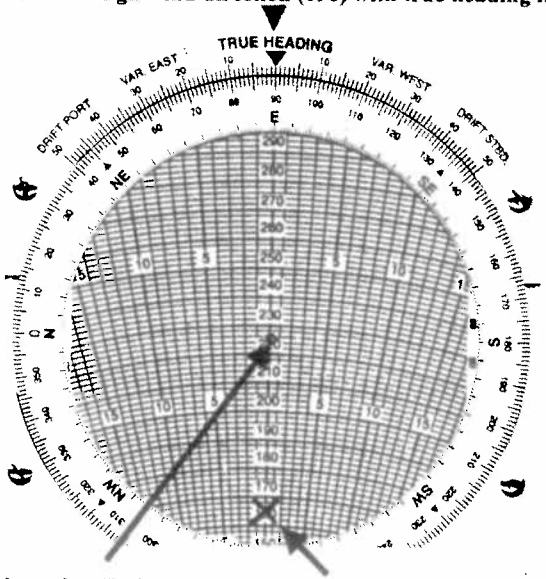
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (090) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (60 kts).

c. Move the slide up or down until the TAS (225 kts) allgns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (090) with true heading index mark

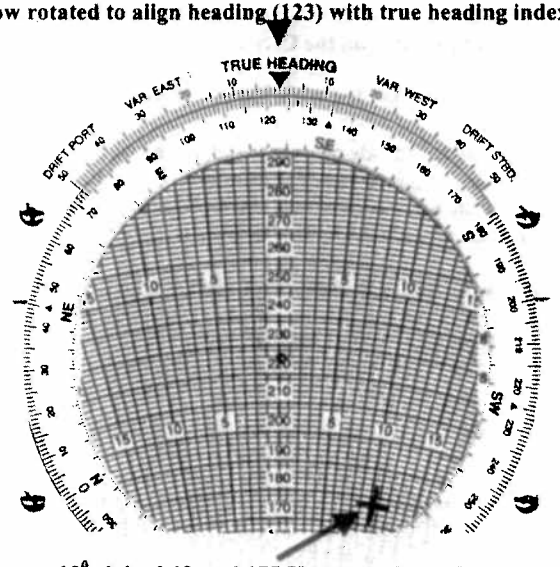


2. Set slide so that TAS (225 kts) aligns with centre dot
3. Draw a cross below the centre dot to represent wind speed (60 kts)

d. Rotate the window to align the heading direction (123) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 10^0 right drift 177 kts. Adding this to the heading gives a track of 133^0 177 kts. This is closest to 134^0 178 kts (option c). This situation is illustrated below.

1. **Window rotated to align heading (123) with true heading index mark**



2. **Cross indicates 10^0 right drift and 177 Kts ground speed.**

<u>CRP5 54 a.</u>

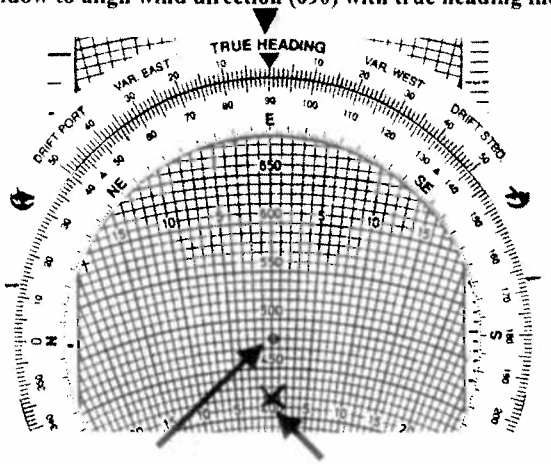
To solve this type of problem on the CRP5:

a. **Rotate the window so that the wind direction (090) aligns with the true heading index.**

b. **Using the high speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (60 kts).**

c. **Move the slide up or down until the TAS (480 kts) aligns with the centre dot. This situation is illustrated below.**

1. **Rotate window to align wind direction (090) with true heading index mark**



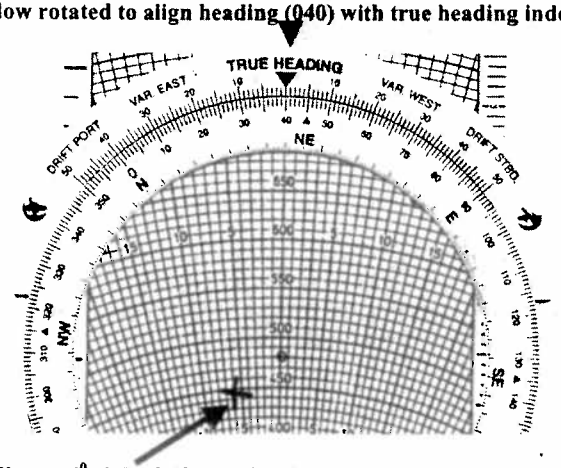
2. **Set slide so that TAS (480 kts) aligns with centre dot**

3. **Draw a cross below the centre dot to represent wind speed (60 kts)**

d. **Rotate the window to align the heading direction (040) with the true heading index mark.**

e. **Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 6^0 left drift 445 kts. Adding this to the heading gives a track of 034^0 445 kts (option a). This situation is illustrated below.**

1. **Window rotated to align heading (040) with true heading index mark**



2. **Cross indicates 6^0 right drift and 445 Kts ground speed.**

CRP5 55 a.

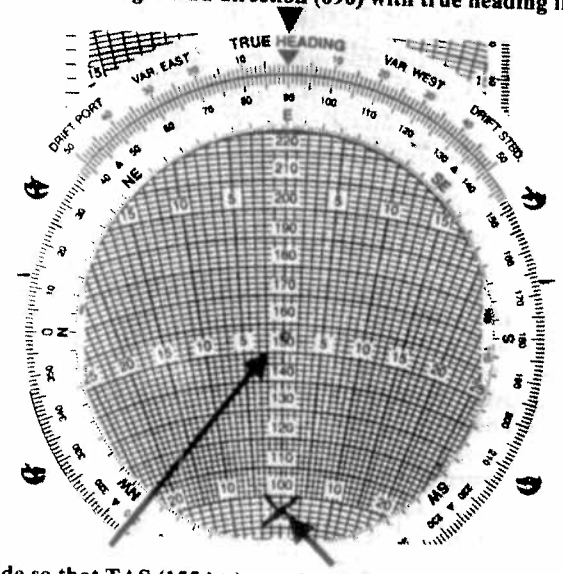
To solve this type of problem on the CRP5:

a. **Rotate the window so that the wind direction (090) aligns with the true heading index.**

b. **Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (60 kts).**

c. **Move the slide up or down until the TAS (155 kts) aligns with the centre dot. This situation is illustrated below.**

1. **Rotate window to align wind direction (090) with true heading index mark**



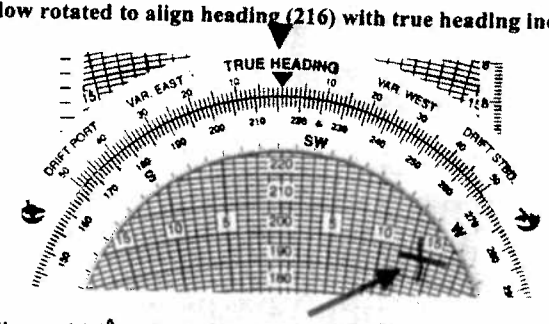
2. **Set slide so that TAS (155 kts) aligns with centre dot**

3. **Draw a cross below the centre dot to represent wind speed (60 kts)**

d. **Rotate the window to align the heading direction (216) with the true heading index mark.**

e. **Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 14.5° right drift 197 kts. Adding this to the heading gives a track of 230.5° 197 kts. This is closest to 231° 196 kts (option a). This situation is illustrated below.**

1. **Window rotated to align heading (216) with true heading index mark**



2. **Cross indicates 14.5° right drift and 197 Kts ground speed.**

CRP5 56 b.

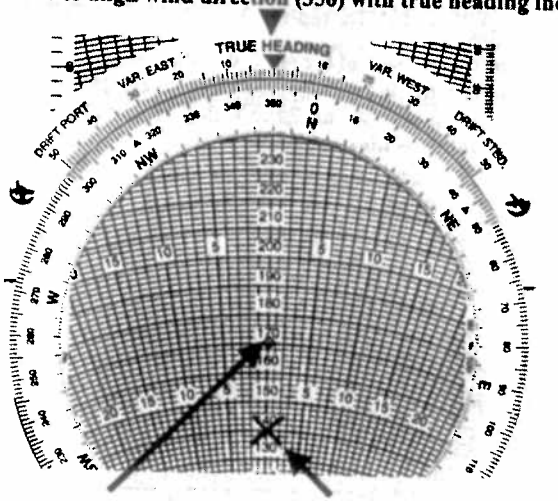
To solve this type of problem on the CRP5:

a. **Rotate the window so that the wind direction (350) aligns with the true heading index.**

b. **Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (30 kts).**

c. **Move the slide up or down until the TAS (170 kts) aligns with the centre dot. This situation is illustrated below.**

1. **Rotate window to align wind direction (350) with true heading index mark**



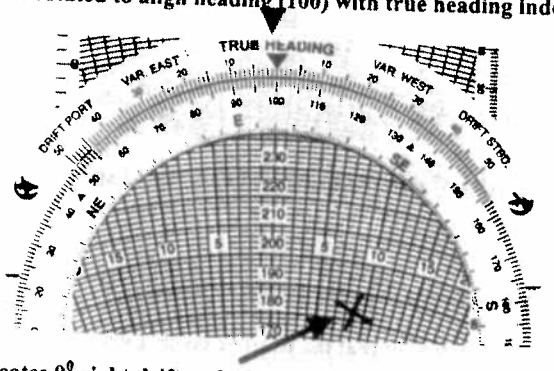
2. **Set slide so that TAS (170 kts) aligns with centre dot**

3. **Draw a cross below the centre dot to represent wind speed (30 kts)**

d. **Rotate the window to align the heading direction (100) with the true heading index mark.**

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 9^0 right drift 183 kts. Adding this to the heading gives a track of 109^0 183 kts. This is closest to 109^0 182 kts (option b). This situation is illustrated below.

1. Window rotated to align heading (100) with true heading index mark



2. Cross indicates 9^0 right drift and 183 Kts ground speed.

<u>CRP5 57 b.</u>

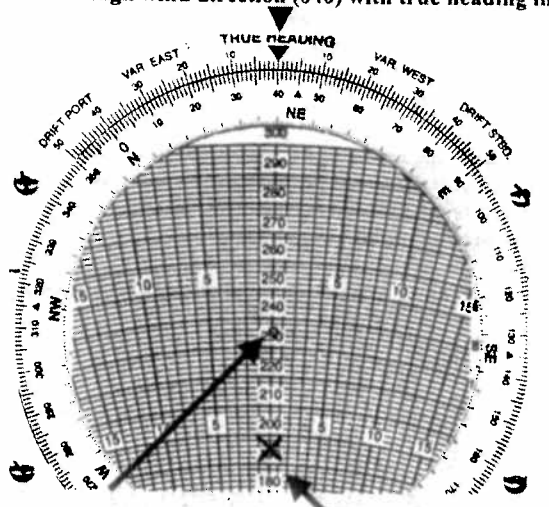
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (040) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (40 kts).

c. Move the slide up or down until the TAS (235 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (040) with true heading index mark



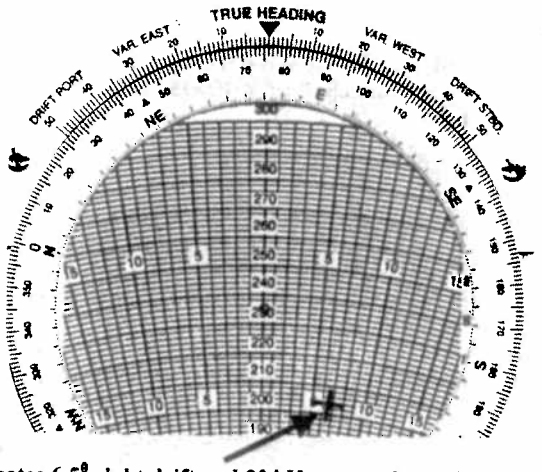
2. Set slide so that TAS (235 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (40 kts)

d. Rotate the window to align the heading direction (076) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 6.5^0 right drift 204 kts. This is closest to 7^0 right 204kts (option b). This situation is illustrated below.

1. Window rotated to align heading (076) with true heading index mark



2. Cross indicates 6.5^0 right drift and 204 Kts ground speed.

CRP5 58 a.

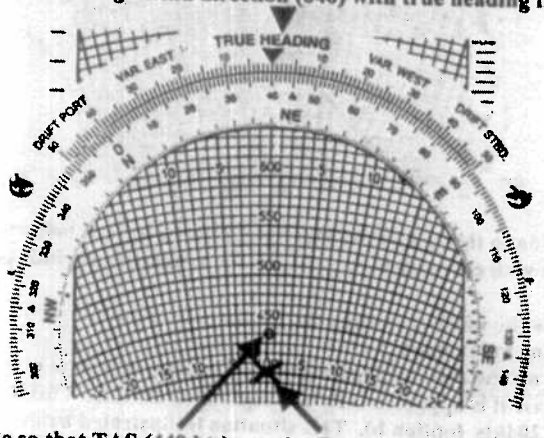
To solve this type of problem on the CRP5:

a. **Rotate the window so that the wind direction (040) aligns with the true heading index.**

b. **Using the high speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (40 kts).**

c. **Move the slide up or down until the TAS (440 kts) aligns with the centre dot. This situation is illustrated below.**

1. **Rotate window to align wind direction (040) with true heading index mark**



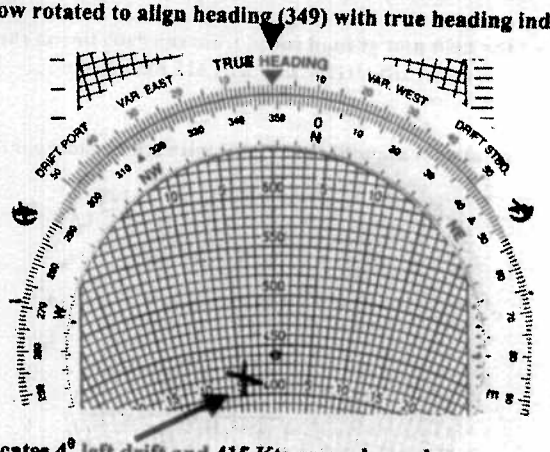
2. **Set slide so that TAS (440 kts) aligns with centre dot**

3. **Draw a cross below the centre dot to represent wind speed (40 kts)**

d. **Rotate the window to align the heading direction (349) with the true heading index mark.**

e. **Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 4° left drift 415 kts (option a). This situation is illustrated below.**

1. **Window rotated to align heading (349) with true heading index mark**



2. **Cross indicates 4° left drift and 415 Kts ground speed.**

CRP5 59 c.

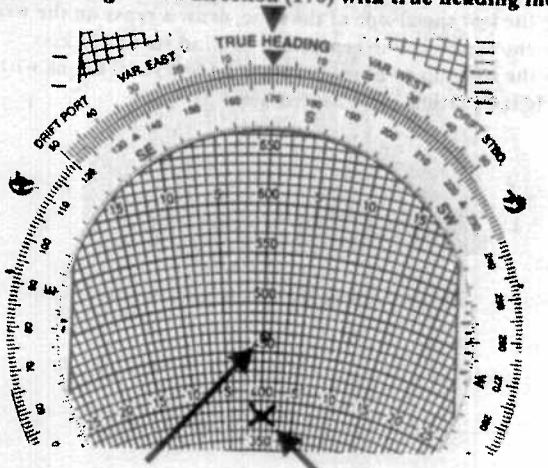
To solve this type of problem on the CRP5:

a. **Rotate the window so that the wind direction (170) aligns with the true heading index.**

b. **Using the high speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (80 kts).**

c. **Move the slide up or down until the TAS (465 kts) aligns with the centre dot. This situation is illustrated below.**

1. **Rotate window to align wind direction (170) with true heading index mark**



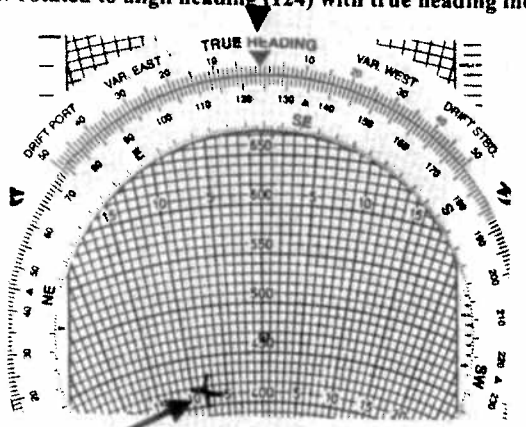
2. **Set slide so that TAS (465 kts) aligns with centre dot**

3. **Draw a cross below the centre dot to represent wind speed (80 kts)**

d. Rotate the window to align the heading direction (124) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 8^0 left drift 415 kts (option c). This situation is illustrated below.

1. Window rotated to align heading (124) with true heading index mark



2. Cross indicates 8^0 left drift and 415 Kts ground speed.

CRP5 60 d.

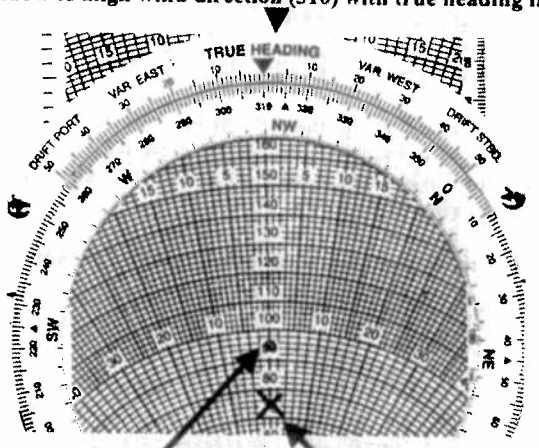
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (310) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (20 kts).

c. Move the slide up or down until the TAS (95 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (310) with true heading index mark



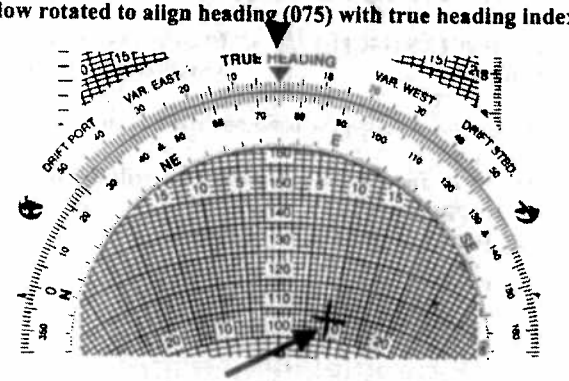
2. Set slide so that TAS (95 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (20 kts)

d. Rotate the window to align the heading direction (075) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 9^0 right drift 107 kts. This is closest to 9^0R 108 Kts (option d). This situation is illustrated below.

1. Window rotated to align heading (075) with true heading index mark



2. Cross indicates 9^0 right drift and 107 Kts ground speed.

CRP5 61 b.

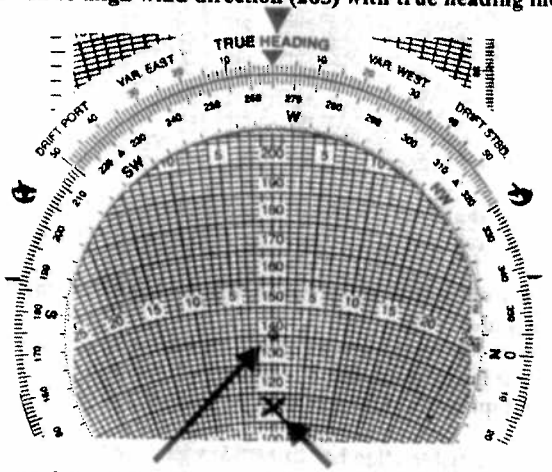
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (265) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (25 kts).

c. Move the slide up or down until the TAS (140 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (265) with true heading index mark



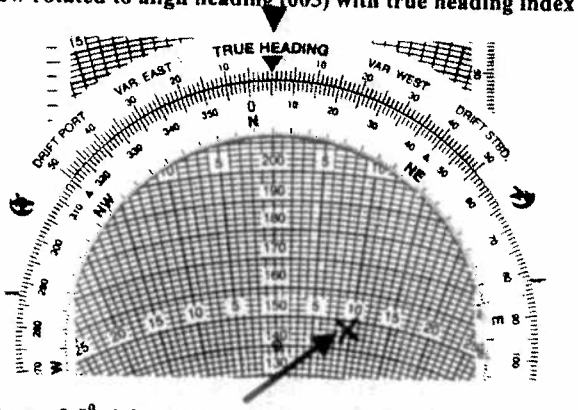
2. Set slide so that TAS (140 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (25 kts)

d. Rotate the window to align the heading direction (005) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 9.5^0 right drift 147 kts. This is closest to 10^0R 146 Kts (option b). This situation is illustrated below.

1. Window rotated to align heading (005) with true heading index mark



2. Cross indicates 9.5^0 right drift and 147 Kts ground speed.

CRP5 62 b.

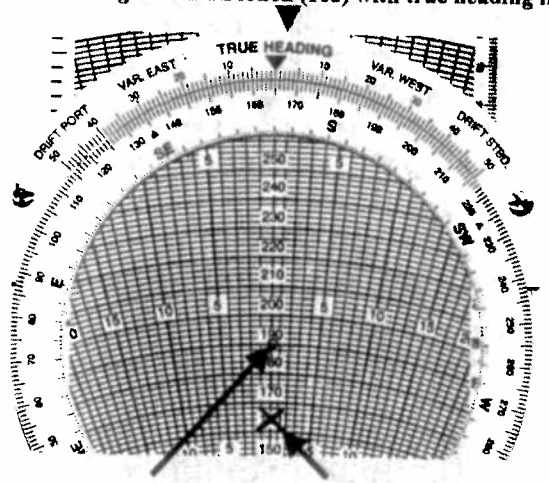
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (165) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (25 kts).

c. Move the slide up or down until the TAS (190 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (165) with true heading index mark



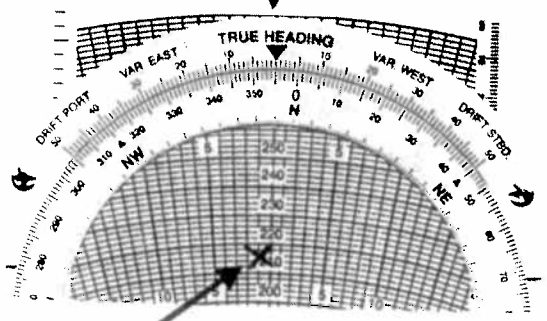
2. Set slide so that TAS (190 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (25 kts)

d. **Rotate the window to align the heading direction (355) with the true heading index mark.**

e. **Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 1^0 left drift 215 kts (option b). This situation is illustrated below.**

1. **Window rotated to align heading (355) with true heading index mark**



2. **Cross indicates 1^0 left drift and 215 Kts ground speed.**

CRP5 63 d.

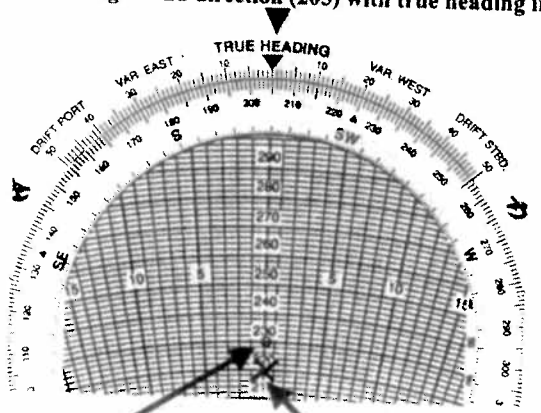
To solve this type of problem on the CRP5:

a. **Rotate the window so that the wind direction (205) aligns with the true heading index.**

b. **Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (10 kts).**

c. **Move the slide up or down until the TAS (230 kts) aligns with the centre dot. This situation is illustrated below.**

1. **Rotate window to align wind direction (205) with true heading index mark**



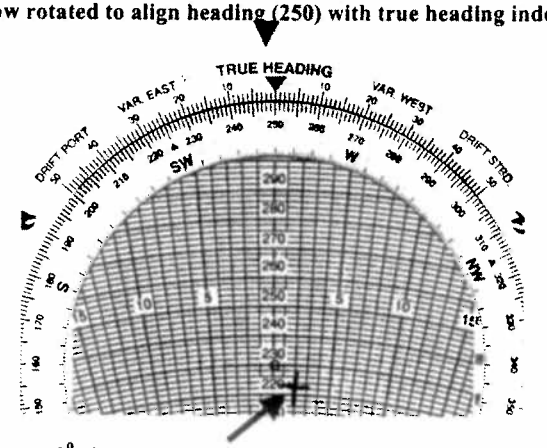
2. **Set slide so that TAS (230 kts) aligns with centre dot**

3. **Draw a cross below the centre dot to represent wind speed (10 kts)**

d. **Rotate the window to align the heading direction (250) with the true heading index mark.**

e. **Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 2^0 right drift 223 kts (option d). This situation is illustrated below.**

1. **Window rotated to align heading (250) with true heading index mark**



2. **Cross indicates 2^0 right drift and 223 Kts ground speed.**

CRP5 64 b.

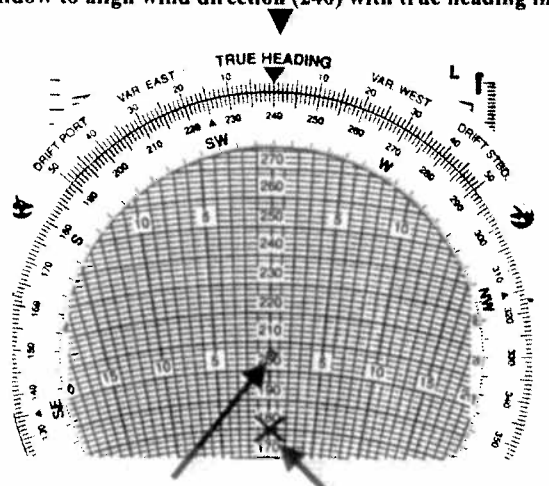
To solve this type of problem on the CRP5:

a. **Rotate the window so that the wind direction (240) aligns with the true heading index.**

b. **Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (25 kts).**

c. **Move the slide up or down until the TAS (205 kts) aligns with the centre dot. This situation is illustrated below.**

1. Rotate window to align wind direction (240) with true heading index mark



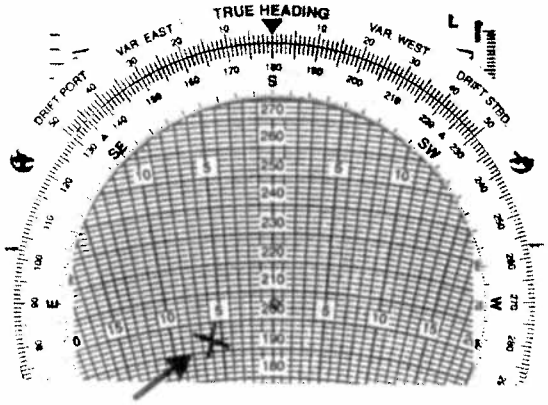
2. Set slide so that TAS (205 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (25 kts)

d. Rotate the window to align the heading direction (180) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 6^0 left drift 194 kts (option b). This situation is illustrated below.

1. Window rotated to align heading (180) with true heading index mark



2. Cross indicates 6^0 left drift and 194 Kts ground speed.

CRP5 65 a.

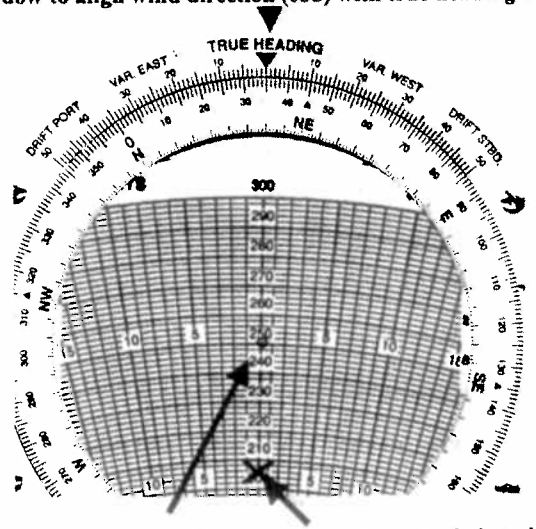
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (035) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (45 kts).

c. Move the slide up or down until the TAS (250 kts) allgns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (035) with true heading index mark



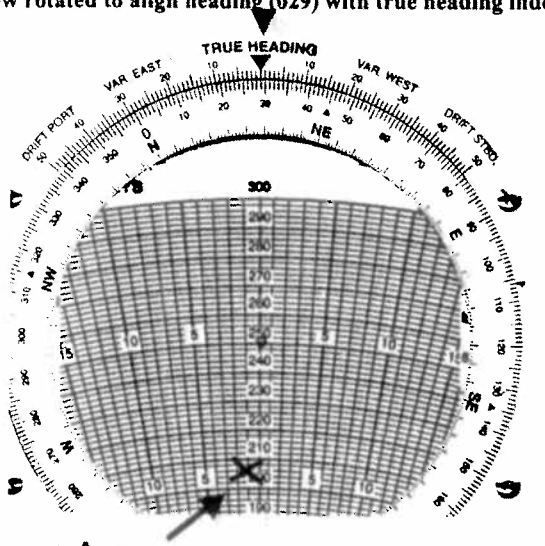
2. Set slide so that TAS (250 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (45 kts)

d. Rotate the window to align the heading direction (029) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 1.3^0 left drift 206 kts. This is closest to 10 left drift 205 Kts (option a). This situation is illustrated below.

1. Window rotated to align heading (029) with true heading index mark



2. Cross indicates 1.3^0 left drift and 206 Kts ground speed.

CRP5 66 c.

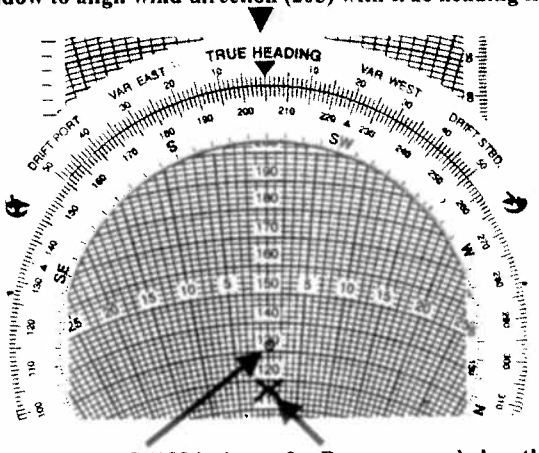
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (205) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (15 kts).

c. Move the slide up or down until the TAS (132 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (205) with true heading index mark



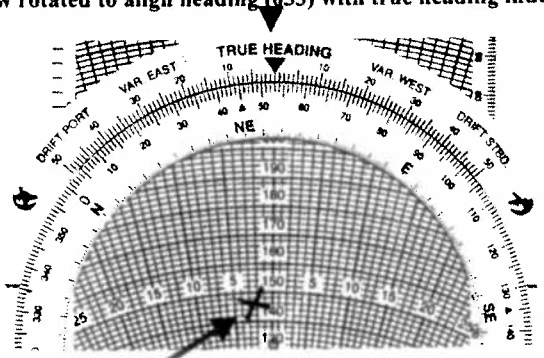
2. Set slide so that TAS (132 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (15 kts)

d. Rotate the window to align the heading direction (053) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 2.5^0 left drift 146 kts. Adding this to the heading gives a track of 050.5^0 146 kts. This is closest to 050 145 kts (option c). This situation is illustrated below.

1. Window rotated to align heading (053) with true heading index mark



2. Cross indicates 2.5^0 left drift and 146 Kts ground speed.

CRP5 67 b,

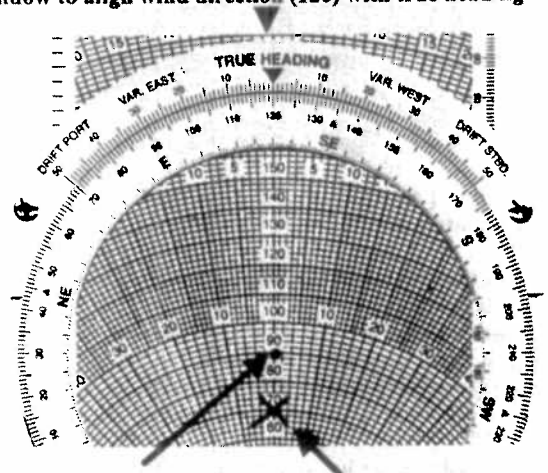
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (120) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (20 kts).

c. Move the slide up or down until the TAS (90 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (120) with true heading index mark



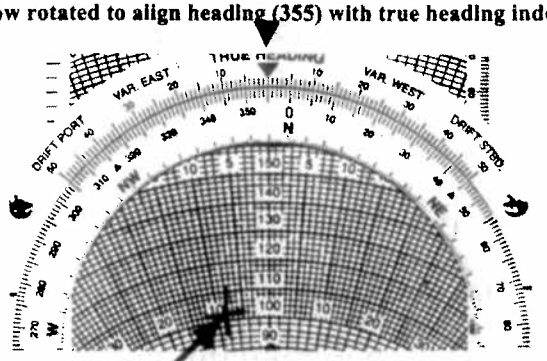
2. Set slide so that TAS (90 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (20 kts)

d. Rotate the window to align the heading direction (355) with the true heading index mark.

e. Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 8^0 left drift 102 kts. Adding this to the heading gives a track of 347^0 102 kts. This is closest to 346 102 kts (option b). This situation is illustrated below.

Window rotated to align heading (355) with true heading index mark



2. Cross indicates 8^0 left drift and 102 Kts ground speed.

CRP5 68 a.

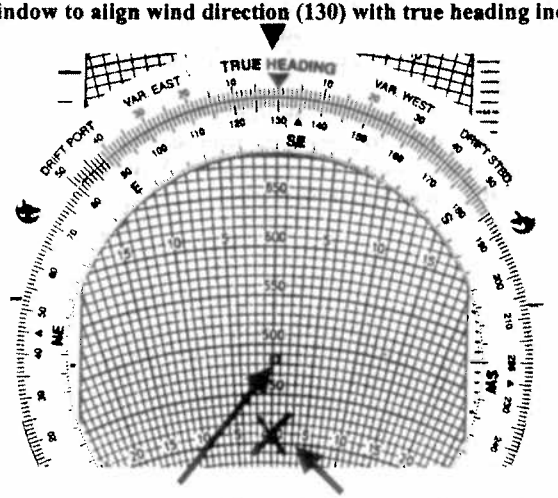
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (130) aligns with the true heading index.

b. Using the high speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (75 kts).

c. Move the slide up or down until the TAS (485 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (130) with true heading index mark



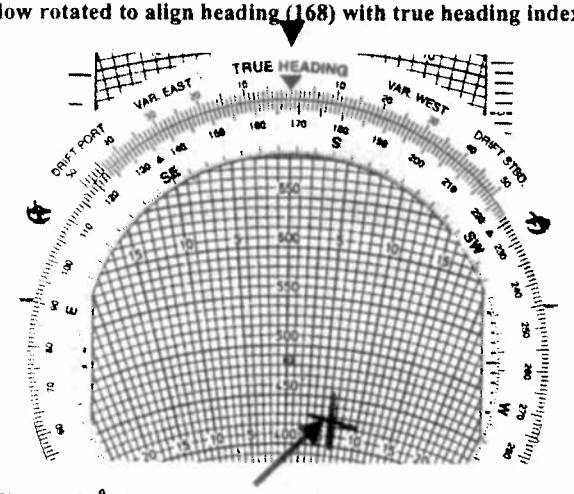
2. Set slide so that TAS (485 kts) aligns with centre dot

3. Draw a cross below the centre dot to represent wind speed (75 kts)

d. Rotate the window to align the heading direction (168) with the true heading index mark.

e. **Read off the drift and ground speed from the drift line at the cross. In this case it is approximately 6.5^0 right drift 425 kts. Adding this to the heading gives a track of 174.5^0 425 kts. This is closest to 174 428 kts (option a). This situation is illustrated below.**

1. **Window rotated to align heading (168) with true heading index mark**



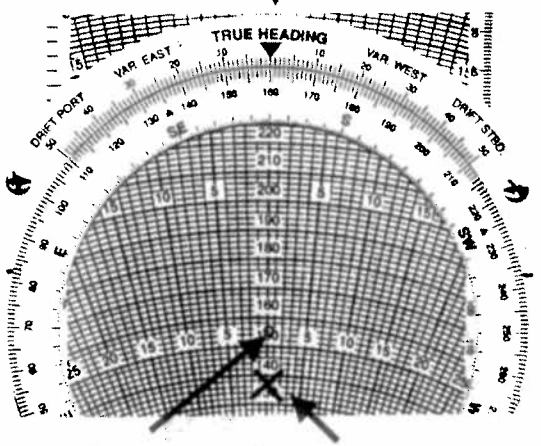
2. **Cross indicates 6.5^0 right drift and 425 Kts ground speed.**

<u>CRP5 69 b.</u>

To solve this type of problem on the CRP5:

a. **Rotate the window so that the wind direction (160) aligns with the true heading index.**
b. **Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (18 kts).**
c. **Move the slide up or down until the TAS (155 kts) aligns with the centre dot. This situation is illustrated below.**

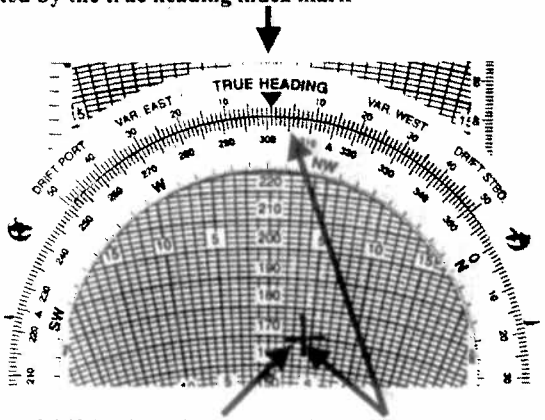
1. **Rotate window to align wind direction (160) with true heading index mark**



2. **Set centre dot to align with 155 TAS**
3. **Draw a cross below the centre dot to represent 18 kts wind speed**

d. **Rotate window to align track (305) with true heading index mark.**
e. **Read off the drift at the cross. In this case it is 4^0 right drift.**
f. **Rotate the window to allgn the track (305) with the drift (4 right) on the outer scale. Recheck the drift indicated by the cross. In this case it is still approximately 4^0 right. The drift indicated by the cross is the same as that on the outer scale so the drift is said to be balanced.**
g. **Read off the heading to steer on the window disc opposite the true heading index mark and the ground indicated by the cross. In this case it is 301^0 169 kts (option b). This situation is illustrated below.**

1. **Required heading to steer on the window disc (301°)is indicated by the true heading index mark**



2. **Ground speed 169 kts is indicated by the cross**

3. **Drift indicated by cross (4 right) is the same s that indicated by the required track (305) on the window aligned with (4 right) on then outer scale.**

CRP5 70 a.

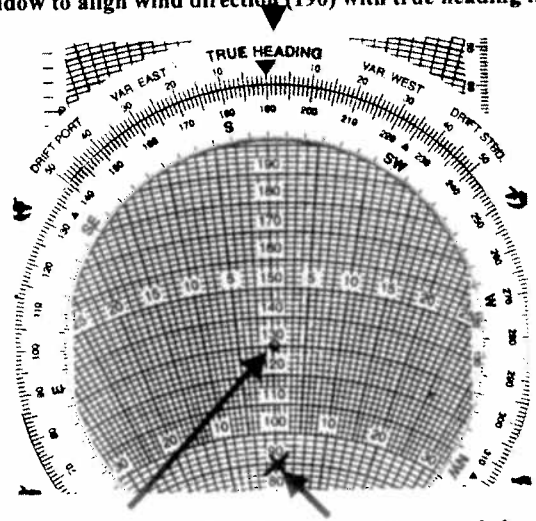
To solve this type of problem on the CRP5:

a. **Rotate the window so that the wind direction (190) aligns with the true heading index.**

b. **Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (40 kts).**

c. **Move the slide up or down until the TAS (130 kts) aligns with the centre dot. This situation is illustrated below.**

1. **Rotate window to align wind direction (190) with true heading index mark**



2. **Set centre dot to align with 130 TAS**

3. **Draw a cross below the centre dot to represent 40 kts wind speed**

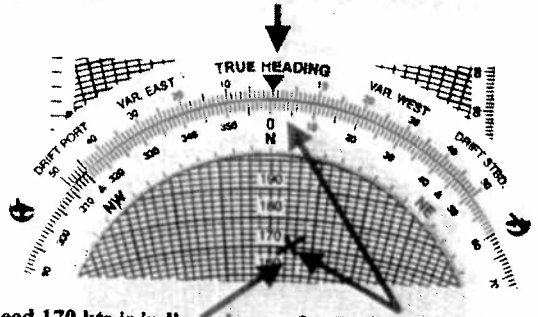
d. **Rotate window to align track (003) with true heading index mark.**

e. **Read off the drift at the cross. In this case it is 2° right drift.**

f. **Rotate the window to align the track (003) with the drift (2 right) on the outer scale. Recheck the drift indicated by the cross. In this case it is approximately 2.5° right. Rotate the window to align the track (003) with 2.5 right drift, and again check the drift indicated by the cross. The drift indicated by the cross and that indicated where track 003 aligns with the outer scale are both is 2.5 right. The drift is now said to be balanced.**

g. **Read off the heading to steer on the window disc opposite the true heading index mark and the ground indicated by the cross. In this case it is 000.5° 170 kts. This is closest to 001° 170 kts (option a). This situation is illustrated below.**

1. Required heading to steer on the window disc (000.5°)is indicated by the true heading index mark



2. Ground speed 170 kts is indicated by the cross

3. Drift indicated by cross (2.5 right) is the same s that indicated by the required track (003) on the window aligned with (2.5 right) on then outer scale.

CRP5 71 c.

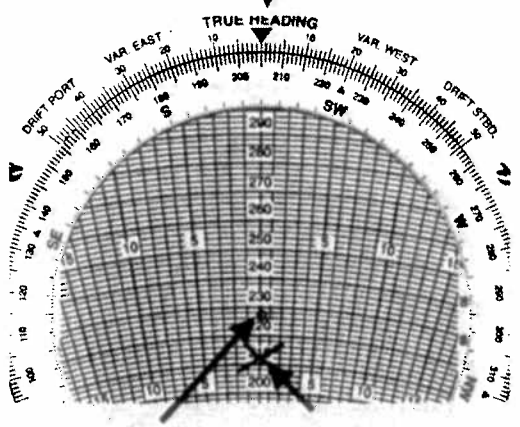
To solve this type of problem on the CRP5:

a. Rotate the window so that the wind direction (205) aligns with the true heading index.

b. Using the low speed side of the slide, draw a cross on the window directly below the centre dot to represent the wind speed (15 kts).

c. Move the slide up or down until the TAS (227 kts) aligns with the centre dot. This situation is illustrated below.

1. Rotate window to align wind direction (205) with true heading index mark



2. Set centre dot to align with 227 TAS

3. Draw a cross below the centre dot to represent 15 kts wind speed

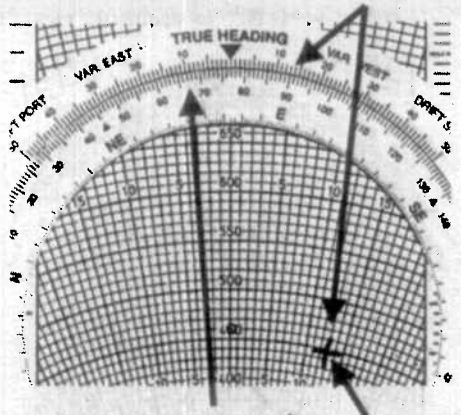
d. Rotate window to align track (316) with true heading index mark.

e. Read off the drift at the cross. In this case it is 3.5° right drift.

f. Rotate the window to align the track (316) with the drift 3.5 right on the outer scale. Recheck the drift indicated by the cross. In this case it is still approximately 3.5° right. The drift indicated by the cross and that indicated where track 316 aligns with the outer scale are both is 3.5 right. The drift is now said to be balanced.

g. Read off the heading to steer on the window disc opposite the true heading index mark and the ground indicated by the cross. In this case it is 312.5° 231 kts. This is closest to 312° 232 kts (option c). This situation is illustrated below.

1. Drift balanced with both 090° and cross aligned with about 13° drift.



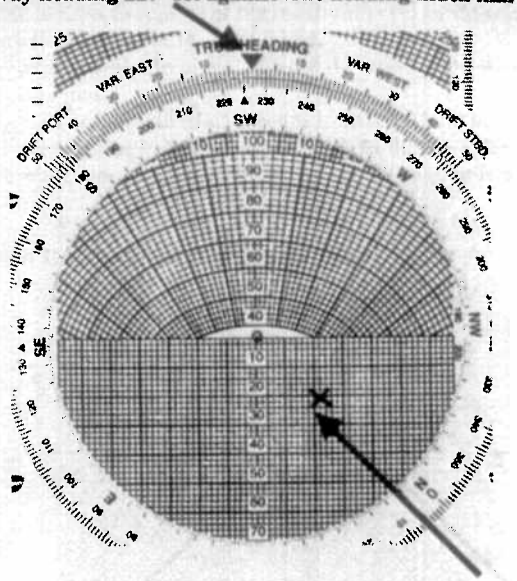
2. 10° E variation aligned with 067°.
3. Adding 20 deviation gives 0690.
4. Cross indicates 449 kts ground speed.

CRP5 87 b.

To solve this type of problem using the CRP5:

a. Wind directions provided by ATIS and runway directions are both given in terms of magnetic headings. The variation can therefore be ignored in this question.
b. Set the low speed slide so that the centre dot is at the top of the square grid at the base of the slide.
c. Set wind direction 180° against the true heading index mark.
d. Draw a cross 30 kts below the centre dot to represent the wind.
e. Align the runway heading 227° with the true heading index mark.
f. Read off 22 kts (option a) crosswind component by measuring the horizontal distance from the centre line of the grid to the cross. These settings are illustrated below.

1. Runway heading 227° set against true heading index mark.



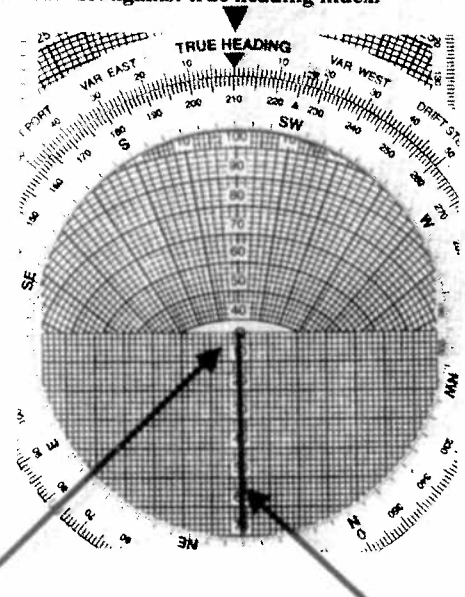
2. Horizontal distance from centre line to cross indicates 22 kt crosswind.

CRP5 88 d.

To solve this type of problem using the CRP5:

a. Both the wind direction given by ATIS and the runway direction are specified as magnetic bearings, so the variation can be ignored.
b. Using the low speed side of the slide set the centre dot at the top edge of the square gridded area at the base of the slide.
c. Rotate the window to align the wind direction 210° with the true heading index mark.
d. Draw a vertical line down the centre from the centre dot to the bottom of the window. This situation is illustrated below.

1. Wind direction 210^0 set against true heading index.



2. Centre dot at top of square grid. 3. Straight line drawn below dot

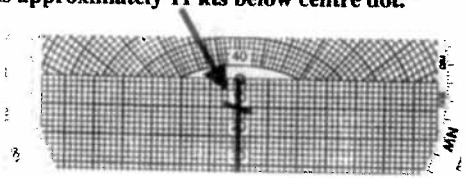
e. Rotate window to align runway direction 047^0 with true heading index mark.

f. Moving the slide upwards, align the centre dot with the 40 kts arc. Draw a cross at the point where the previously drawn straight line. Move the slide back down to its original position with the centre dot at the top of the square gridded area.

g. Rotate the window to position the cross on the centre line directly below the centre dot.

h. Measure the distance down from the centre dot to the cross. This is approximately 11 kts (option d). this situation is illustrated below.

1. Cross is approximately 11 kts below centre dot.



CRP5 89 a.

To solve this type of problem using the CRP5:

a. Set the low speed side of the slide so that the top line of the squared section aligns with the centre dot in the window.

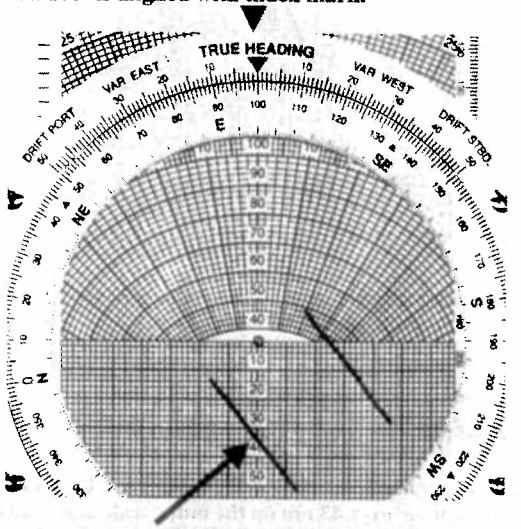
b. Rotate the window to align the runway direction (063).

c. Draw vertical lines to represent the maximum crosswind component 20 kts to the left and right of the centre line.

d. Rotate the window disc to align the wind direction (100) with the true heading index mark.

e. The maximum acceptable wind speed is indicted where one of these lines crosses the centre line below the centre dot. In this case the maximum allowable wind speed is 33 kts (option a). This situation is illustrated below.

1. Wind direction 100^0 is aligned with index mark.



2. Maximum acceptable wind speed (33 kts) is indicated where one of the lines crosses the centre line below the centre dot.

CRP5 90 d.

To solve this type of problem using the CRP5:

a. Using the high speed slide set 450 kts TAS at the centre dot.

b. Set wind direction 200^0 against the true heading index mark.

c. Draw a cross on the centre line 60 kts below the centre dot.

d. Align course 250^0 with true heading index mark.

e. The cross now indicates 6.5^0 right drift.

f. Align course 250^0 with 6.5^0 right drift and read off 6.0^0 right drift at the cross.

g. Set course 250^0 at 6.0^0 right drift and again read of drift at the cross.

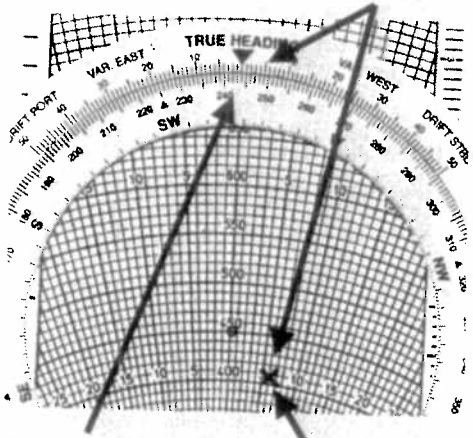
h. Repeating this process will eventually give approximately 6.0^0 drift both on the outer scale and at the cross. The drift is now said to be balanced.

i. Read off the heading 244^0 opposite the true heading index mark.

j. Read off the ground speed 407 kts at the cross.

k. Flight time = distance (315 nm) divided by ground speed (407 kts) = 46.4 min. ETA at B = ETD at A (0650) + 46.4 min = 0736.4, or approximately 0736 (option d). The above settings are illustrated below.

1. Drift balanced with both 250^0 and cross aligned with about 6^0 drift.



2. True heading index aligned with 244^0.

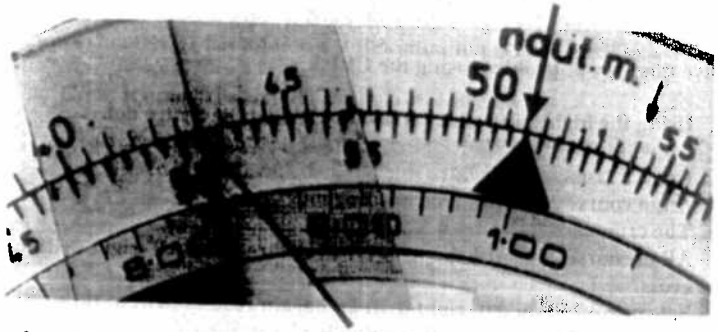
3. Cross indicates 407 kts ground speed.

CRP5 91 a.

To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 510 kts on the outer scale.
b. Position the cursor over 43 nm on the outer scale and read off 5.5 min where cursor crosses the inner scale. This is closest to 5 min (option a).
c. These settings are illustrated below.

1. 60 min index aligned with 510 kts.



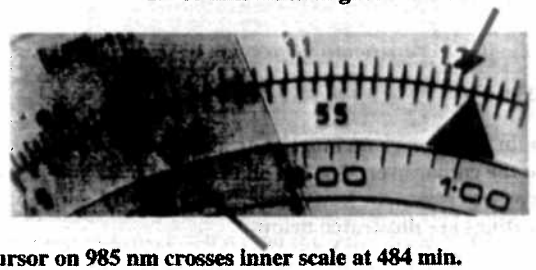
2. Cursor on 43 nm crosses inner scale at 5.5 min.

CRP5 92 b.

To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 122 kts on the outer scale.
b. Position the cursor over 985 nm on the outer scale and read off 484 min where cursor crosses the inner scale. This 8 hr 04 min (option b).
c. These settings are illustrated below.

1. 60 min index aligned with 122 kts.



2. Cursor on 985 nm crosses inner scale at 484 min.

CRP5 93 d.

To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 236 kts on the outer scale.
b. Position the cursor over 354 nm on the outer scale and read off 90 min where cursor crosses the inner scale. This 1 hr 30 min (option d).
c. These settings are illustrated below.

1. 60 min index aligned with 236 kts.

2. Cursor on 354 nm crosses inner scale at 90 min.

CRP5 94 d.

To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 435 kts on the outer scale.
b. Position the cursor over 1920 nm on the outer scale and read off 265 min where cursor crosses the inner scale. This 4 hr 25 min (option d).
c. These settings are illustrated below.

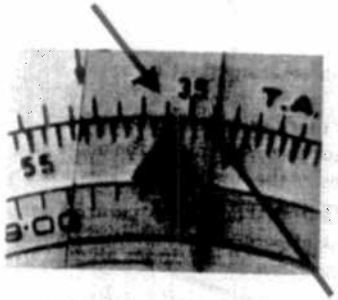
1. 60 min index aligned with 435 kts.

2. Cursor on 1920 nm crosses inner scale at 265 min.

CRP5 95 d.
To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 345 kts on the outer scale.
b. Position the cursor over 3560 nm on the outer scale and read off 619 min where cursor crosses the inner scale. This 10 hr 19 min (option d).
c. These settings are illustrated below.

1. 60 min index aligned with 345 kts.

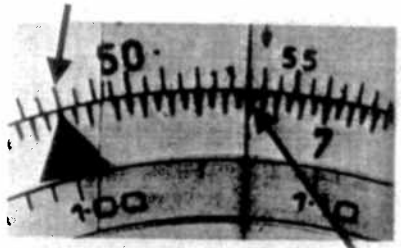


2. Cursor on 3560 nm crosses inner scale at 619 min.

CRP5 96 a.
To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 480 kts on the outer scale.
b. Position the cursor over 5360 nm on the outer scale and read off 670 min where cursor crosses the inner scale. This 11 hr 10 min (option a).
c. These settings are illustrated below.

1. 60 min index aligned with 480 kts.



2. Cursor on 5360 nm crosses inner scale at 670 min.

CRP5 97 c.
To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 95 kts on the outer scale.
b. Position the cursor over 480 nm on the outer scale and read off 303 min where cursor crosses the inner scale. This 5 hr 03 min (option c).
c. These settings are illustrated below.

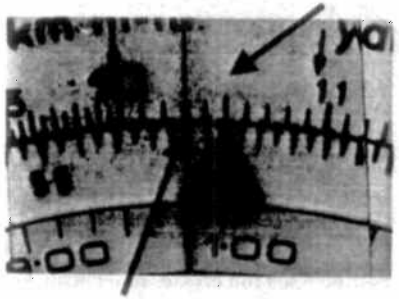
1. 60 min index aligned with 95 kts.

2. Cursor on 480 nm crosses inner scale at 303 min.

CRP5 98 a.
To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 105 kts on the outer scale.
b. Position the cursor over 103 nm on the outer scale and read off 59 min where cursor crosses the inner scale. This 00 hr 59 min (option a).
c. These settings are illustrated below.

1. 60 min index aligned with 105 kts.



2. Cursor on 103 nm crosses inner scale at 59 min.

CRP5 99 d.

To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 120 kts on the outer scale.
b. Position the cursor over 84 nm on the outer scale and read off 42 min where cursor crosses the inner scale. This 00 hr 42 min (option d).

CRP5 100 b.

To solve this type of problem using the CRP5:

a. Set 60 min index mark on inner scale against 135 kts on the outer scale.
b. Position the cursor over 433 nm on the outer scale and read off 192 min where cursor crosses the inner scale. This 3 hr 12 min (option b).
c. These settings are illustrated below.

1. 60 min index aligned with 135 kts.

2. Cursor on 433 nm crosses inner scale at 192 min.

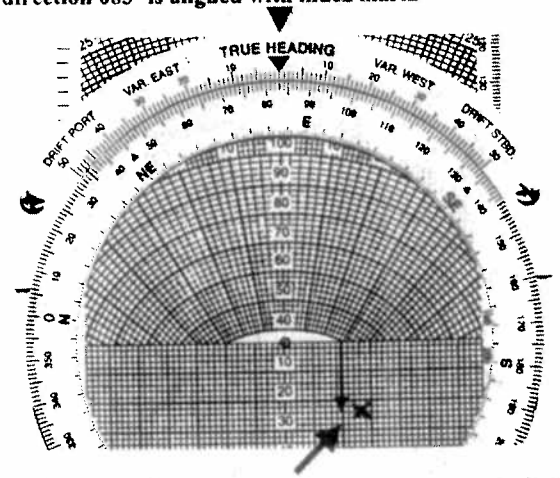
CRP5 101 a.

a. Set the low speed side of the slide so that the top line of the squared section aligns with the centre dot in the window.
b. Rotate the window to align the wind direction (035) with the true heading index mark.
c. Draw a cross to represent the wind speed (35 kts) on the centre line below the centre dot.

d. Rotate the window disc to align the runway direction (083) with the true heading index mark.

e. The headwind component (24 kts) (option a) is the vertical distance from the centre dot at the top of the gridded area, to the cross. This situation is illustrated below.

1. Runway direction 083^0 is aligned with index mark.



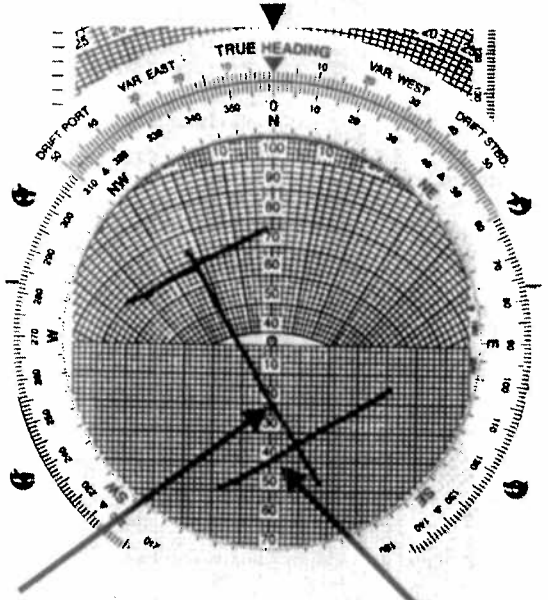
2. Vertical distance from dot at top of gridded area to cross indicates headwind component 24 kts.

CRP5 102 a.

To solve this type of problem using the CRP5:

a. Set the low speed side of the slide so that the top line of the squared section aligns with the centre dot in the window.
b. Rotate the window to align the wind direction (060) with the true heading index mark.
c. Draw a horizontal line 10 kts below the centre dot to represent the minimum headwind component.
d. Draw two vertical lines, one 35 kts to the left and one 35 kts to the right of the centre dot.
e. Rotate the window until 000 aligns with the true heading index mark.
f. Read off the minimum (20 kts) and maximum (40 kts) wind speeds where these lines cross the centre line below the centre dot. These values are option b. This situation is illustrated below.

1. 000° is aligned with index mark.



2. Minimum 20 kts wind speed indicated where this line crosses centre line.

3. Maximum wind speed 40 kts indicated where this line Crosses centre line.

CRP5 103 a.
To solve this type of problem using the CRP5:

a. Position the low speed slide so that the centre dot is on the top line of the square gridded area of the slide.
b. Rotate the window to align the wind direction 280° with the true heading index mark.
c. Draw a cross on the centre line 40 kts below the centre dot.
d. Rotate the window to align the runway direction 230° with the true heading index mark.
e. Read of the cross wind component be counting the squares between the center line and the cross 30 kts. This is closest to option a 31 kts.

CRP5 104 c.
To solve this type of problem using the CRP5:

a. Dividing 48 nm by 10 min gives a ground speed of 288 kts.
b. Set the high speed slide so that 275 kts TAS is at the centre dot.
c. Align 066° heading on the window scale with 11° E variation on the outer scale.

d. With a heading of 066° and a course of 075° the drift is 9° right. Draw a cross on the 288 kts arc at 9° right drift.
e. Rotate the window to align the cross on the centre line below the centre dot.
f. Read of wind direction 340° at the true heading index, and wind speed 45 kts by counting down from the centre dot to the cross. The wind is 340°/45 kts (option c).

CRP5 105 a.
To solve this type of problem using the CRP5:

a. Dividing 64 nm by 11 min gives a ground speed of 320 kts.
b. Set the high speed slide so that 360 kts TAS is at the centre dot.
c. Aiign 215° heading on the window scale with 15° E variation on the outer scale.
d. With a heading of 215° and a course of 210° the drift is 5° left. Draw a cross on the 320 kts arc at 5° left drift.
e. Rotate the window to align the cross on the centre line below the centre dot.
f. Read of wind direction 265° at the true heading index, and wind speed 50 kts by counting down from the centre dot to the cross. The wind is 265°/50 kts (option a).

CRP5 106 b.
It is not necessary to use the CRP5 to solve this type of problem. Drift angle is greatest when the wind is at 90° to the track. So for a track of 040° the greatest drift will occur when the wind is from 310° or 130° (option b).

CRP5 107 d.
To solve this type of problem using a CRP5:

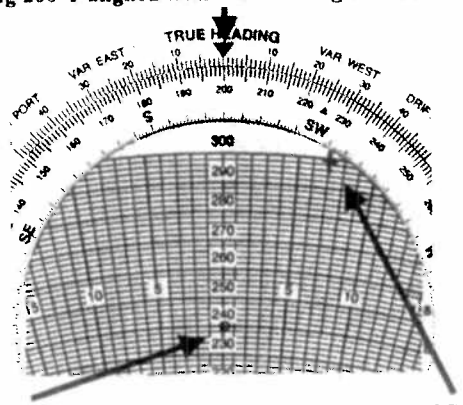
a. Set temperature +20°C against altitude in thousands of feet (8) in the airspeed window.
b. With the cursor set at 120 kts on the inner scale it will cross the outer scale at 141 kts (option d).

CRP5 108 d.
To solve this type of problem using the CRP5:

a. At 12000 ft in the ISA the temperature is 15°C – (12 x 2°C) = -9°C. To convert CAS to TAS set ISA conditions by aligning the –9°C with 12 in the airspeed window. With the cursor aligned with 200 kt on the inner scale it will cross the outer scale at 240 kts TAS.
b. Calculate ground speed by dividing the distance flown (105 nm) by the time taken 21 minutes then multiply by 60 to get 300 kts ground speed.
c. With heading 215°M and 15°W variation, the heading is 200°T.

d. With track 222°M and heading 215°M the drift is 7° right.
e. Set the low speed slide with TAS 240 kts at the centre dot.
f. Align heading 200°T with the true heading index.
g. Draw a cross to represent ground speed on the 300 kt radial at 7° right drift. This situation is illustrated below.

1. Heading 200°T aligned with true heading index mark.



2. Centre dot on 240 kts TAS. 3. Cross drawn at 300 kts GS, 7 right drift.

h. Rotate the window to align the cross on the centre line below the centre ot. Read off the 52° T/69 kts, or approximately 050°/70 kts (option d).

CRP5 109 b.
It is not necessary to use the CRP5 to solve this type of problem. Drift angle is greatest when the wind is at 90° to the course. So for a course of 095° the greatest drift will occur when the wind is from 005° or 185° (option b).

CRP5 110 c.
To solve this type of problem using the CRP5:

a. Set the 60 min index mark on the inners scale against 240 on the outer scale.
b. Against 500 on the outer scale read off 124.5 or approximately 125 min (option c) on the inner scale.

CRP5 111 c.
To solve this type of problem using the CRP5:

a. Flight time between X and Y = 1252 – 1232 = 20 min.
b. To find the ground speed divide the distance between X and Y, (40 nm) by time (20 min) by setting 20 on the inner scale against 40 0n the outer scale.

The 60 min index on the inner scale will now align with 120 on the outer. This means that the ground speed is 120 nm/hr.
c. To find the time taken to fly from Y to Z divide the distance (75 nm) by the ground speed (120). To do this, align 120 on the inner scale with 75 on the outer scale. The 60 min index on the inner will now align with 37.5 on the outer. This means that the time between Y and Z will be 37.5 min.
d. Adding this to the ATA at Y gives 1252 + 37.5 min = 1329.5 or approximately 1330 UTC (option c).

CRP5 112 d.
To solve this type of problem using the CRP5:

a. Flight time between A and B = 1027 – 1010 = 17 min.
b. To find the ground speed divide the distance between A and B, (30 nm) by time (17 min) by setting 17 on the inner scale against 30 on the outer scale. The 60 min index on the inner scale will now align with 105.8 on the outer. This means that the ground speed is 105.8 nm/hr.
c. To find the time taken to fly from B to C divide the distance (20 nm) by the ground speed (105.8). To do this, align 105.8 on the inner scale with 20 on the outer scale. The 60 min index on the inner will now align with 11.35 min on the outer. This means that the time between B and C will be 11.35 min.
d. Adding this to the ATA at C gives 1027 + 11.35 min = 1038.25 or approximately 1038 UTC (option d).

CRP5 113 b.
To solve this type of problem using the CRP5:

a. Flight time between X and Y = 1450 – 1420 = 30 min.
b. To find the ground speed divide the distance between A and B, (30 nm) by time (30 min) by setting 30 on the inner scale against 30 on the outer scale. The 60 min index on the inner scale will now align with 60 on the outer. This means that the ground speed is 60 nm/hr.
c. To find the time taken to fly from Y to Z divide the distance (20 nm) by the ground speed (60). To do this, align 60 on the inner scale with 20 on the outer scale. The 60 min index on the inner will now align with 20 min on the outer. This means that the time between B and C will be 20 min.
d. Adding this to the ATA at Y gives 1450 + 20 min = 1510 UTC (option b).

CRP5 114 d.
To solve this type of problem using the CRP5:

a. To set the CRP5 to ISA conditions, set 10 on the inner scale and 10 on the outer scale.
b. Opposite 5000 ft in the altitude window set 35°C.
c. Opposite 5 (to represent 5000) on the inner scale read off 5550 on the outer scale. This means that the true altitude is 5550 ft (option d).

CRP5 115 a.

To solve this type of problem using the CRP5:

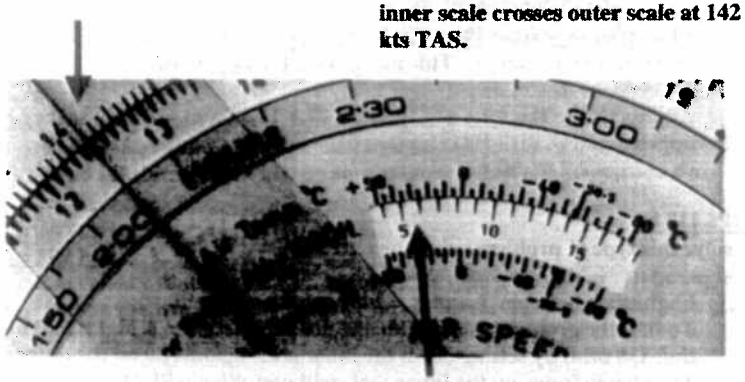
a. To set the CRP5 to ISA conditions, set 10 on the inner scale and 10 on the outer scale.
b. Opposite 7000 ft in the altitude window set 30°C.
b. Opposite 7 (to represent 7000) on the inner scale read off 7750 on the outer scale. This means that the true altitude is 7750 ft (option a).

CRP5 116 a.

To solve this type of problem using a CRP5:

a. Set temperature +25°C against altitude in thousands of feet (6) in the airspeed window.
b. With the cursor set at 125 kts on the inner scale it will cross the outer scale at 142 kts (option a). These settings are illustrated below.

2. Cursor aligned with 125 kts on inner scale crosses outer scale at 142 kts TAS.



1. 25°C set against 6000 ft in Airspeed window.

CRP5 117 b.

To solve this type of problem using a CRP5:

a. Set temperature +5°C against altitude in thousands of feet (16) in the airspeed window.
b. With the cursor set at 130 kts on the inner scale it will cross the outer scale at 173 kts (option b). These settings are illustrated below.

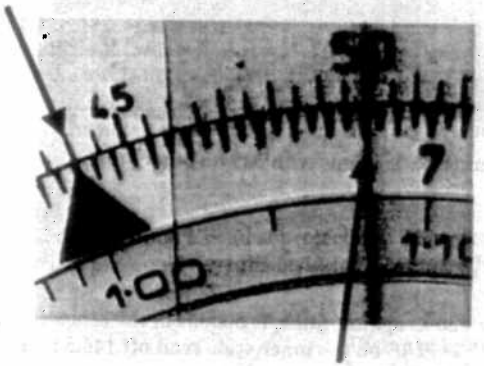
2. Cursor allgned with 130 kts on inner scale crosses outer scale at 173 kts TAS.

1. 5°C set against 16000 ft in Airspeed window.

CRP5 118 a.

a. Set the 60 min index mark on the inners scale against 440 on the outer scale.
b. Against 500 on the outer scale read off 68.2 or approximately 68 min (option a) on the inner scale. These settings are illustrated below.

1. 60 min index on inner scale set against 440 on outer scale.

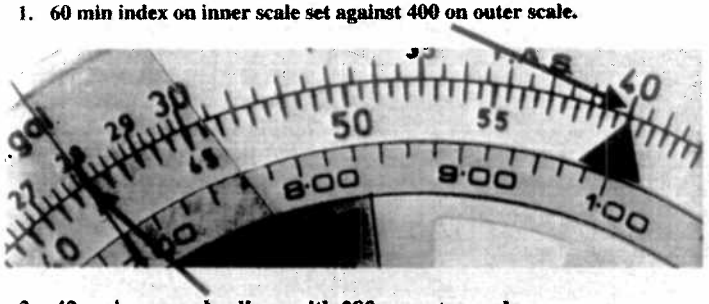


2. 500 on outer scale aligns with 68.2 on inner scale.

CRP5 119 c.

a. Set the 60 min index mark on the inners scale against 400 on the outer scale.
b. Against 42 on the inner scale read off 280 nm (option c) on the outer scale. These settings are illustrated below.

1. 60 min index on inner scale set against 400 on outer scale.



2. 42 on inner scale aligns with 280 on outer scale.

CRP5 120 b.

a. Set the 60 min index mark on the inners scale against 420 on the outer scale.
b. Against 47 on the inner scale read off 329 nm (option b) on the outer scale.
These settings are illustrated below.

1. 60 min index on inner scale set against 420 on outer scale.

2. 47 on inner scale aligns with 329 on outer scale.

CRP5 121 d.

To solve this type of problem using the CRP5:

a. Set OAT = +20°C against altitude 6000 ft in the airspeed window.
b. Against 130 kts IAS on the inner scale read off 146.5 kt TAS on the outer scale (option d).

CRP5 122.

To solve this type of problem using the CRP5:

a. Set OAT = +25°C against altitude 2000 ft in the airspeed window.
b. Against 110 kts IAS on the inner scale read off 116 kt TAS on the outer scale (option a).

CRP5 123 a.

To solve this type of problem using the CRP5:

a. Set OAT = +15°C against altitude 4500 ft in the airspeed window.
b. Against 100 kts IAS on the inner scale read off 100 kt TAS on the outer scale (option a).

CRP5 124 d.

To solve this type of problem using the CRP5:

a. Set OAT = -15°C against altitude 7500 ft in the airspeed window.
b. Against 97 kts IAS on the inner scale read off 105.5 kt TAS on the outer scale (option d).

CRP5 125 a.

To solve this type of problem using the CRP5:

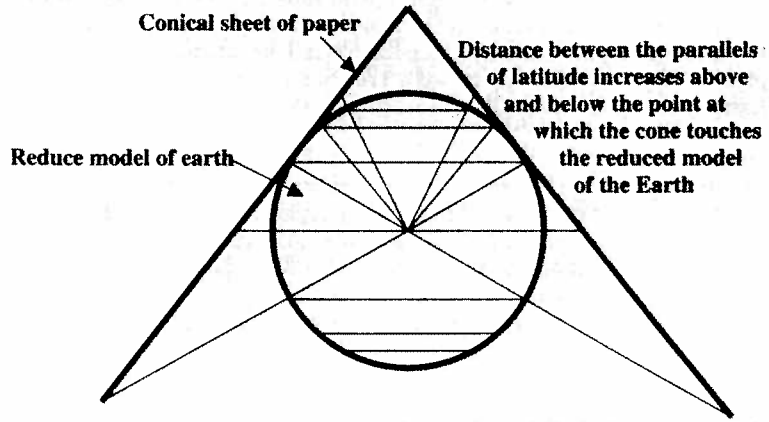
c. Set OAT = +10°C against altitude 2500 ft in the airspeed window.
d. Against 89 kts IAS on the inner scale read off 92.5 kt TAS on the outer scale (option a).

CHART THEORY 1 a.

The terms "magnetic variation" refers to the difference between True North and Magnetic North directions at any point on the earth. Variation is caused by the fact that the Magnetic and Geographical North Poles are not in exactly the same place. Variation is the angle between True North and Magnetic North, so a Westerly variation means that true North is to the East of magnetic North (option a). It should be noted that options c and d refers of compass deviation.

CHART THEORY 2 a.

A Lambert's chart is based upon a conical projection. This means that the graticule of the earth is projected onto the inside of a cone as illustrated below.



This method of projection causes the scale to increase as distance increases away from the line at which the cone is in contact with the model of the Earth. The scale can therefore be correct only along this line of contact. In order to make such a projection conformal the scale is reduced mathematically at all points. This is the equivalent of having the cone pass below the surface of the model of the earth as illustrated below. This produces two lines of parallel at which the scale is correct. These are termed the "Standard Parallels". Scale between these parallels reduces while scale outside of the standard parallels increases as distance away from the parallels increases. The nominal scale of a Lambert's Conformal chart is therefore correct only along the standard parallels (option a).

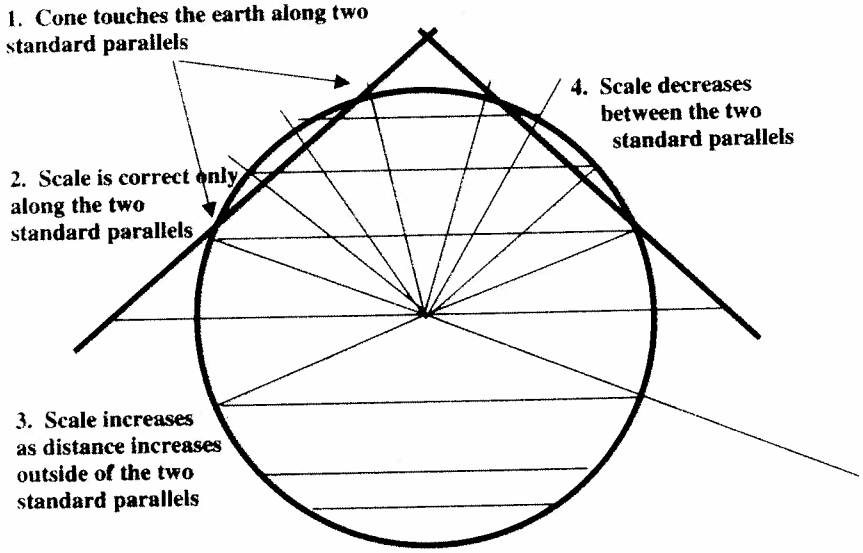


CHART THEORY 3 b.

The terms "magnetic variation" refers to the difference between True North and Magnetic North directions at any point on the earth. Variation is caused by the fact that the Magnetic and Geographical North Poles are not in exactly the same place. Variation is the angle between True North and Magnetic North, so an Easterly variation means that true North is to the West of magnetic North

CHART THEORY 4 c.

The most suitable chart for use in any given region of the world is that which gives the most accurate representation of sizes and relative positions of the various features within that region. In the case of the polar regions, the most accurate representation is provided by a Polar Stereographic Chart (option c). This is produced by projecting the graticule of the reduce Earth onto a flat sheet of paper that is in tangential to the reduced Earth at the pole as illustrated

below. The scale of such a chart is most accurate in the region very close to the pole, but becomes increasing inaccurate as distance from the pole increases.

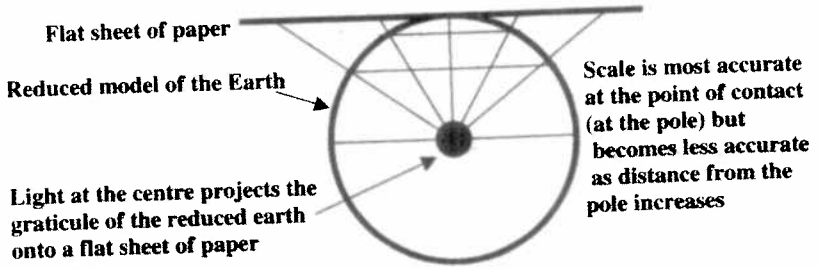
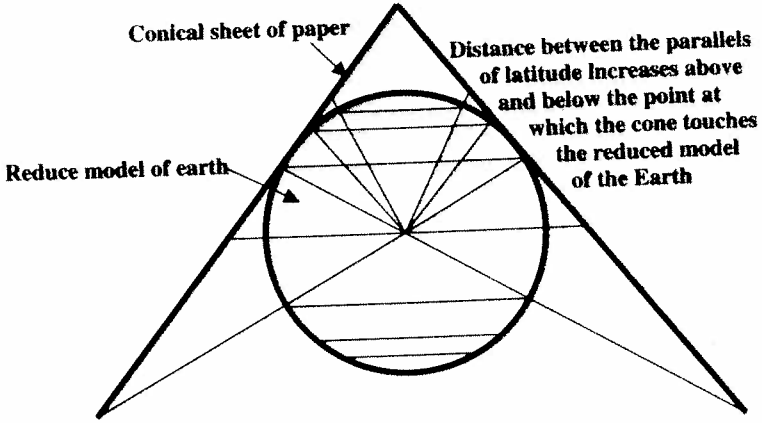


CHART THEORY 5 a.

The term "chart convergency" refers to the angle of inclination between two meridians on the chart measured at any latitude. A Lambert's chart is based upon a conical projection. This means that the graticule of the earth is projected onto the inside of a cone as illustrated below.



This method of projection causes the scale and chart convergency to increase as distance increases away from the line at which the cone is in contact with the model of the Earth. The scale and chart convergency can therefore be correct only along this line of contact. In order to make such a projection conformal the scale is reduced mathematically at all points. This is the equivalent of having the cone pass below the surface of the model of the earth as illustrated below. This produces two lines of parallel at which the scale is correct. These are termed the "Standard Parallels". Scale between these parallels reduces while scale outside of the standard parallels increases as distance away from the parallels increases. Scale on a Lambert's Conformal chart are therefore most accurate along the standard parallels. But the convergence of the meridians is most accurately represented at the parallel of origin, which is located midway between the two standard parallels (option a).

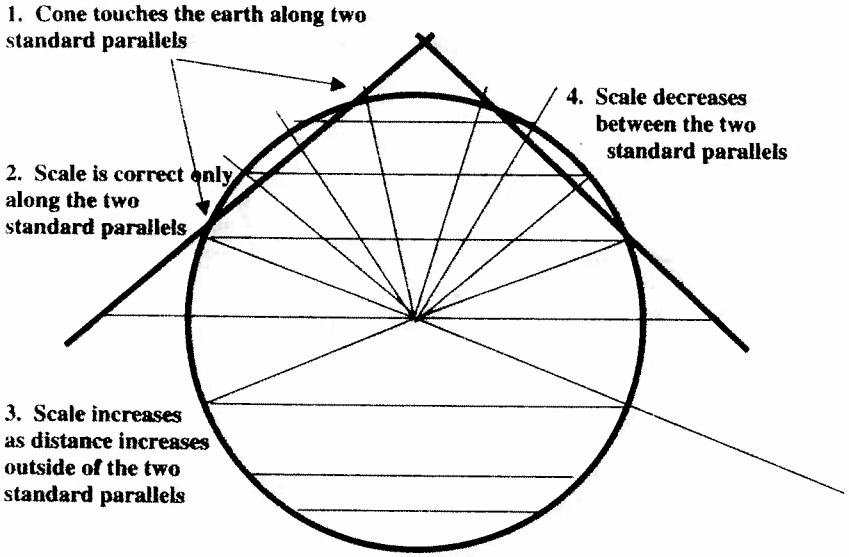
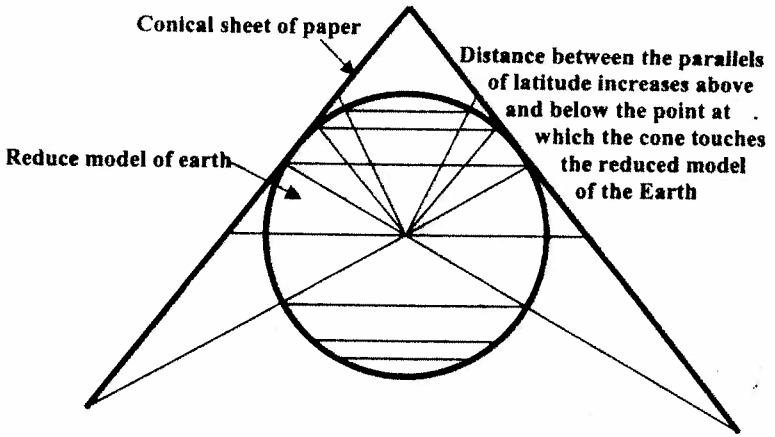


CHART THEORY 6 c.

A Rhumb Line is a regularly curved line on the surface of the earth that cuts all meridians in its path at the same angle. Direct Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the model to form a cylinder. This process produces one of the requirements of an orthomorphic/conformal chart in that all of the meridians and parallels of latitude cross at 90 degrees to each other. In addition to this, all of the meridians are straight lines. This means that a straight-line track drawn on the chart will cross al meridians at the same angle. A Rhumb line track on a Mercator chart is therefore a straight line (option c).

CHART THEORY 7 c.

A Lambert's chart is based upon a conical projection. This means that the graticule of the earth is projected onto the inside of a cone as illustrated below.



This method of projection causes the scale to increase as distance increases away from the line at which the cone is in contact with the model of the Earth. The scale can therefore be correct only along this line of contact. In order to make such a projection conformal the scale is reduced mathematically at all points. This is the equivalent of having the cone pass below the surface of the model of the earth as illustrated below. This produces two lines of parallel at which the scale is correct. These are termed the "Standard Parallels". Scale between these parallels reduces while scale outside of the standard parallels increases as distance away from the parallels increases. The nominal scale of a Lambert's Conformal chart is therefore correct only along the standard parallels (option c).

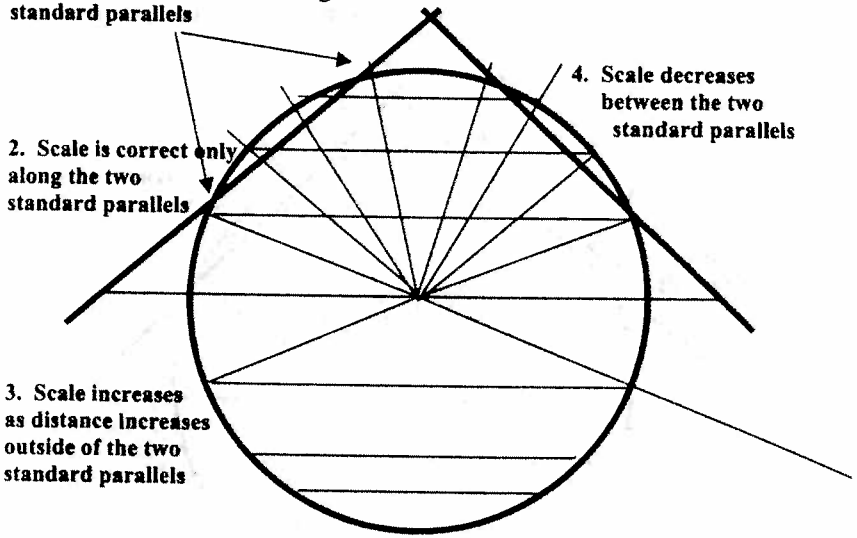
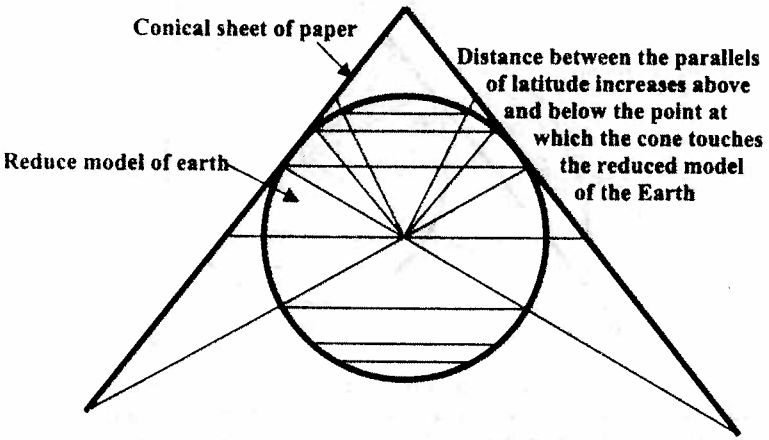


CHART THEORY 8 b.

A Lambert's chart is based upon a conical projection. This means that the graticule of the earth is projected onto the inside of a cone as illustrated below.



This method of projection causes the scale to increase as distance increases away from the line at which the cone is in contact with the model of the Earth. The scale can therefore be correct only along this line of contact. In order to make such a projection conformal the scale is reduced mathematically at all points. This is the equivalent of having the cone pass below the surface of the model of the earth as illustrated below. This produces two lines of parallel at which the scale is correct. These are termed the "Standard Parallels". Scale between these parallels reduces while scale outside of the standard parallels increases as distance away from the parallels increases. The nominal scale of a Lambert's Conformal chart is therefore correct only along the standard parallels (option b).

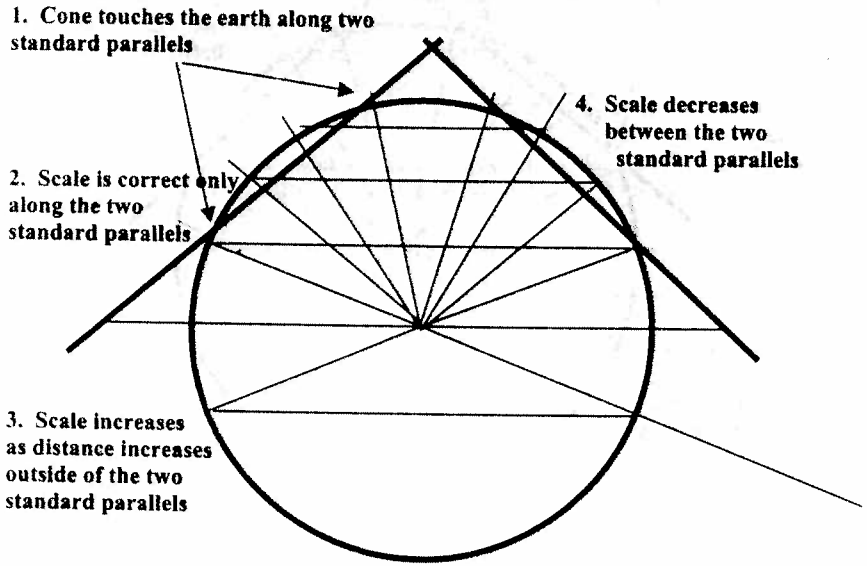


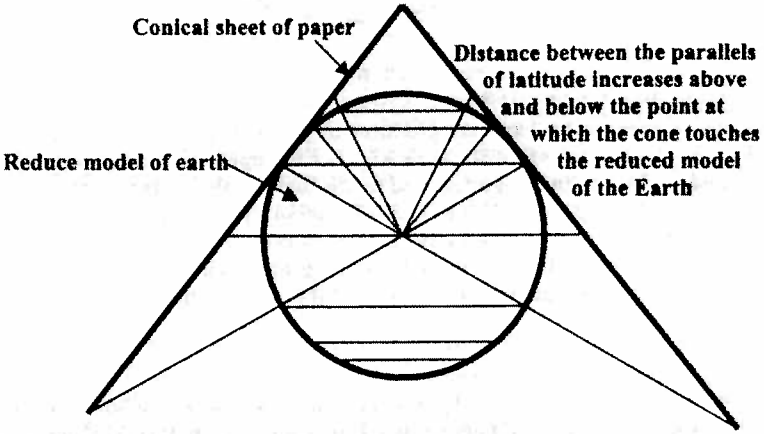
CHART THEORY 9 c.

A Great Circle is a circle drawn on the surface of the earth such that its centre is the centre of the earth. Great circles include all meridians plus the equator. Direct Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the equator to form a cylinder. This process produces one of the requirements of an orthomorphic/conformal chart in that all of the meridians and parallels of latitude cross at 90 degrees to each other. In addition to this, all of the meridians and parallels of latitude, including the Equator are shown as straight lines. Great circle representing the meridians and the equator are therefore shown as straight lines.

But Great Circles may also be inclined at any angle, provided their centre is located at the centre of the earth. Such Great Circles will cross each meridian or parallel of latitude in their paths at slightly different angle to the one before. This means that with the exception of the Equator and the meridians, great circles are shown as curves concave to the equator on Direct Mercator charts (option c).

CHART THEORY 10 d.

A Lambert's chart is based upon a conical projection. This means that the graticule of the earth is projected onto the inside of a cone as illustrated below.



This method of projection causes the scale to increase as distance increases away from the line at which the cone is in contact with the model of the Earth. The scale can therefore be correct only along this line of contact. In order to make such a projection conformal the scale is reduced mathematically at all points. This is the equivalent of having the cone pass below the surface of the model of the earth as illustrated below. This produces two lines of parallel at which the scale is correct. These are termed the "Standard Parallels". Scale between these parallels reduces while scale outside of the standard parallels increases as distance away from the parallels increases. The nominal scale of a Lambert's Conformal chart is therefore correct only along the standard parallels. But

because the scale increases at either side of the parallel of origin, the convergence is most accurate at the parallel of origin, which is located midway between the standard parallels (option d).

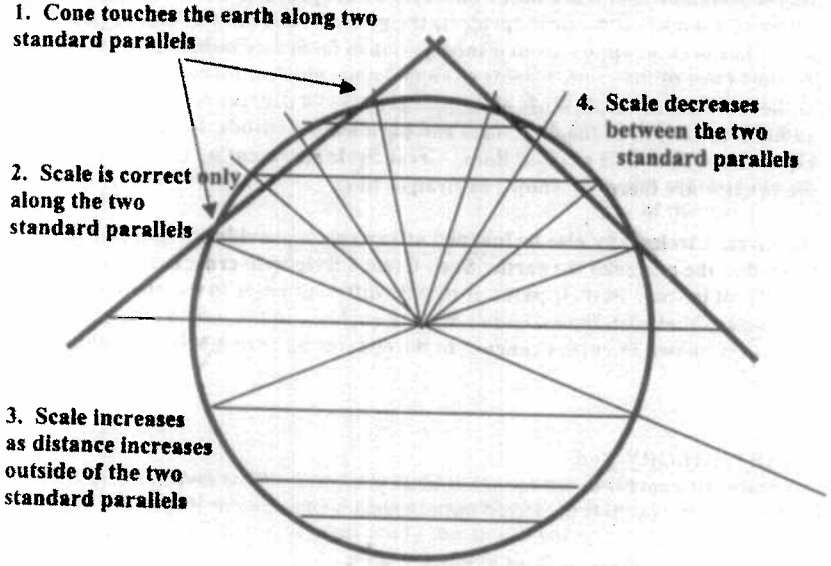


CHART THEORY 11 a.

Transverse Mercator charts are produced by projecting the graticule of a model of the earth onto the inside of a sheet of paper wrapped around the earth to form a cylinder. This cylinder is aligned so that it contacts the surface of the earth at the poles and along a meridian and anti-meridian. This projection is then mathematically adjusted to achieve orthomorphism. The scale on such a chart is exactly correct only along the meridian of tangency, which is the line along which the cylinder is in contact with the surface of the earth (option a).

CHART THEORY 12 b.

A Lamberts chart is produced by projecting the graticule of a model of the earth onto the inside of a cone of paper which is then unfolded to form the chart. This process produces a graticule in which the meridians are straight lines converging upon the nearest pole. In the Northern hemisphere each meridian points directly at the North Pole. Because the meridians converge, any straight line not in a north-south direction on such a chart will cross each successive meridian in its path at a slightly different angle. This means that the direction of the track will change continuously along any straight line track. This change of track is caused by the convergence of the meridians, so the difference in the departure and arrival track between two points is equal to the convergence of the chart (option b). This situation is illustrated below.

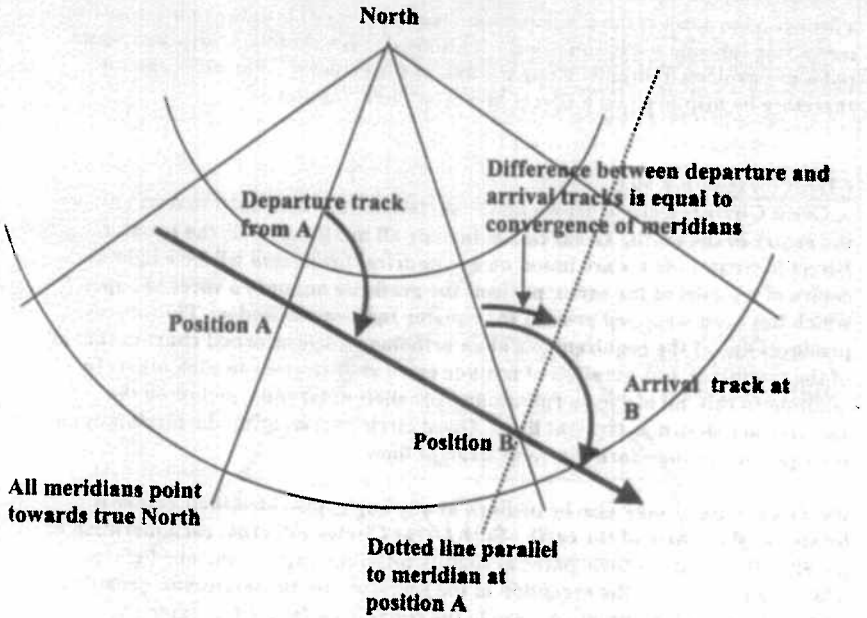


CHART THEORY 13 a.

A Rhumb Line is a regularly curved line on the surface of the earth that cuts al of the meridians in its path at the same angle. A second property of Rhumb Lines is that when extended to circle the earth, the centre of this circle is not located at the centre of the earth. This in turn means that the r5adius of curvature of a Rhumb Line is less than that of the earth. Because all of the parallels of latitude cross all meridians at the same angle, they are all Rhumb Lines, with the exception of the Equator (option a).

CHART THEORY 14 c.

Direct Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the model to form a cylinder. This process produces one of the requirements of an orthomorphic/conformal chart in that all of the meridians and parallels of latitude cross at 90 degrees to each other. In addition to this, all of the meridians are straight lines. This means that all meridians on a Direct Mercator chart are parallel, equally spaced, vertical straight lines (option c).

CHART THEORY 15 d.

Direct Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the equator of the model to form a cylinder.

This process causes the spacing between the parallels of latitude to increases with increasing latitude north and south. This also means that the North and South poles are projected directly along the axis of the cylinder. The poles cannot therefore be displayed on a Direct Mercator chart (option d).

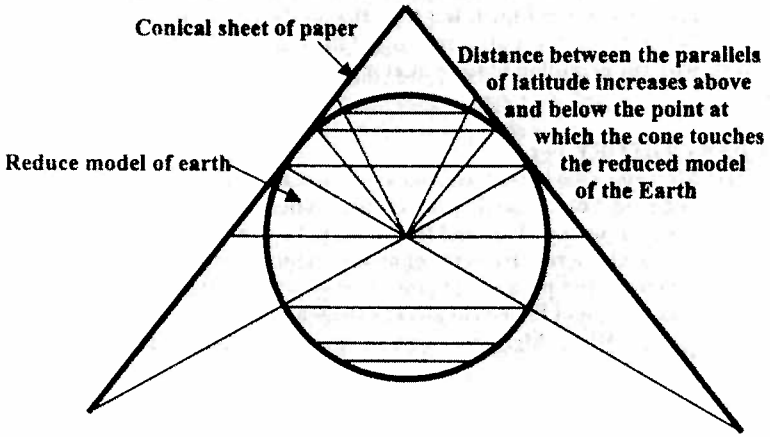
CHART THEORY 16 a.

A Great Circle is a circle drawn on the surface of the earth such that its centre is the centre of the earth. Great circles include all meridians plus the equator. Direct Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the equator to form a cylinder. This process produces one of the requirements of an orthomorphic/conformal chart in that all of the meridians and parallels of latitude cross at 90 degrees to each other. In addition to this, all of the meridians and parallels of latitude, including the Equator are shown as straight lines. Great circle representing the meridians and the equator are therefore shown as straight lines.

But Great Circles may also be inclined at any angle, provided their centre is located at the centre of the earth. Such Great Circles will cross each meridian or parallel of latitude in their paths at slightly different angle to the one before. This means that with the exception of the Equator and the meridians, great circles are shown as curves concave to the equator on Direct Mercator charts (option a).

CHART THEORY 17 b.

A Lambert's chart is based upon a conical projection. This means that the graticule of the earth is projected onto the inside of a cone as illustrated below.



This method of projection causes the scale to increase as distance increases away from the line at which the cone is in contact with the model of the Earth. The scale can therefore be correct only along this line of contact. In order to make such a projection conformal the scale is reduced mathematically at all points.

This is the equivalent of having the cone pass below the surface of the model of the earth as illustrated below. This produces two lines of parallel at which the scale is correct. These are termed the "Standard Parallels". Scale between these parallels reduces while scale outside of the standard parallels increases as distance away from the parallels increases. This means that the distance between parallels of latitude equal numbers of degrees apart, reduces between and increases outside of the standard parallels (option b).

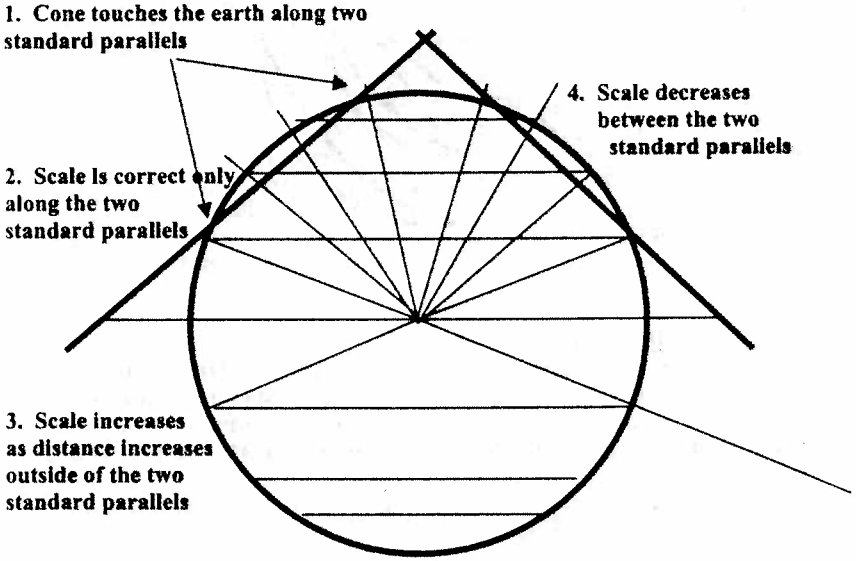


CHART THEORY 18 a.

A Polar Stereographic chart is produced by projecting the graticule of a model of the Earth onto a flat sheet of paper that is in contact with the model at the pole. This produces a series of concentric circles centred on the pole. On all such projections Rhumb Lines and Great Circles appear as curves, such that the Great Circle is always closer to the pole than is the Rhumb Line. But as illustrated below, as latitude increases towards the pole, the curvature of the Great Circle gradually reduces. This means that the higher the latitude, the closer the Great Circle approximates to a straight line (option a).

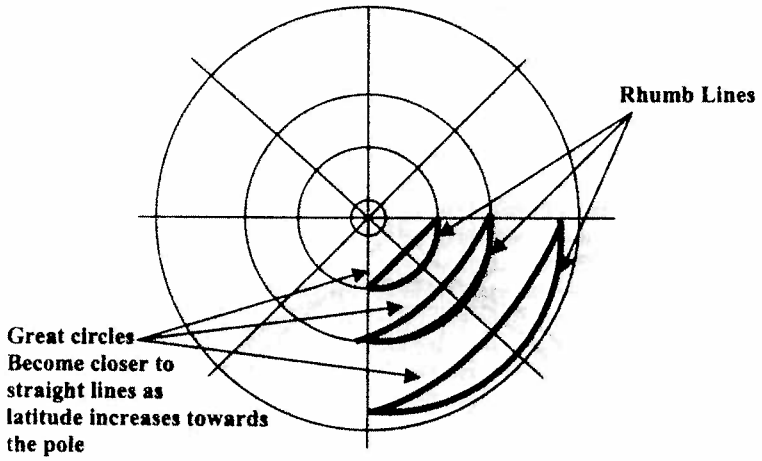


CHART THEORY 19 b.

A Polar Stereographic chart is produced by projecting the graticule of a model of the Earth onto a flat sheet of paper that is in contact with the model at the pole. This produces a series of concentric circles centred on the pole. On all such projections Rhumb Lines and Great Circles appear as curves concave to the pole (option b).

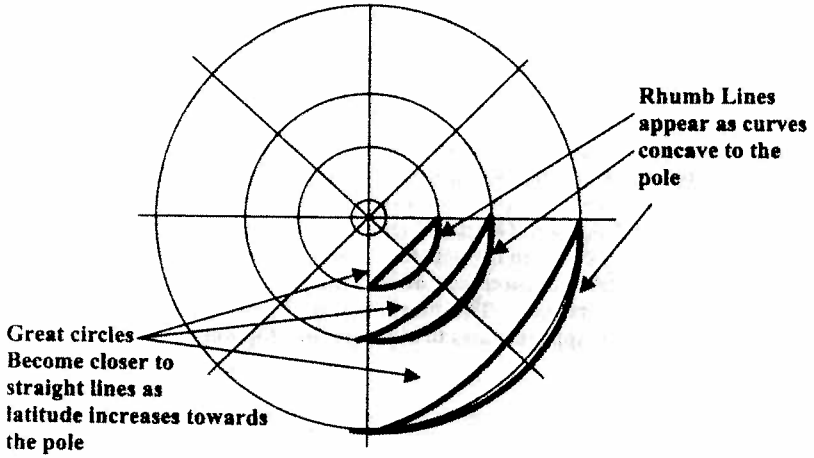


CHART THEORY 20 c.

A Polar Stereographic chart is produced by projecting the graticule of a model of the Earth onto a flat sheet of paper that is in contact with the model at one of the poles. This produces a series of concentric circles centred on the pole and the meridians are represented as straight lines radiating out from the pole. The

scale of a polar stereographic is correct only at the pole and increases with increasing distance from the pole. The term "Convergence factor" refers to the ratio of chart convergence to earth convergence and is 1 when these two convergences are equal. On a polar stereographic chart this convergence factor 1 only at the pole (option c).

CHART THEORY 21 a.

A Rhumb Line is a regularly curved line on the surface of the earth that cuts all meridians in its path at the same angle. Direct Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the model to form a cylinder. This process produces one of the requirements of an orthomorphic/conformal chart in that all of the meridians and parallels of latitude cross at 90 degrees to each other. In addition to this, all of the meridians are straight lines. This means that a straight-line track drawn on the chart will cross al meridians at the same angle. A Rhumb line track on a Mercator chart is therefore a straight line (option a).

CHART THEORY 22 c.

A Lamberts chart is produced by projecting the graticule of a model of the earth onto the inside of a cone of paper which is then unfolded to form the chart. This process produces a graticule in which the meridians are straight lines converging upon the nearest pole. The scale of such a projection is correct only along the line at which the cone touches the model of the earth. To improve the accuracy of the chart it is mathematically adjusted to simulate the situation in which the cone passes slightly below the surface of the model earth. This produces two standard parallels along which the scale is correct. These standard parallels are the lines along which the cone would pass through the surface of the model earth. The parallel midway between the two standard parallels is called the parallel of origin. The graticule produced by this process is illustrated below.

The only truly straight lines on such a chart are the parallels of longitude (option c). Great circles represented by curve concave to the parallel of origin and are approximately straight line when very close to it. But the only perfectly straight lines on such a chart are the meridians of latitude.

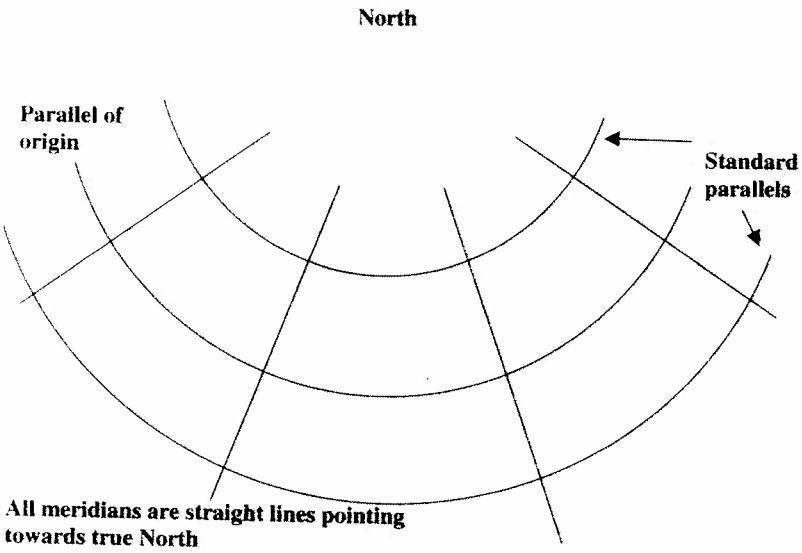


CHART THEORY 23 d.

Direct Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the model to form a cylinder. This process produces one of the requirements of an orthomorphic/conformal chart in that all of the meridians and parallels of latitude cross at 90 degrees to each other. In addition to this, all of the meridians are straight lines. But the scale on such charts is correct only at the Equator, then expands directly with the secant of the latitude north and south (option d).

CHART THEORY 24 b.

A rhumb line is part of a circle around the earth, which does not have its centre at the centre of the earth. This means that the radius of a rhumb line circle is always less than that of the earth. It is possible for rhumb lines to be oriented in any direction, so their appearance on any chart will depend upon the direction from which the earth is being viewed and the direction of the rhumb line. This can be demonstrated by considering any parallel of latitude. When viewed from a point at the same latitude as the rhumb line it will appear to be a straight line. But when viewed from one of the poles it will appear to be a circle or part of a circle with its centre at the pole. A Polar stereographic chart represents the earth as viewed from above one of the poles. This means that any rhumb line other than those running directly north-south, will appear as curves concave to the nearer pole (option b).

CHART THEORY 25 a.

Transverse Mercator charts are produced by projecting the graticule of a model of the earth onto the inside of a sheet of paper wrapped around the earth to form a cylinder. This cylinder is aligned so that it contacts the surface of the earth at the poles and along a meridian and anti-meridian. This projection is then mathematically adjusted to achieve orthomorphism. The line of contact between the cylinder and the earth is called the meridian of tangency, and this is the only meridian that appears a straight line on the chart. All of the other meridians are distorted such that they appear as complex curves. Because of this distortion, the convergency of the chart is correct only along the datum meridian and at the poles and equator (option a).

CHART THEORY 26 d.

A Polar Stereographic Chart (option d) is produced by projecting the graticule of the reduce Earth onto a flat sheet of paper that is in tangential to the reduced Earth at the pole as illustrated below.

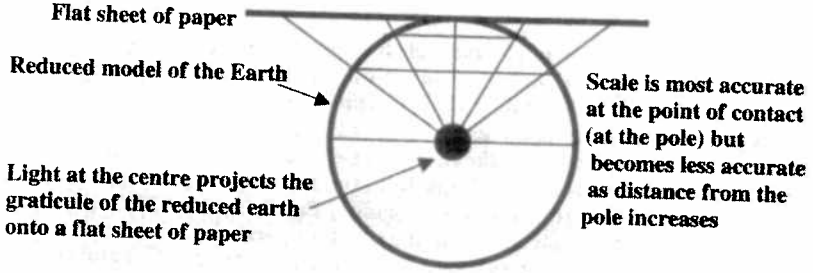


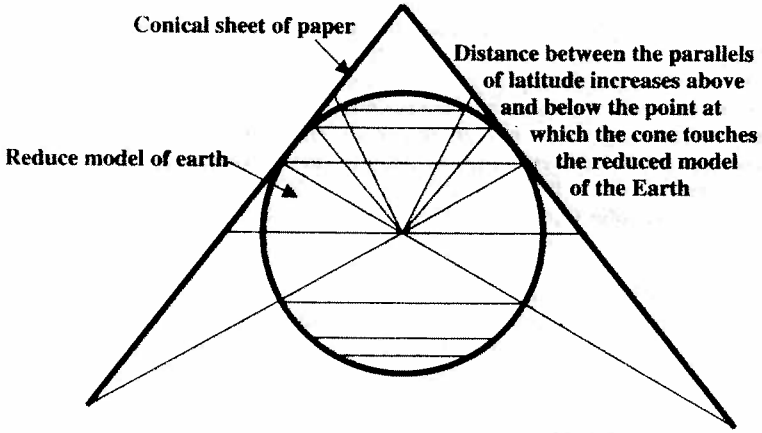
CHART THEORY 27 b.

A Great Circle is a circle drawn on the surface of the earth such that its centre is the centre of the earth. Great circles include all meridians plus the equator. Direct Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the equator to form a cylinder. This process produces one of the requirements of an orthomorphic/conformal chart in that all of the meridians and parallels of latitude cross at 90 degrees to each other. In addition to this, all of the meridians and parallels of latitude, including the Equator are shown as straight lines. Great circle representing the meridians and the equator are therefore shown as straight lines.

But Great Circles may also be inclined at any angle, provided their centre is located at the centre of the earth. Such Great Circles will cross each meridian or parallel of latitude in their paths at slightly different angle to the one before. This means that with the exception of the Equator and the meridians, great circles are shown as curves convex to the nearest pole on Direct Mercator charts (option b).

CHART THEORY 28 b.

A Lambert's chart is based upon a conical projection. This means that the graticule of the earth is projected onto the inside of a cone as illustrated below.



This method of projection causes the scale to increase as distance increases away from the line at which the cone is in contact with the model of the Earth. The scale can therefore be correct only along this line of contact. In order to make such a projection conformal the scale is reduced mathematically at all points. This is the equivalent of having the cone pass below the surface of the model of the earth as illustrated below. This produces two lines of parallel at which the scale is correct. These are termed the "Standard Parallels". Scale between these parallels reduces while scale outside of the standard parallels increases as distance away from the parallels increases. The nominal scale of a Lambert's Conformal chart is therefore constant along any parallel of latitude (option b).

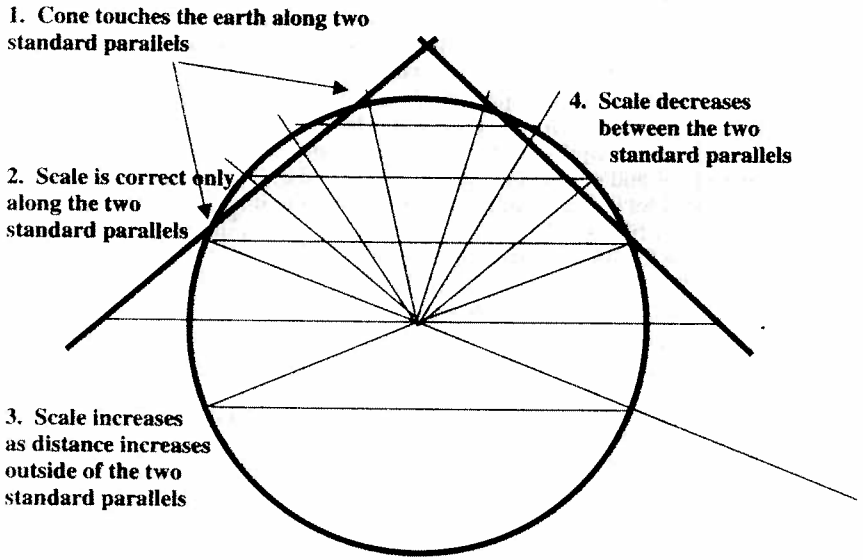


CHART THEORY 29 c.

A Great Circle is a circle drawn on the surface of the earth such that its centre is the centre of the earth. Great circles include all meridians plus the equator. Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the earth to form a cylinder. In the case of Transverse Mercator charts the line of contact between the paper cylinder and the earth is one of the meridians. This meridian is called the great circle of tangency. One of the effects of this form of projection is that the scale is correct only along this great circle of tangency (option c) then expands with increasing distance either side.

CHART THEORY 30.

A flight Information region (FIR) boundary is indicated by a line _ _ _ _ _ (option b).

CHART THEORY 31.

The symbol for an uncontrolled route is marked with a - line (option d).

CHART THEORY 32.

The symbol for a Control Zone (CTR) on an aeronautical chart i option a.

— — — — — —

CHART THEORY 33 b.

Symbol 8 is a lightship, 6 is an exceptionally high obstacle, 13 is a VOR, 15 is an unlighted obstacle.

CHART THEORY 34 a.

Symbol 13 is a VOR, 8 is a lightship, 6 is an exceptionally high obstacle, 15 is an unlighted obstacle.

CHART THEORY 35 b.

Symbol 15 is an unlighted obstacle, 1 is a basic radio aid, 13 is a VOR, and 14 is a VOR TAC.

CHART THEORY 36 c.

Symbol 3 is an aeronautical ground light, 10 is an exceptionally high lighted obstacle, 14 is a VOR TAC, and 15 is an unlighted obstacle.

CHART THEORY 37 d.

Symbol 14 is a VOR TAC, 1 is a basic radio aid, 3 is an aeronautical light and 7 is a VOR DME.

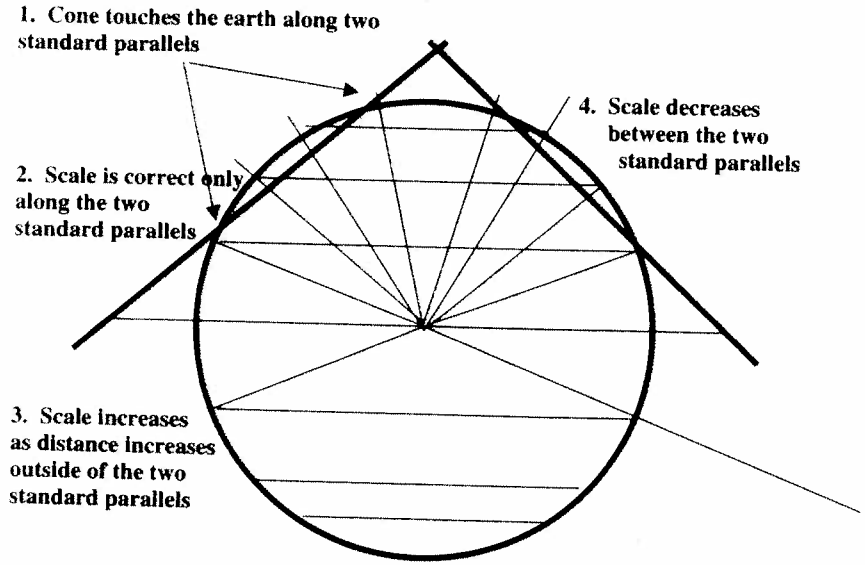
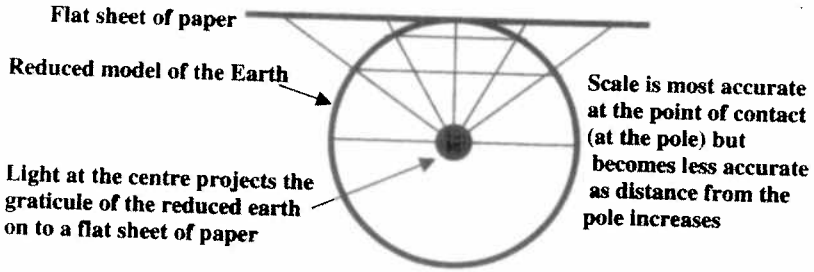


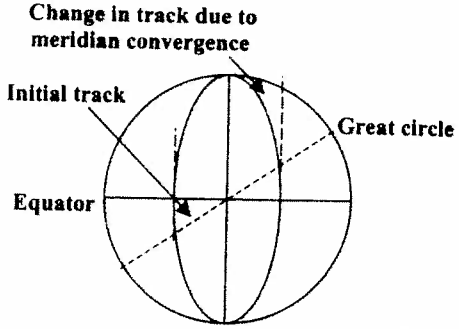
CHART THEORY 50 b.

The most suitable chart for use in any given region of the world is that which gives the most accurate representation of sizes and relative positions of the various features within that region. In the case of the polar regions, the most accurate representation is provided by a Polar Stereographic Chart (option b). This is produced by projecting the graticule of the reduce Earth onto a flat sheet of paper that is in tangential to the reduced Earth at the pole as illustrated below. The scale of such a chart is most accurate in the region very close to the pole, but becomes increasing inaccurate as distance from the pole increases.



CIRCLES 1 a.

The track at any point on a great circle is the angle between the great circle direction and the meridian at that point. All meridians are parallel at the equator, but gradually converge as latitude increases towards either of the two poles. This causes the track of great circles other than the meridians and the equator, to change as latitude changes. This effect is illustrated at the right.



This change of track between any two points on a great circle is equal to the convergency of the meridians between these two points. The change in great circle track between two points can be calculated using the convergency equation below:

Convergency = change in longitude x Sin of mean latitude.

The change in longitude = initial longitude – final longitude

Which in this question = 148^0 W – 141^0 W = 7^0

The mean latitude = (initial latitude + final latitude) / 2

Which in this question = (59^0 S + 61^0 S) / 2 = 60^0

Inserting these figures into the standard equation gives:

Convergency = 7^0 x sin 60 = 6.06^0

So between points A and B, the great circle track increases by approximately 6^0 (option a).

CIRCLES 2 a.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 45^0 N, and the departure is 280 nm.

Inserting these figures into the above equation gives:

Change in longitude = 280 nm/Cos 45^0 = 395.98' which divided by 60 = is 6^0 36'.

The question states that point B is to the east of point A so subtracting the above figure from the longitude of b gives: B (45° 15'E) – (6^0 36') = 38^0 39' (option a).

CIRCLES 3 a.

To solve this type of problem the following points must be noted:

a. A straight line on a Lambert conformal chart is a great circle.
b. The direction of great circles changes along their lengths by an amount equal to the convergence of the meriadians between any two points on the great circle.
c. For a Lambert conformal chart the equation for the convergence of meridians is:

Convergence = Change in longitude x constant of the cone

The initial course at point A (40° N 050° W) is 043° (T) and at point B is 055° (T). This means that the difference in course is 12^0, which is also the convergence between the meridians at A and B. So the convergence between points A and B is 12^0.

The question states that the constant of the cone is 0.75.

Inserting these values into the convergence equation above gives:

12^0 = Change in longitude x 0.75

Rearranging this gives Change in longitude = 12^0 / 0.75 = 16^0.

The initial longitude at point A is 050° W so the longitude at point B is 050° W - 16^0 = 34^0 (option a).

CIRCLES 4 c.

The direction of a great circle track varies along its length such that it cuts each meridian a slightly different angle. These changes are caused by the convergence of the meridians as latitude increases towards either of the two poles. The difference between the great circle direction and the rhumb line direction is the conversion angle. This angle can be calculated using the standard equation:

Conversion angle = ½ the change in longitude x the sin of the mean latitude

The change of longitude is the difference between the final and initial longitudes, which in this question is from 030°W, to 060°E = 90 degrees.

The latitude is constant at 70°S so the conversion angle in this question is:

Conversion angle = ½ x 90^0 x sin 70^0 = 42.29^6.

The latitude is constant so the rhumb line direction is 90^0 so the great circle direction is 90^0 + 42.29^0 = 132.29^0 or approximately 132^0 (option c).

CIRCLES 5 c.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 58^0 42' N, and the departure is 6 nm.

Inserting these figures into the above equation gives:

Change in longitude = 6 nm / Cos 58^0 42' = 11.55'.

The question states that point B is to the east of point A so subtracting the above figure from the longitude of A gives:

Longitude of B = (094° 00'W) – (11.55') = 93^0 48.45' W (closest to option c).

CIRCLES 6 b.

This question states that an incorrect longitude has been put into the INS. An INS system will accept such an error, and will calculate all subsequent longitude positions based upon the error. This means that all subsequent longitudes with include the same magnitude of error as the longitude originally put into the system.

The initial error is the difference between the longitude put into the INS and the actual longitude. If the two longitudes are in different directions the error can be calculated using the equation:

Longitude error = input longitude + actual longitude

Inserting the data provided gives:

Longitude error = (139° 46.3'W) + (139° 46.3'E) = 279^0 32.6' The input position is to the west of the actual position so the error is 279^0 32.6' W

When the aircraft subsequently arrives at position point 52° N 180°W, the indicated position will be 279° 32.6' W of that point.

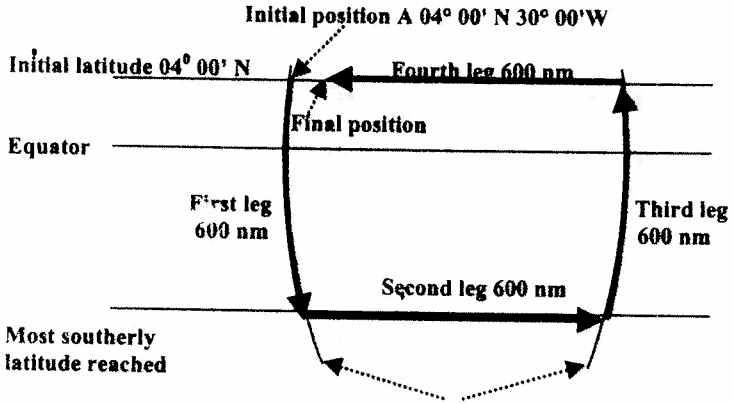
So the indicated position will be

(52° N 180°W) + (279° 32.6' W) = 459° 32.6' W.

But longitudes must be within the range 180° E to 180° W so by subtracting 360°, the indicated position of 459° 32.6' W is more properly expressed as 99° 32.6' W, which is closest to option b.

CIRCLES 7 c.

When solving this type of question it is helpful to start with a sketch of the situation as illustrated below.



Meridian converge to the North and South of the equator

To calculate the change in latitude during the first leg (Northerly) and third leg (Southerly) use the fact that each nm along any meridian is equal to 1' latitude. So 600 nm = 600' which is 10° change of latitude.

So the most Southerly latitude reached is 10° South of the initial latitude of (04° 00' N). The most Southerly latitude is therefore 06° 00' S.

During the second leg the aircraft flies 600 nm to the East at latitude 06° 00' S. Using the departure equation to calculate the change in longitude gives:

Departure = Change in longitude x Cos latitude

Which can be rearranged to give: Change in longitude = Departure/Cos latitude

Inserting the data above gives:

Change in longitude = 600 nm / Cos 06° 00' which = 603.3' E.

Dividing this by 60 gives change in longitude = 10° 3.3' E so the longitude at the end of the second leg:

Longitude = initial longitude (030° 00'W) + (10° 3.3' E) = 19° 56.7' W

During the fourth leg at latitude 04° 00' N the aircraft flies 600 nm west. The final change in longitude can be calculated using the same departure equation:

Change in longitude = 600 nm / Cos 04° 00' which = 601.47' W.

Dividing this by 60 gives change in longitude = 10° 1.47'W, so the longitude at the final longitude at the end of the fourth leg is equal to the longitude at the end of the third leg (19° 56.7' W) + the change of longitude during the fourth leg (10° 1.47'W) which gives final longitude of 29° 58.17' W, which is closest to (option c).

CIRCLES 8 c.

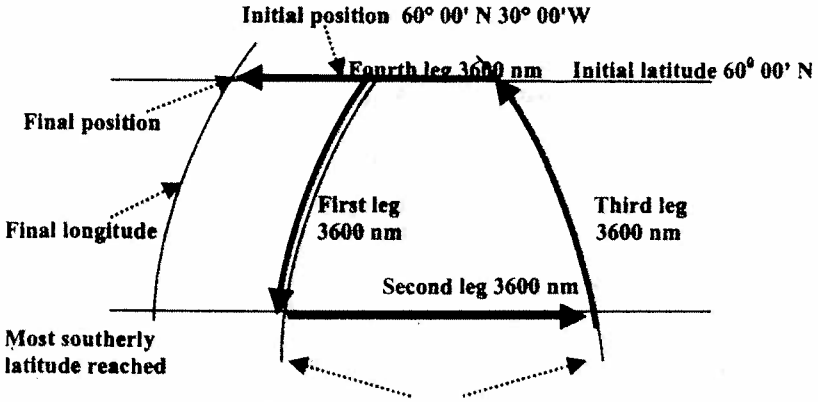
The difference between the initial great circle track and the mean great circle track is the conversion angle. This can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

So for any given change in longitude the conversion angle will be greatest where the sin of the change in latitude is greatest. Of the options given in this question option a gives sin 27.5 = 0.46, option b gives sin 0 = 0, option c gives sin 57.5 = 0.84, and option d gives sin 0 = 0. So option c, give the greatest difference between initial and mean great circle track.

CIRCLES 9 b.

When solving this type of question it is helpful to start with a sketch of the situation as illustrated below.



Meridian converge as to the North and South of the equator

To calculate the change in latitude during the first leg (Northerly) and third leg (Southerly) use the fact that each nm along any meridian is equal to 1' latitude. So 3600 nm = 3600' which is 60^0 change of latitude.

So the most Southerly latitude reached is 60^0 South of the initial latitude of (60^0 00' N). The most Southerly latitude is therefore the Equator.

During the second leg the aircraft flies 3600 nm to the East at latitude 00^0 00' S. Using the departure equation to calculate the change in longitude gives:

Departure = Change in longitude x Cos latitude

Which can be rearranged to give: Change in longitude = Departure/Cos latitude

Inserting the data above gives:

Change in longitude = 3600 nm / Cos 00^0 00' which = 3600' E.

Dividing this by 60 gives change in longitude = 60^0 E so the longitude at the end of the second leg:

Longitude = initial longitude (30° 00'W) + (60^0 00' E) = 30^0 00' E

During the third the aircraft flies 3600 nm North taking it back to latitude 60^0 N but now at longitude 30^0 00' E.

During the fourth leg at latitude 60^0 00' N the aircraft flies 3600 nm west. The final change in longitude can be calculated using the same departure equation:

Change in longitude = 3600 nm / Cos 60^0 00' which = 7200' W.

Dividing this by 60 gives change in longitude = 120^0 00'W, so the longitude at the final longitude at the end of the fourth leg is equal to the longitude at the end of the third leg (30^0 00' E) + the change of longitude during the fourth leg (120^0 00' W) which gives a final longitude of 90^0 00' W.

So the final position is 60^0 00' N 90^0 00' W (option b).

CIRCLES 10 d.

The great circle bearing from any point to any other point is equal to the Rhumb line bearing plus the conversion angle. This can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 060° E to 030° W, which is a change of 90°

Both points are at 70° S, so the change in latitude is nil, so the mean latitude is 70° S.

Inserting these figures into the conversion angle equation gives:

Conversion angle = ½ x 90^0 x Sin 70^0 which = 42.3^0

The rhumb line bearing from point A to point B is 090^0, so the great circle bearing is 090^0 + 42.3^0 = 132.3^0 or approximately 135^0 (option d).

CIRCLES 11 c.

The distance between any two meridians on any specified parallel of latitude is called the departure. This can be calculated using the standard equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude

To use this equation the distance given in the question must be converted from km into nm. This can be done using the CRP5 or by using the conversion factor 1.85 km = 1 nm to give 315 km / 1.85 = 170.27 nm

The latitude in this question is constant at 60^0 N so putting these figures into the above equation gives:

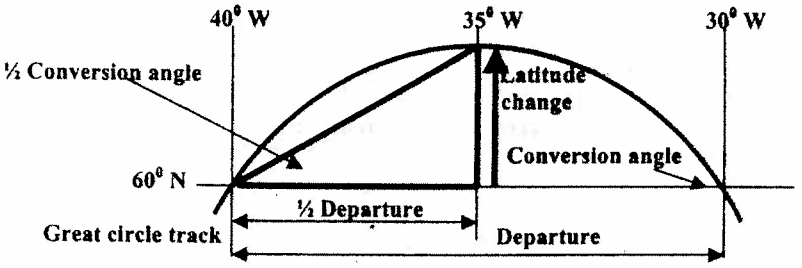
Change in longitude = 170.27 nm / Cos 60 = 340.54' which is 5.68^0.

The aircraft is flying East so the new longitude will be the initial longitude – the change in longitude.

So new longitude = 005° W-5.68^0. = 0.68^0 E which is approximately 000^0 40' E (option c).

CIRCLES 12 a.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 40^0 W – 30^0 W = 10^0

The latitude of both points is 60^0 N so the mean latitude is also 60^0 N

So conversion angle = ½ x 10^0 x Sin 60^0 Which = 4.33^0

So the angle in the triangle in the diagram above, which is half of the conversion angle, is 2.165^0

Departure between the two points = Change in longitude (in minutes) x Cos latitude

Which is Departure = 600' Cos 60^0 = 300 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 2.165^0 x 150 nm which = 5.67nm

Each nm along a meridian equates to 1 minute of latitude, so 5.67 nm equates to a change of latitude of 5.67 minutes.

The initial latitude was 60^0 N so the new latitude is 60^0 5.67' N. Option a. 60^0 5' N is the closest to this figure.

CIRCLES 13 a.

On a Lambert conformal conic chart Great Circle routes are represented by complex curves. But over short distances Great Circles are represented by straight lines. Although the distance betweens points A and B is not stated in may be assumed that the straight line course referred to in the question is a Great Circle.

The direction of a great Circle route changes along its length due to the convergency of the meridians. The change in direction between any two points on a great circle route is equal to the convergency angle. On a Lamberts chart this can be calculated using the standard equation:

Convergency = Change in longitude x the constant of the cone of the chart

This equation can be rearranged to give:

Change in longitude = Convergency / the constant of the cone for the chart

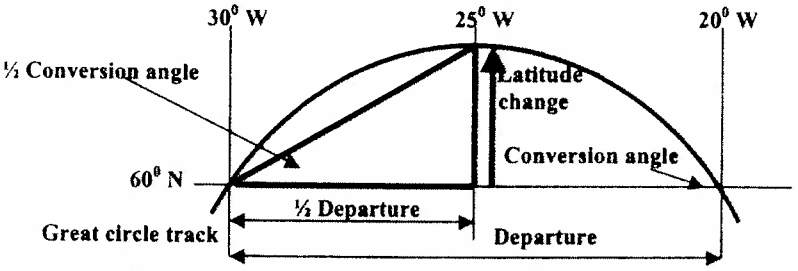
The question states that the course at point A is 080^0 and that at point B is 092^0. This means that the convergency is 12^0 E. The question also states that the cone constant for the chart is 0.8. Inserting these figures into the above equation gives:

Change in longitude = 12^0 E / 0.8 = 15^0 E.

Adding this change to the initial longitude gives (004°W) X (15^0 E) = 011^0 E (option a).

CIRCLES 14 d.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the

departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 30^0 W – 20^0 W = 10^0

The latitude of both points is 60^0 N so the mean latitude is also 60^0 N

So conversion angle = ½ x 10^0 x Sin 60^0 Which = 4.33^0

So the angle in the triangle in the above diagram is 2.165^0

Departure between the two points = Change in longitude (In minutes) x Cos latitude

Which is Departure = 600' Cos 60^0 = 300 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 2.165^0 x 150 nm which = 5.67nm

Each nm along a meridian equates to 1 minute of latitude, so 5.67 nm equates to a change of latitude of 5.67 minutes.

The initial latitude was 60^0 N so the new latitude is 60^0 5.67' N. Option a. 60^0 5' N is the closest to this figure.

CIRCLES 15 a.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 60^0 N, and the departure is 900 nm.

Inserting these figures into the above equation gives:

Change in longitude = 900 nm / Cos 60^0 = 1800' which is 30^0.

Longitude of x = (160° E) + (30^0) = 190^0 E, But latitudes go only 180^0 East or West, so 190^0 E is more properly described as 170^0 W (option a).

CIRCLES 16 c.

The track change at any point on a great circle is equal to the convergence of the meridian between the initial point and the point being considered. This can be calculated using the standard equation:

Convergence = Change in longitude x sin of the mean latitude

Change in longitude = final longitude – initial longitude which in this question is

Change in longitude = 010^0 W – 020^0 W = -10^0

The mean latitude = (initial latitude + final latitude) / 2 which in this question is

Mean latitude = (60^0N + 60^0N)/2 = 60^0N

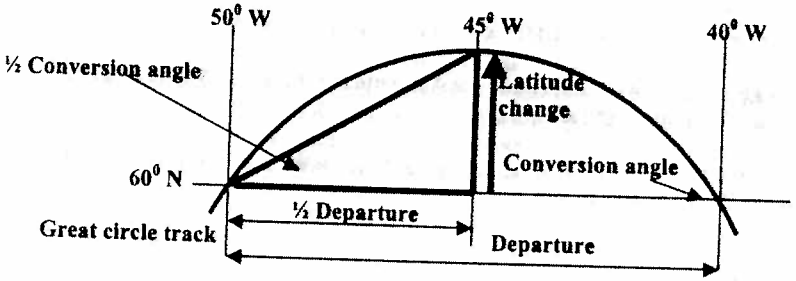
Inserting the above data into the convergence equation above gives:

Convergence = -10^0 x Sin 60^0 = -8.66^0 or approximately -9^0

So the great circle track must be decreased by 9^0 (option c).

CIRCLES 17 c.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 50^0 W – 40^0 W = 10^0

The latitude of both points is 60^0 N so the mean latitude is also 60^0 N

So conversion angle = ½ x 10^0 x Sin 60^0 Which = 4.33^0

So the angle in the triangle in the above diagram is 2.165^0

Departure between the two points = Change in longitude (in minutes) x Cos latitude

Which is Departure = 600' Cos 60^0 = 300 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 2.165^0 x 150 nm which = 5.67nm

Each nm along a meridian equates to 1 minute of latitude, so 5.67 nm equates to a change of latitude of 5.67 minutes.

The initial latitude was 60^0 N so the new latitude is 60^0 5.67' N. Option c. 60^0 5' N is the closest to this figure.

CIRCLES 18 a.

The distance in nm between two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 60^0 N, and the departure is 1200 nm.

Inserting these figures into the above equation gives:

Change in longitude = 1200 nm / Cos 60^0 = 2400' which is 40^0.

Longitude of x = (160° E) + (40^0) = 200^0 E, But latitudes go only 180^0 East or West, so 200^0 E is more properly described as 160^0 W (option a).

CIRCLES 19 c.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 60^0 N, and the departure is 1800 nm East.

Inserting these figures into the above equation gives:

Change in longitude = 1800 nm East / Cos 60^0 = 3600' which is 60^0 East.

Longitude of x = (60° E) + (60^0 East) = 120^0 E (option c).

CIRCLES 20 c.

To solve this type of problem it must first be noted that INS systems follow Great circle tracks. The difference between a Great circle direction and a Rhumb Line direction is the conversion angle. In this question both points are at latitude 45^0 S so the Rhumb Line track from 45^0 S 010^0 W to 45^0 S 030^0 W will be will be a constant 270^0. The great circle direction at point B will be 270^0 plus the conversion angle.

The Conversion angle = ½ change in longitude x Sin of mean latitude.

The change in longitude = initial longitude – final longitude

Which in this question = 30^0 W – 10^0 W = 20^0

The mean latitude in this question is constant at 45^0 N

Inserting these figures into the standard equation gives:

Conversion angle = ½ x 45 x sin 20 = 7.695^0

So at point B the Great Circle direction is 270^0 + 7.695^0 = 277.695^0 which is closest to 277^0 (option c).

CIRCLES 21 c.
Selecting DSRTK/STS causes the INS to display selected track. INS systems fly great circle routes. The great circle bearing from any point to any other point is equal to the Rhumb line bearing plus the conversion angle. This can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 020° W to 030° W, which is a change of 10°

Both points are at 55° N, so the change in latitude is nil, so the mean latitude is 55° N.

Inserting these figures into the conversion angle equation gives:

Conversion angle = ½ x 10^0 x Sin 55^0 which = 4.1^0

The rhumb line bearing from point A to point B is 270^0, so the great circle bearing is 270^0 + 4.1^0 = 274.1^0 or approximately 274^0 (option c).

CIRCLES 22 d.
The difference in great circle track between any two points is equal to the convergence of the meridians between these points. This can be calculated using the equation:

Convergence = Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 142° W to 148° W, which is a change of 6^0.

The mean latitude is equal to (Initial latitude + final latitude)/2 which in this questions is (59° + 61°) / 2 = 60°.

Inserting these figures into the conversion angle equation gives:

Convergence = 6^0 x Sin 60^0 which = 5.2^0

So the great circle track from a to B increases by 5.2^0 or approximately 5^0 at point B (option d).

CIRCLES 23 a.
INS systems cause aircraft to fly great circle tracks. The direction flown along these tracks varies with the convergence of the meridians. this convergence can be calculated using the equation:

Convergence = Change in longitude x Sin of the mean latitude.

So for any given change in latitude, the convergence will be greatest when the Sin of the change in latitude is greatest. The sin of an angle increases from zero at zero degrees to 1 at 90 degrees. So convergence between any two longitudes is greatest when the mean latitude is greatest. In option a the mean latitude is 60^0, in option b it is 55^0, in option c it is 0^0 and in option d it is 27.5^0. So option a, has the greatest mean latitude and hence the greatest convergence and change in great circle track.

CIRCLES 24 c.
The difference between a great circle track and a rhumb line bearing is equal to the conversion angle. This can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 30° W to 20° W, which is a change of -10^0.

The mean latitude is equal to (Initial latitude + final latitude)/2 which in this questions is (55° + 54°) / 2 = 54.5°.

Inserting these figures into the convergence equation gives:

Convergence = ½ x (-10^0) x Sin 54.5^0 which = -4.07^0

So the great circle track from A to B is the rhumb line track minus 4.07^0.

The question states that the great circle track is 100^0 T so the rhumb line bearing is 100^0 T + 4.07^0 = 104.07^0 T or approximately 104^0 T (option c)

CIRCLES 25 c.
The direction of a great circle track varies along its path in direct proportion to the convergence of the meridians crossed. This convergence can be calculated using the equation:

Convergence = Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 70° W to 80° W, which is a change of $+10^0$.

The latitude is constant at 60° S.

Inserting these figures into the convergence equation gives:

Convergence = $+10^0$ x Sin 60^0 which = $+8.66^0$.

So the track increases by approximately 9^0 between waypoint 2 and waypoint 3. So the initial track is approximately 9^0 less than the final one (option c).

CIRCLES 26 a.

The difference between a great circle track and a rhumb line track is equal to the conversion angle. The conversion angle can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 10° W to 30° W, which is a change of $+20^0$.

The latitude is constant at 45° S.

Inserting these figures into the conversion angle equation gives:

Convergence = ½ x ($+20^0$) x Sin 45^0 which = $+7.07^0$.

So the track increases by approximately $+7.07^0$ between point A and point B.

The rhumb line track between points a and B is 270^0, so the great circle track at point B will be $270^0 + 7.07^0 = 277.07^0$ or approximately 277^0 (option a).

CIRCLES 27 d.

The direction of a great circle track varies along its path in direct proportion to the convergence of the meridians crossed. This convergence can be calculated using the equation:

Convergence = Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 30° W at waypoint 1 to 20° W at waypoint 2, which is a change of -10^0.

The latitude is constant at 60° S.

Inserting these figures into the convergence equation gives:

Convergence = -10^0 x Sin 60^0 which = -8.66^0.

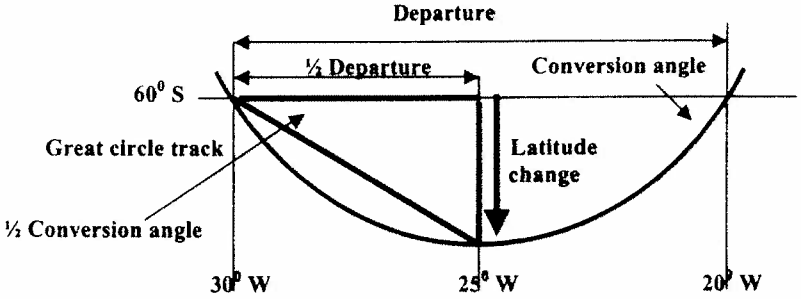
So the track decreases by 8.66^0, or approximately 9^0 when passing waypoint 2 (option d).

CIRCLES 28 d.

A rhumb line is one that cuts all meridians at the same angle (option d). This angle may by 90^0 in the case of line of latitude or 0^0 in the case of the meridians.

CIRCLES 29 d.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 30^0 W – 20^0 W = 10^0

The latitude of both points is 60^0 S so the mean latitude is also 60^0 S

So conversion angle = ½ x 10^0 x Sin 60^0 Which = 4.33^0

So the angle in the triangle in the above diagram is 2.165^0

Departure between the two points = Change in longitude (in minutes) x Cos latitude

Which is Departure = 600' Cos 60^0 = 300 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 2.165^0 x 150 nm which = 5.67nm

Each nm along a meridian equates to 1 minute of latitude, so 5.67 nm equates to a change of latitude of 5.67 minutes.

The initial latitude was 60^0 N so the new latitude is 60^0 5.67' S. Option d. 60^0 06' S is the closest to this figure.

CIRCLES 30 c.

A rhumb line is one that cuts all meridians along its path at the same angle. In the case of meridians this angle is zero. Although a rhumb line will not give the shortest distance between two points, it has the advantage that its direction does not change along its length. So two fly between any two points at a constant true heading it is necessary to fly a rhumb line track (option c).

CIRCLES 31 a.

The difference between the true great circle track and the true rhumb line track between any two points is equal to the conversion angle. This conversion angle can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 165° W at waypoint A to 177° E at waypoint B, which is a change of 18^0.

The latitude is constant at 60° S.

Inserting these figures into the convergence equation gives:

Convergence = ½ x 18^0 x Sin 60^0 which = 7.79^0.

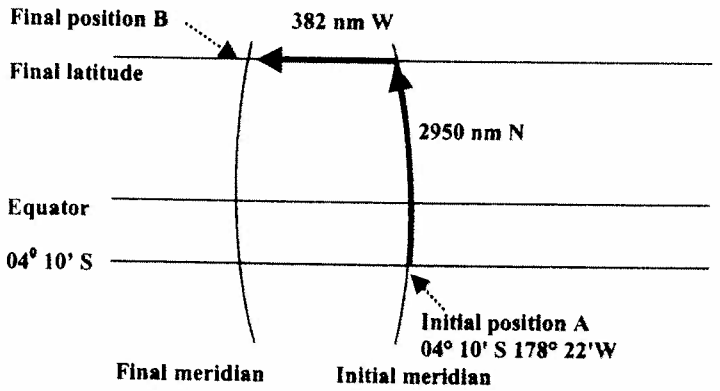
So the track decreases by 7.79^0, or approximately 7.8^0 when departing from point A (option a).

CIRCLES 32 b.

A great circle is one for which the radius of the circle is the same as the radius of the earth. This means that the centre of any great circle must be the centre of the earth. Rhumb lines are circles or arcs of circles which intersect all of the meridians that they cross at the same angle. Parallels of latitude are rhumb lines because they cross all meridians at the same angle. But the centre of a parallel of latitude will be the centre of the earth only if the parallel is the equator. So parallels of latitude are rhumb lines but not great circles (option b).

CIRCLES 33 b.

To solve this type of problem it is helpful to start with a simple sketch of the situation as illustrated below:



The distance flown in nm along any meridian is equal the change in latitude in minutes. So flying 2950 nm North causes a change of latitude of 2950' N or 49^0 10' N making the final latitude equal to the initial latitude (04° 10' S) + 49^0 10' N which = 45^0 00' N.

The change in longitude caused by flying 382 nm westward at the new latitude can be calculated using the equation:

Departure = Change in longitude x Cos latitude,
Where the departure is equal to the distance flown along the parallel of latitude.

This equation can be rearranged to give:

Change in longitude = Departure / Cos latitude

Inserting the above figures gives:

Change in longitude = 382 nm / Cos 45^0 which = 540.2' or approximately 9^0

Adding this to the initial longitude gives (178° 22'W) + 9^0 W = 187^0 22' W. But maximum possible longitudes are 180^0 W and 180^0 E, so 187^0 22' W is more properly expressed as 172^0 28' E (option b).

CIRCLES 34 b.
A rhumb line is a line on the surface of the earth cutting all meridians within its length at the same angle (option b). Rhumb lines include all parallels of latitude and all meridians.

CIRCLES 35 d.
The direction of a great circle varies constantly along its length, such that it cuts each meridian at a slightly different angle. If a great circle track and a rhumb line track are drawn between two points, the tracks differ at each end but are parallel in the center. This means that if the average true course of a great circle between two points is 100^0, then the true course of the rhumb line between those points is also 100^0 (option d).

CIRCLES 36 a.
The direction of a great circle track between two points varies due to the convergence of the meridians. The magnitude of this change is equal to the conversion angle, which can be calculated using the equation below. The direction at any point on a great circle is equal to the rhumb line track plus the conversion angle.

Conversion angle = ½ change in longitude x the sin of the mean latitude

The change in longitude in this question is from 120° 00'W to 140° 30'W, which is a change of $+20^0$ 30'.

The latitude in this question is constant at 60° 00'N, so the mean latitude is also 60° 00'N.

Inserting these figures into the conversion angle equation gives:

Conversion angle = ½ x $+20^0$ 30' x sin 60° = $+8.88^0$. or approximately 9^0.

The direction at any point on a great circle track is equal to the rhumb line track plus the conversion angle.

Both points A and B are at the same latitude, so the rhumb line track from point a to point B in this question is 270^0, so the great circle direction at point a is 270^0 + 9^0 = 279^0 (option a).

CIRCLES 37 a.
A rhumb line is a line on the surface of the earth cutting all meridians within its length at the same angle (option b). Rhumb lines are all parallels of latitude and

all meridians (option a). It should be noted that the equator is also a Rhumb Line.

CIRCLES 38 c.
The antipodes of any point are 180^0 away from that point in all directions. So the coordinates of the antipodes of any point are the coordinates of that point plus 180^0 N and 180^0 S. Adding theses figures to the coordinates given in this question gives S41^0 10' E177^0 43.5 (option c)

CIRCLES 39 c.
A Lamberts chart is produced by projecting the graticule of the Earth onto a cone of paper the inside surface of which touches the surface of the reduced Earth along two parallels of latitude. This causes the parallels of latitude to be represented by curves concave to the nearest pole, and the meridians to be represented by straight lines radiating outwards from the nearest pole. Great circles are circles, the centre of which is that of the earth. So any Great Circle that is not a meridian will appear as a curve concave to the parallel of origin on a Lamberts Conformal conic chart (option c). The closer a Great Circle is to being a meridian the closer it will come to being a straight line on a Lamberts Conformal Conic chart.

CIRCLES 40 c.
A Rhumb Line is one that crosses all meridians in its path at the same angle. On a Direct Mercator chart, the meridians are represented by straight parallel lines. This means that Rhumb Lines on such charts are also represented by straight lines (option c).

CIRCLES 41 b.
On a Polar stereographic chart Great Circles at latitudes of 70^0 or more can be considered to be straight lines. This question can therefore be solved by calculating the conversion angle using the equation below, then applying this to the Rhumb Line track.

Conversion angle = ½ Change in longitude x Sin of mean latitude.

In this question the change in longitude is from 65^0 E to 25^0 W which = 90^0 W

The latitude of both positions of 70^0 S so the mean latitude is 70^0 S.

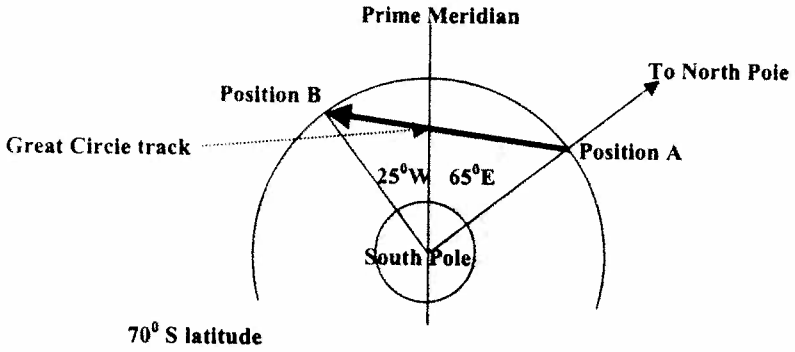
Putting these figures into the above equation gives:

Conversion angle = ½ x 90^0 x Sin 70^0 S = 42.286^0

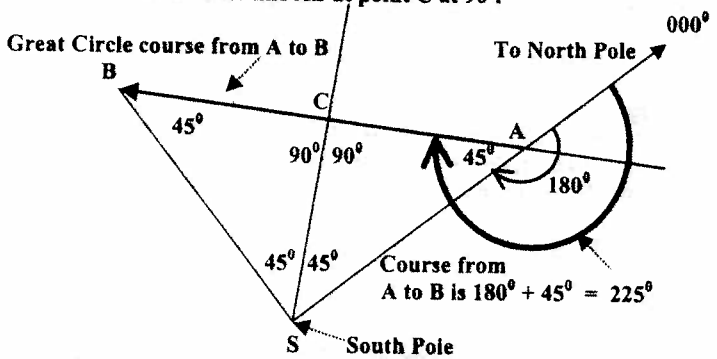
Both positions are on the same parallel of latitude and position B is West of position A, so the Rhumb Line track is 270^0. Applying the conversion angle gives

an initial true Great Circle track of $270^0 - 42.286^0 = 227.714^0$. The option closest to this answer is option b 225^0.

An approximate answer to this question can also be calculated using trigonometry as illustrated.



A line dividing the angle ASB into two equal angles
Crosses the line AB at point C at 90^0.



The total angle enclosed by any triangle is 180^0, so in the triangle ASC the angle CAS is $180^0 - 90^0 - 45^0 = 45^0$. The direction form point A to the south pole is 1800, so the direction form point A to point B is $180^0 + 45^0 = 225^0$.

CIRCLES 42 c.
On a Direct Mercator chart, the meridians are represented by straight parallel lines. A Great Circle is a circle the radius of which is the same as that of the Earth and whose centre is the centre of the Earth. This means that Great Circles on such a chart are represented by curves that are concave to the equator (option c).

CIRCLES 43 a.
A Rhumb line is a circle or arc of a circle the radius of which is less than that of the Earth. This means that the centre of the circle of which any Rhumb Line is

a part, cannot also be the centre of the Earth. This in turn means that Rhumb lines include all parallels of latitude, with the exception of the Equator, which is a great circle (option a).

CIRCLES 44 b.
On a Direct Mercator chart, the meridians are represented by straight parallel lines. A Great Circle is a circle the radius of which is the same as that of the Earth and whose centre is the centre of the Earth. This means that Great Circles on such a chart are represented by curves concave to the equator (option b).

CIRCLES 45 a.
On a Direct Mercator chart, the meridians are represented by straight parallel lines. A Great Circle is a circle the radius of which is the same as that of the Earth and whose centre is the centre of the Earth. This means that with the exception of meridians and the equator, they are curves concave to the equator (option a).

CIRCLES 46 d.
A Rhumb Line is one that crosses all meridians in its path at the same angle. On a Direct Mercator chart, the meridians are represented by straight parallel lines. This means that Rhumb Lines on such a chart are also represented by straight lines (option d).

CIRCLES 47 a.
A polar Stereographic chart is one that is projected onto a flat sheet of paper that is in contact with the nearest pole. This means that only the nearest hemisphere is visible. The parallels of latitude are represented by concentric circles centred on the pole. The meridians are represented by straight lines passing through the nearest Pole.

Great circles are circles the radius of which is the same as that of the earth. The centre of any great circle is the centre of the earth. Great circles include the equator, the meridians, and all circles, the centre of which is the centre of the earth. The higher the latitude of any great circle, the closer it will be to a meridian. This means that the higher the latitude of any great circle, the closer it will become to approximating a straight line on a Polar Stereographic chart (option a).

CIRCLES 48 c.
A Lamberts chart is produced by projecting the graticule of the Earth onto a cone of paper the inside surface of which touches the surface of the reduced Earth. This causes the parallels of latitude to be represented by curves convex to the nearest pole, and the meridians to be represented by straight lines radiating outwards from the nearest pole (option c).

CIRCLES 49 b.

A polar Stereographic chart is one that is projected onto a flat sheet of paper that is in contact with the nearest pole. This means that only the nearest hemisphere is visible. The parallels of latitude are represented by concentric circles centred on the pole. The meridians are represented by straight lines passing through the nearest Pole. A Rhumb Line is one that crosses all meridians in its path at the same angle. Because the meridians on a Polar Stereographic chart radiate outwards from the nearest pole, Rhumb Lines (other than meridians) on such charts are represented by curves concave to the nearest pole (option b).

CIRCLES 50 b.

On a Direct Mercator chart, the meridians are represented by straight parallel lines. A Great Circle is a circle the radius of which is the same as that of the Earth and whose centre is the centre of the Earth. This means that With the exception of meridians and the equator, they are curves convex to the nearest pole (option b).

CIRCLES 51 a.

On a Polar stereographic chart Great Circles at latitudes of 70^0 or more can be considered to be straight lines. This question can therefore be solved by calculating the conversion angle using the equation below, then applying this to the Rhumb Line track.

Conversion angle = ½ Change in longitude x Sin of mean latitude.

In this question the change in longitude is from 60^0 W to 60^0 E which = 120^0 W

The latitude of both positions of 70^0 S so the mean latitude is 70^0 S.

Putting these figures into the above equation gives:

Conversion angle = ½ x 120^0 x Sin 70^0 S = 56.38^0

Both positions are on the same parallel of latitude and position B is West of position A, so the Rhumb Line track is 090^0. Applying the conversion angle gives an initial true Great Circle track of $090^0 - 56.38^0 = 33.618^0$. The option closest to this answer is option a, 030^0.

CIRCLES 52 a.

A Lamberts Conformal Conic projection is produced by projecting the graticule of the Earth onto a cone of paper the inside surface of which touches the surface of the reduced Earth along two parallels of latitude. This causes the parallels of latitude to be represented by curves concave to the nearest pole, and the meridians to be represented by straight lines radiating outwards from the nearest pole. Great circles are circles, the centre of which is that of the earth. So any Great Circle that is not a meridian will appear as a curve concave to the

parallel of origin on a Lamberts Conformal conic chart. But the closer a Great Circle is to being a meridian the closer it will come to being a straight line. So straight lines on a lamberts Conformal Conic chart must be either parallels of longitude or approximately great circles (option a).

CIRCLES 53 c.

A Rhumb Line is one that crosses all meridians in its path at the same angle. On a Direct Mercator chart, the meridians are represented by straight parallel lines. This means that Rhumb Lines on such a chart are also represented by straight lines (option c).

CIRCLES 54 d.

A polar Stereographic chart is one that is projected onto a flat sheet of paper that is in contact with the nearest pole. This means that only the nearest hemisphere is visible. The parallels of latitude are represented by concentric circles centred on the pole. The meridians are represented by straight lines passing through the nearest Pole. A Rhumb Line is one that crosses all meridians in its path at thé same angle. Because the meridians on a Polar Stereographic chart radiate outwards from the nearest pole, Rhumb Lines on such charts are represented by curves concave to the nearest pole (option d).

CIRCLES 55 a.

The Parallel of Origin of a Lamberts Chart is midway between the standard parallels. The standard parallels in this chart are at 37^0 N and 65^0N so the Parallel of Origin is at $(37^0 + 65^0)/2 = 51^0$ N.

Great Circles on Lamberts Charts are represented by straight lines between any two points on the Parallel of Origin. At all other points on the chart, Great Circles are represented by curves concave to the Parallel of origin. The two points in this question are south of the Parallel of Origin, so the Great Circle between them will also be to the South of a straight line between them.

Rhumb lines of Lamberts Charts are curves concave to the pole of origin , which in this case is the North Pole. So the Rhumb Line between points a and B will also be to the South. So both the Great Circle and the Rhumb Line between points A and B will be to the South (option a)

CIRCLES 56 a.

On a Polar stereographic chart Great Circles at latitudes of 75^0 or more can be considered to be straight lines. This question can therefore be solved by calculating the conversion angle using the equation below, then applying this to the Rhumb Line track.

Conversion angle = ½ Change in longitude x Sin of mean latitude.

In this question the change in longitude is from 65^0 E to 25^0 W which = 90^0 W

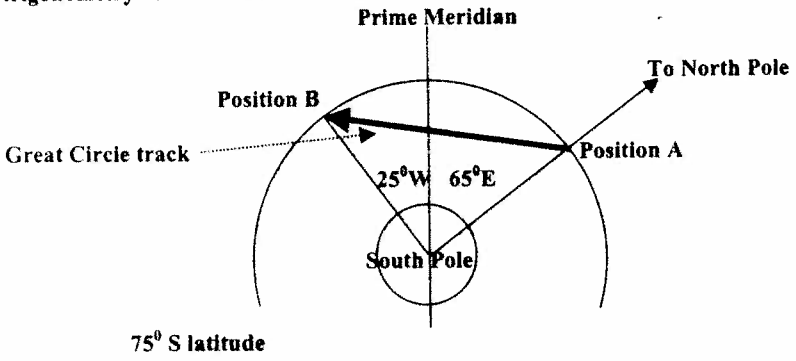
The latitude of both positions of 75^0 S so the mean latitude is 75^0 S.

Putting these figures into the above equation gives:

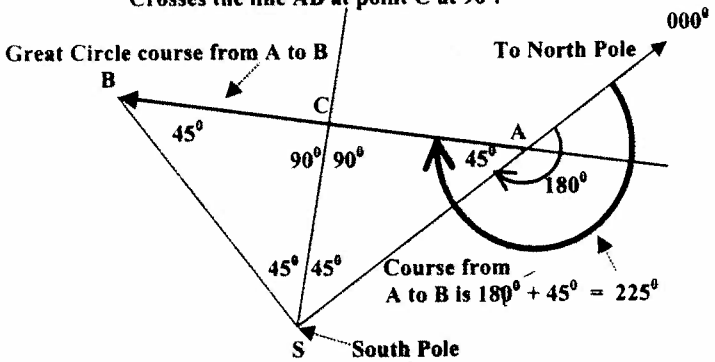
Conversion angle = ½ x 90^0 x Sin 75^0 S = 43.47^0

Both positions are on the same parallel of latitude and position B is West of position A, so the Rhumb Line track is 270^0. Applying the conversion angle gives an initial true Great Circle track of $270^0 - 43.47^0 = 226.53^0$. The option closest to this answer is option a, 225^0.

An approximate answer to this question can also be calculated using trigonometry as illustrated.



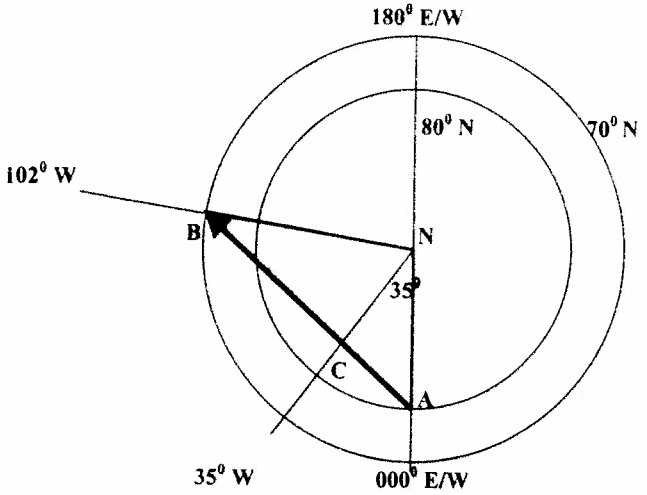
A line dividing the angle ASB into two equal angles
Crosses the line AB at point C at 90^0.



The total angle enclosed by any triangle is 180^0, so in the triangle ASC the angle CAS is $180^0 - 90^0 - 45^0 = 45^0$. The direction form point A to the south pole is 180^0, so the direction form point A to point B is $180^0 + 45^0 = 225^0$.

CIRCLES 57 b.

To solve this type of problem it is necessary to make a sketch of the situation as illustrated below:

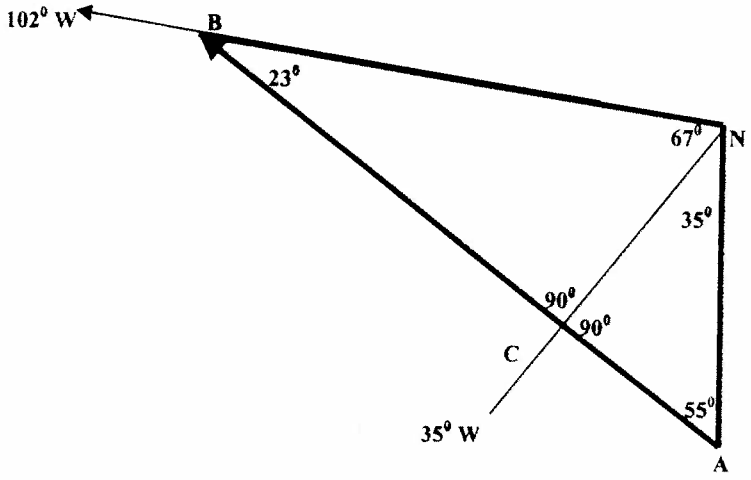


The question states that the highest latitude on the route from a to B is at longitude 35^0 W. This means that the angle ANC in the above diagram is 35^0 and that the line from N to 35^0 W crosses the line AB at 90^0. The sum of the angle in any triangle is 180^0 so angle NAC is $180^0 - (90^0 + 35^0) = 65^0$.

Angle ANB is 102^0 and angle ANC is 35^0, so angle CAN is $102^0 - 35^0 = 67^0$.

In triangle CNB, angle CBN is $180^0 - (90^0 + 67^0) = 23^0$.

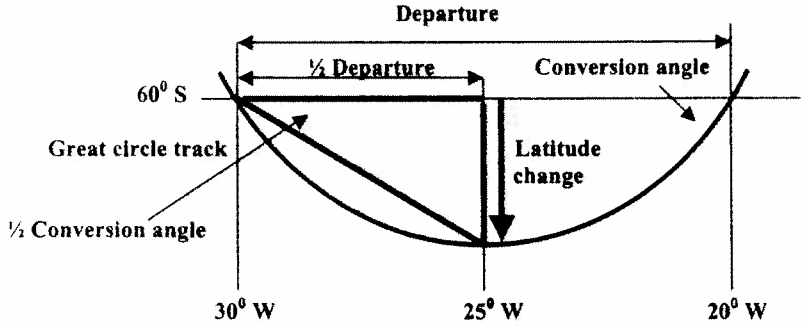
The diagram below illustrates the two triangles with the above results included.



The line from B to N is at 000^0 so the line from n to B is 180^0. Adding to this the angle ABN (23^0) give a course of $180^0 + 23^0 = 203^0$ (option b)

CIRCLES 58 b.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 30^0 W – 20^0 W = 10^0

The latitude of both points is 60^0 S so the mean latitude is also 60^0 S

So conversion angle = ½ x 10^0 x Sin 60^0 Which = 4.33^0

So the angle in the triangle in the above diagram is 2.165^0

Departure between the two points = Change in longitude (in minutes) x Cos latitude

Which is Departure = 600' Cos 60^0 = 300 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 2.165^0 x 150 nm which = 5.67nm

Each nm along a meridian equates to 1 minute of latitude, so 5.67 nm equates to a change of latitude of 5.67 minutes.

The initial latitude was 60^0 S so the new latitude is 60^0 5.67' S. Option b, 60^0 05.7' S is the closest to this figure.

CIRCLES 59 a.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 45^0 N, and the departure is 350 nm.

Inserting these figures into the above equation gives:

Change in longitude = 350 nm / Cos 45^0 = 495' which is 8^0 15'.

The question states that point B is to the east of point A so subtracting the above figure from the longitude of b gives: B (45° 15'E) – (8^0 15') = 37^0 (option a).

CIRCLES 60 c.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 45^0 N, and the departure is 200 nm.

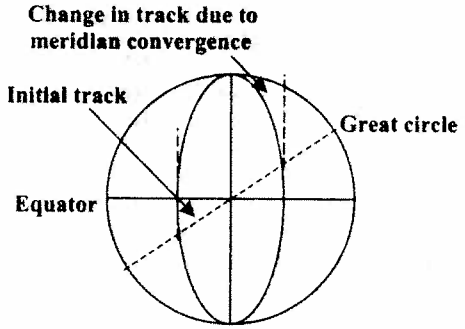
Inserting these figures into the above equation gives:

Change in longitude = 200 nm / Cos 45^0 = 283' which is 4^0 43'.

The question states that point B is to the east of point A so subtracting the above figure from the longitude of B gives: B (45° 15'E).– (4^0 43') = 40^0 32' (option c).

CIRCLES 61 a.

The track at any point on a great circle is the angle between the great circle direction and the meridian at that point. All meridians are parallel at the equator, but gradually converge as latitude increases towards either of the two poles. This causes the track of great circles other than the meridians and the equator, to change as latitude changes. This effect is illustrated at the right.



This change of track between any two points on a great circle is equal to the convergency of the meridians between these two points. The change in great circle track between two points can be calculated using the convergency equation below:

Convergency = change in longitude x Sin of mean latitude.

The change in longitude = initial longitude – final longitude

Which in this question = 150^0 W – 140^0 W = 10^0

The mean latitude = (initial latitude + final latitude) / 2

Which in this question = (57^0 S + 63^0 S) / 2 = 60^0

Inserting these figures into the standard equation gives:

Convergency = 10^0 x sin 60 = 8.66^0

So between points A and B, the great circle track increases by approximately 9^0 (option a).

CIRCLES 62 a.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 45^0 N, and the departure is 280 nm.

Inserting these figures into the above equation gives:

Change in longitude = 280 nm / Cos 45^0 = 395.98' which is 6^0 36'.

The question states that point B is to the east of point A so subtracting the above figure from the longitude of b gives: B (50° 15'E) – (6^0 36') = 43^0 39' E (option a).

CIRCLES 63 b.

To solve this type of problem the following points must be noted:

a. A straight line on a Lambert conformal chart is a great circle.
b. The direction of great circles changes along their lengths by an amount equal to the convergence of the meriadians between any two points on the great circle.
c. For a Lambert conformal chart the equation for the convergence of meridians is:

   Convergence = Change in longitude x constant of the cone

The initial course at point A (40° N 050° W) is 043° (T) and at point B is 055° (T). This means that the difference in course is 12^0, which is also the convergence between the meridians at A and B. So the convergence angle between points A and B is 12^0.

The question states that the constant of the cone is 0.85.

Inserting these values into the convergence equation above gives:

12^0 = Change in longitude x 0.85

Rearranging this gives Change in longitude = 12^0 / 0.85 = 14.12^0.

The initial longitude at point A is 050° W so the longitude at point B is 050° W – 14.12^0 = 35.88^0 = or approximately 36^0 W (option b).

CIRCLES 64 c.

The direction of a great circle track varies along its length such that it cuts each meridian at a slightly different angle. These changes are caused by the convergence of the meridians as latitude increases towards either of the two poles. The difference between the great circle direction and the rhumb line direction is the conversion angle. This angle can be calculated using the standard equation:

Conversion angle = ½ the change in longitude x the sin of the mean latitude

The change of longitude is the difference between the final and initial longitudes, which in this question is from 035°W, to 065°E = 100 degrees.

The latitude is constant at 70°S so the conversion angle in this question is:

Conversion angle = ½ x 100^0 x sin 70^0 = 46.99^0.

The latitude is constant so the rhumb line direction is 90^0 so the great circle direction is $90^0 + 46.99^0 = 136.99^0$ or approximately 137^0 (option c).

CIRCLES 65 c.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 58^0 42' N, and the departure is 15 nm.

Inserting these figures into the above equation gives:

Change in longitude = 15 nm / Cos 58^0 42' = 28.87'.

The question states that point B is to the east of point A so subtracting the above figure from the longitude of A gives:

Longitude of B = (094° 00'W) – (28.87') = 93^0 31.13' W (option c).

CIRCLES 66 b.

This question states that an incorrect longitude has been put into the INS. An INS system will accept such an error, and will calculate all subsequent longitude positions based upon the error. This means that all subsequent longitudes with include the same magnitude of error as the longitude originally put into the system.

The initial error is the difference between the longitude put into the INS and the actual longitude. If the two longitudes are in different directions the error can be calculated using the equation:

Longitude error = input longitude + actual longitude

Inserting the data provided gives:

Longitude error = (139° 46.3'W) + (139° 46.3'E) = 279^0 32.6' The input position is to the west of the actual position so the error is 279^0 32.6' W

When the aircraft subsequently arrives at position point 52° N 180°W, the indicated position will be 279^0 32.6' W of that point.

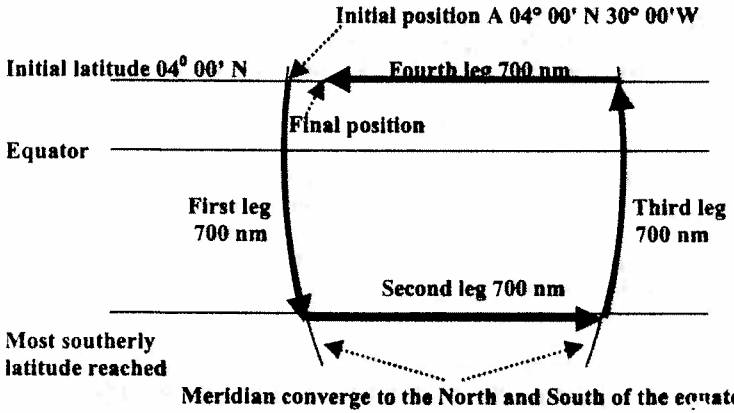
So the indicated position will be

(52° N 180°W) + (279^0 32.6' W) = 459^0 32.6' W.

But longitudes must be within the range 180^0 E to 180^0 W so by subtracting 360^0, the indicated position of 459^0 32.6' W is more properly expressed as 99^0 32.6' W, which is closest to option b.

CIRCLES 67 c.

When solving this type of question it is helpful to start with a sketch of the situation as illustrated below.



To calculate the change in latitude during the first leg (Northerly) and third leg (Southerly) use the fact that each nm along any meridian is equal to 1' latitude. So 700 nm = 700' which is 11^0 40' change of latitude.

So the most Southerly latitude reached is 11^0 40' South of the initial latitude of (04^0 00' N). The most Southerly latitude is therefore 07^0 40' S.

During the second leg the aircraft flies 700 nm to the East at latitude 07^0 40' S. Using the departure equation to calculate the change in longitude gives:

Departure = Change in longitude x Cos latitude

Which can be rearranged to give: Change in longitude = Departure/Cos latitude

Inserting the data above gives:

Change in longitude = 700 nm / Cos 07^0 40' which = 706.3' E.

Dividing this by 60 gives change in longitude = 11^0 46.3' E so the longitude at the end of the second leg:

Longitude = initial longitude (030° 00'W) + (11^0 46.3' E) = 18^0 13.7' W

During the fourth leg at latitude 04^0 00' N the aircraft flies 700 nm west. The final change in longitude can be calculated using the same departure equation:

Change in longitude = 700 nm / Cos 04^0 00' which = 701.71' W.

Dividing this by 60 gives change in longitude = 11^0 41.71'W, so the longitude at the final longitude at the end of the fourth leg is equal to the longitude at the end of the third leg (18^0 13.7' W) + the change of longitude during the fourth leg (11^0 41.71' W) which gives a final longitude of 29^0 55.4' W (option c).

CIRCLES 68 c.

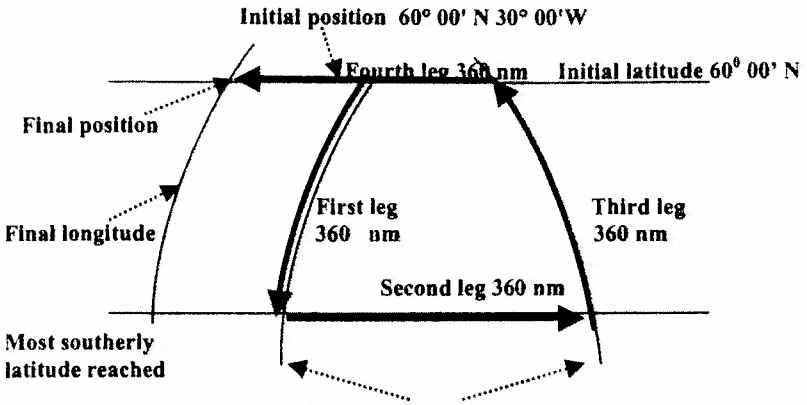
The difference between the initial great circle track and the mean great circle track is the conversion angle. This can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

So for any given change in longitude the conversion angle will be greatest where the sin of the mean latitude is greatest. Of the options given in this question option a gives sin 27.5 = 0.46, option b gives sin 0 = 0, option c gives sin 57.5 = 0.84, and option d gives sin 0 = 0. So option c, give the greatest difference between initial and mean great circle track.

CIRCLES 69 b.

When solving this type of question it is helpful to start with a sketch of the situation as illustrated below.



Meridian converge as to the North and South of the equator

To calculate the change in latitude during the first leg (Northerly) and third leg (Southerly) use the fact that each nm along any meridian is equal to 1' latitude. So 360 nm = 360' which is 6^0 change of latitude.

So the most Southerly latitude reached is 6^0 South of the initial latitude of (60^0 00' N). The most Southerly latitude is therefore 54^0 00' N.

During the second leg the aircraft flies 360 nm to the East at latitude 54^0 00' N. Using the departure equation to calculate the change in longitude gives:

Departure = Change in longitude x Cos latitude

Which can be rearranged to give: Change in longitude = Departure/Cos latitude

Inserting the data above gives:

Change in longitude = 360 nm / Cos 54^0 00' which = 612.47' E.

Dividing this by 60 gives change in longitude = 10^0 12.47' E so the longitude at the end of the second leg:

Longitude = Initial longitude (30° 00'W) + (10^0 12.47' E) = 19^0 47.53' W

During the third the aircraft flies 360 nm North taking it back to latitude 60^0 N but now at longitude 19^0 47.53' W.

During the fourth leg at latitude 60^0 00' N the aircraft flies 360 nm west. The final change in longitude can be calculated using the same departure equation:

Change in longitude = 360 nm / Cos 60^0 00' which = 720' W.

Dividing this by 60 gives change in longitude = 12^0 00'W, so the longitude at the final longitude at the end of the fourth leg is equal to the longitude at the end of the third leg (19^0 47.53' W) + the change of longitude during the fourth leg (12^0 00' W) which gives a final longitude of 31^0 47.53 W.

So the final position is 60^0 00' N 31^0 47.53 W, 0r approximately 60^0 00' N 31^0 48 W (option b).

CIRCLES 70 d.

The great circle bearing from any point to any other point is equal to the Rhumb line bearing plus the conversion angle. This can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 050° E to 030° W, which is a change of 80°

Both points are at 70° S, so the change in latitude is nil, so the mean latitude is 70° S.

Inserting these figures into the conversion angle equation gives:

Conversion angle = ½ x 80^0 x Sin 70^0 which = 37.59^0

The rhumb line bearing from point A to point B is 090^0, so the great circle bearing is $090^0 + 37.59^0 = 127.59^0$ or approximately 128^0 (option d).

CIRCLES 71 c.

The distance between any two meridians on any specified parallel of latitude is called the departure. This can be calculated using the standard equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude

To use this equation the distance given in the question must be converted from km into nm. This can be done using the CRP5 or by using the conversion factor 1.85 km = 1 nm to give 350 km / 1.85 = 189.19 nm

The latitude in this question is constant at 60^0 N so putting these figures into the above equation gives:

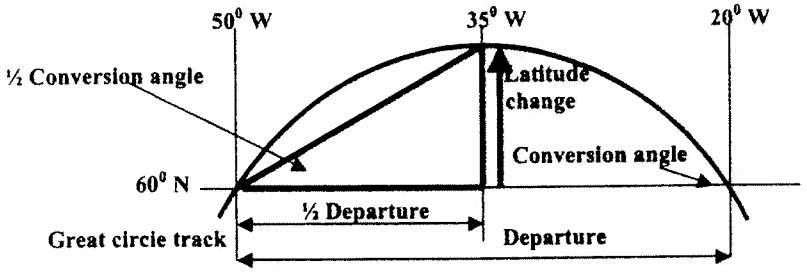
Change in longitude = 189.19 nm / Cos 60 = 378.38' which is 6.31^0.

The aircraft is flying East so the new longitude will be the initial longitude – the change in longitude.

So new longitude = 005° W - 6.31^0. = 1.31^0 E which is approximately 001^0 19' E (option c).

CIRCLES 72 a.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 50^0 W – 20^0 W = 30^0

The latitude of both points is 60^0 N so the mean latitude is also 60^0 N

So conversion angle = ½ x 30^0 x Sin 60^0 Which = 12.99^0

So the angle in the triangle in the above diagram is 6.49°

Departure between the two points = Change in longitude (in minutes) x Cos latitude

Which is Departure = 1800' Cos 60° = 900 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 6.49° x 450 nm which = 51.19nm

Each nm along a meridian equates to 1 minute of latitude, so 51.19 nm equates to a change of latitude of 51.19 minutes.

The initial latitude was 60° N so the new latitude is 60° 51.19' N. Option a. 60° 51' N is the closest to this figure.

CIRCLES 73 a.

On a Lambert conformal conic chart Great Circle routes are represented by complex curves. But over short distances Great Circles are represented by straight lines. Although the distance betweens points A and B is not stated in may be assumed that the straight line course referred to in the question is a Great Circle.

The direction of a great Circle route changes along its length due to the convergency of the meridians. The change in direction between any two points on a great circle route is equal to the convergency angle. On a Lamberts chart this can be calculated using the standard equation:

Convergency = Change in longitude x the constant of the cone of the chart

This equation can be rearranged to give:

Change in longitude = Convergency / the constant of the cone for the chart

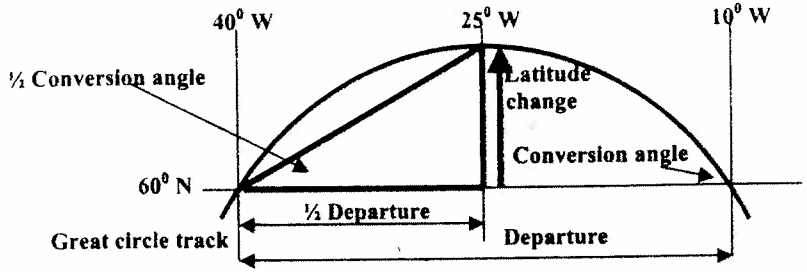
The question states that the course at point A is 075° and that at point B is 095°. This means that the convergency is 20° E. The question also states that the cone constant for the chart is 0.8. Inserting these figures into the above equation gives:

Change in longitude = 20° E / 0.8 = 25° E.

Adding this change to the initial longitude gives (004°W) X (25° E) = 021° E (option a).

CIRCLES 74 a.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 40° W – 10° W = 30°

The latitude of both points is 60° N so the mean latitude is also 60° N

So conversion angle = ½ x 30° x Sin 60° Which = 12.99°

So the angle in the triangle in the above diagram is 6.49°

Departure between the two points = Change in longitude (in minutes) x Cos latitude

Which is Departure = 1800' Cos 60° = 950 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 6.49^0 x 475 nm which = 54.35nm

Each nm along a meridian equates to 1 minute of latitude, so 54.35 nm equates to a change of latitude of 54.35 minutes.

The initial latitude was 60^0 N so the new latitude is 60^0 54.35' N. Option a. 60^0 55' N is the closest to this figure.

CIRCLES 75 a.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude (in minutes) x Cos latitude

This can be rearranged to give:

Change in longitude (in minutes) = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 60^0 N, and the departure is 1200 nm.

Inserting these figures into the above equation gives:

Change in longitude = 1200 nm / Cos 60^0 = 2400' which divided by 60 is 40^0.

Longitude of x = (100° E) + (40^0) = 140^0 E (option a).

CIRCLES 76 c.

The track change at any point on a great circle is equal to the convergence of the meridian between the initial point and the point being considered. This can be calculated using the standard equation:

Convergence = Change in longitude x sin of the mean latitude

Change in longitude = final longitude – initial longitude which in this question is

Change in longitude between waypoints 1 and 2 = 030^0 W – 040^0 W = -10^0

The mean latitude = (initial latitude + final latitude) / 2 which in this question is

Mean latitude = (60^0N + 60^0N)/2 = 60^0N

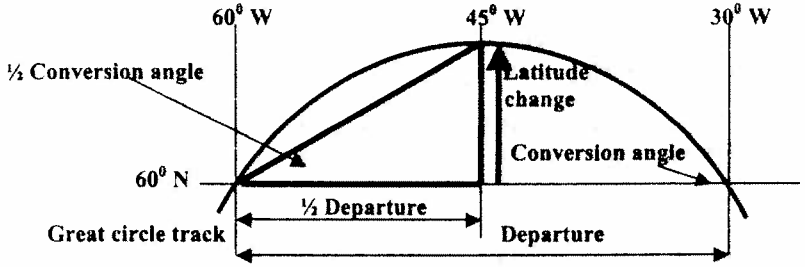
Inserting the above data into the convergence equation above gives:

Convergence = -10^0 x Sin 60^0 = -8.66^0 or approximately -9^0

So the great circle track must be decreased by 9^0 (option c).

CIRCLES 77 c.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 60^0 W – 30^0 W = 30^0

The latitude of both points is 60^0 N so the mean latitude is also 60^0 N

So conversion angle = ½ x 30^0 x Sin 60^0 Which = 12.99^0

So the angle in the triangle in the above diagram is 6.49^0

Departure between the two points = Change in longitude (in minutes) x Cos latitude

Which is Departure = 1800' Cos 60^0 = 950 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 6.49^0 x 475 nm which = 54.04nm

Each nm along a meridian equates to 1 minute of latitude, so 54.04 nm equates to a change of latitude of 54.04 minutes.

The initial latitude was 60^0 N so the new latitude is 60^0 54.04' N. Option a. 60^0 54' N is the closest to this figure.

CIRCLES 78 a.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude (in minutes) x Cos latitude

This can be rearranged to give:

Change in longitude 9in minutes) = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 60^0 N, and the departure is 1200 nm.

Inserting these figures into the above equation gives:

Change in longitude = 1200 nm / Cos 60^0 = 2400' which is 40^0.

Longitude of x = (90° E) + (40^0) = 130^0 E, (option a).

CIRCLES 79 c.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 60^0 N, and the departure is 1800 nm East.

Inserting these figures into the above equation gives:

Change in longitude = 1800 nm East / Cos 60^0 = 3600' which is 60^0 East.

Longitude of x = (160° E) + (60^0 East) = 220^0 E. But longitude run from 180^0 E to 180^0 W, so 220^0 E is more properly expressed as 140^0 W. (option c).

CIRCLES 80 c.

To solve this type of problem it must first be noted that INS systems follow Great circle tracks. The difference between a Great circle direction and a Rhumb Line direction is the conversion angle. In this question both points are at latitude 50^0 S so the Rhumb Line track from 50^0 S 010^0 W to 50^0 S 030^0 W will be will be a constant 270^0. The great circle direction at point B will be 270^0 plus the conversion angle.

The Conversion angle = ½ change in longitude x Sin of mean latitude.

The change in longitude = initial longitude – final longitude

Which in this question = 30^0 W – 10^0 W = 20^0

The mean latitude in this question is constant at 50^0 N

Inserting these figures into the standard equation gives:

Conversion angle = ½ x 50 x sin 20 = 8.55^0

So at point B the Great Circle direction is 270^0 + 8.55^0 = 278.55^0 or approximately 279^0 (option c).

CIRCLES 81 c.

Selecting DSRTK/STS causes the INS to display selected track. INS systems fly great circle routes. The great circle bearing from any point to any other point is equal to the Rhumb line bearing plus the conversion angle. This can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 020° W to 030° W, which is a change of 10°

Both points are at 65° N, so the change in latitude is nil, so the mean latitude is 65° N.

Inserting these figures into the conversion angle equation gives:

Conversion angle = ½ x 10^0 x Sin 65^0 which = 4.53

The rhumb line bearing from point A to point B is 270°, so the great circle bearing is 270° + 4.53° = 274.53° or approximately 275° (option c).

CIRCLES 82 d.

The difference in great circle track between any two points is equal to the convergence of the meridians between these points. This can be calculated using the equation:

Convergence = Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 140° W to 149° W, which is a change of 9°.

The mean latitude is equal to (Initial latitude + final latitude)/2 which in this questions is (59° + 61°) / 2 = 60°.

Inserting these figures into the conversion angle equation gives:

Convergence = 9° x Sin 60° which = 7.79°

So the great circle track from a to B increases by 7.79° or approximately 8° at point B (option d).

CIRCLES 83 d.

INS systems cause aircraft to fly great circle tracks. The direction flown along these tracks varies with the convergence of the meridians. This convergence can be calculated using the equation:

Convergence = Change in longitude x Sin of the mean latitude.

So for any given change in latitude, the convergence will be greatest when the Sin of the change in latitude is reatest. The sin of an angle increases from zero at zero degrees to 1 at 90 degrees. So convergence between any two longitudes is greatest when the mean latitude is greatest. In option a, the mean latitude is 00°, in option b it is 27.5°, in option c it is 60° and in option d it is 65°. So option d, has the greatest mean latitude and hence the greatest convergence and change in great circle track.

CIRCLES 84 c.

The difference between a great circle track and a rhumb line bearing is equal to the conversion angle. This can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 30° W to 20° W, which is a change of -10°.

The mean latitude is equal to (Initial latitude + final latitude)/2 which in this questions is (58° + 51°) / 2 = 54.5°.

Inserting these figures into the convergence equation gives:

Convergence = ½ x (-10°) x Sin 54.5° which = -4.07°

So the great circle track from A to B is the rhumb line track minus 4.07°.

The question states that the great circle track is 100° T so the rhumb line bearing is 100° T + 4.07° = 104.07° T or approximately 104° T (option c)

CIRCLES 85 c.

The direction of a great circle track varies along its path in direct proportion to the convergence of the meridians crossed. This convergence can be calculated using the equation:

Convergence = Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 70° W to 80° W, which is a change of +10°.

The latitude is constant at 70° S.

Inserting these figures into the convergence equation gives:

Convergence = +10° x Sin 70° which = +9.4°.

So the track increases by 9.4° between waypoint 2 and waypoint 3. So the initial track is approximately 9.4° less than the final one (option c).

CIRCLES 86 a.

The difference between a great circle track and a rhumb line track is equal to the conversion angle. The conversion angle can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 10° W to 20° W, which is a change of +10°.

The latitude is constant at 65° S.

Inserting these figures into the conversion angle equation gives:

Convergence = ½ x (+10°) x Sin 65° which = +4.53°.

So the track increases by approximately +4.53° between point A and point B.

The rhumb line track between points a and B is 270°, so the great circle track at point B will be $270^{\circ} + 4.53^{\circ} = 274.53^{\circ}$ or approximately 275° (option a).

CIRCLES 87 d.

The direction of a great circle track varies along its path in direct proportion to the convergence of the meridians crossed. This convergence can be calculated using the equation:

Convergence = Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 50° W at waypoint 1 to 30° W at waypoint 2, which is a change of -10°.

The latitude is constant at 70° S.

Inserting these figures into the convergence equation gives:

Convergence = -10° x Sin 70° which = -9.4°.

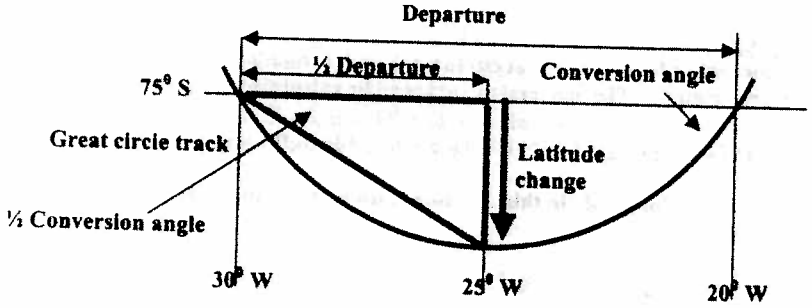
So the track decreases by 9.4°, or approximately 9° when passing waypoint 2 (option d).

CIRCLES 88 a.

A rhumb line is one that cuts all meridians at the same angle (option a). This angle may by 90° in the case of line of latitude or 0° in the case of the meridians.

CIRCLES 89 d.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the

departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 30° W – 20° W = 10°

The latitude of both points is 75° S so the mean latitude is also 75° S

So conversion angle = ½ x 10° x Sin 75° Which = 4.83°

So the angle in the triangle in the above diagram, which is ½ conversion angle is 2.415°

Departure between the two points = Change in longitude (in minutes) x Cos latitude

Which is Departure = 600' Cos 75° = 155 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 2.415° x 155 nm which = 6.54nm

Each nm along a meridian equates to 1 minute of latitude, so 6.54 nm equates to a change of latitude of 6.54 minutes.

The initial latitude was 75° S so the new latitude is 75° 6.54' S. Option a. 60° 07' S is the closest to this figure.

CIRCLES 90 a.

A rhumb line is one that cuts all meridians along its path at the same angle. In the case of meridians this angle is zero. Although a rhumb line will not give the shortest distance between two points, it has the advantage that its direction does not change along its length. So two fly between any two points at a constant true heading it is necessary to fly a rhumb line track (option a).

CIRCLES 91 a.

The difference between the true great circle track and the true rhumb line track between any two points is equal to the conversion angle. This conversion angle can be calculated using the equation:

Conversion angle = ½ Change in longitude x Sin of the mean latitude

The change in longitude in this question is from 160° W at waypoint A to 179° E at waypoint B, which is a change of 19^0.

The latitude is constant at 70° S.

Inserting these figures into the convergence equation gives:

Convergence = ½ x 19^0 x Sin 70^0 which = 8.92^0.

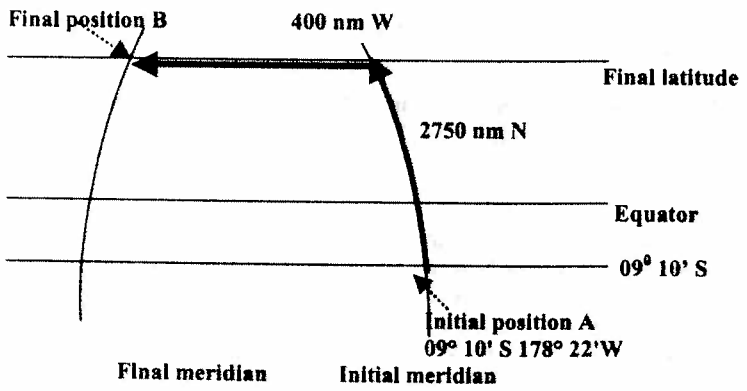
So the track decreases by 8.92^0, or approximately 8.9^0 when departing from point A (option a).

CIRCLES 92 d.

A great circle is one for which the radius of the circle is the same as the radius of the earth. This means that the centre of any great circle must be the centre of the earth. Rhumb lines are circles or arcs of circles, which intersect all of the meridians that they cross at the same angle. Parallels of latitude are rhumb lines because they cross all meridians at the same angle. But the centre of a parallel of latitude will be the centre of the earth only if the parallel is the equator. So parallels of latitude are rhumb lines but not great circles (option d).

CIRCLES 93 b.

To solve this type of problem it is helpful to start with a simple sketch of the situation as illustrated below:



The distance flown in nm along any meridian is equal the change in latitude in minutes. So flying 2750 nm North causes a change of latitude of 2750' N or 45^0 50' N making the final latitude equal to the initial latitude (09° 10' S) + 45^0 50' N which = 36^0 40' N.

The change in longitude caused by flying 400 nm westward at the new latitude can be calculated using the equation:

Departure = Change in longitude x Cos latitude,
Where the departure is equal to the distance flown along the parallel of latitude.

This equation can be rearranged to give:

Change in longitude = Departure / Cos latitude

Inserting the above figures gives:

Change in longitude = 400 nm / Cos 36^0 40' which = 498.7' or approximately 8^0 19'

Adding this to the initial longitude gives (178° 22'W) + 8^0 19 W = 186^0 41' W. But maximum possible longitudes are 180^0 W and 180^0 E, so 186^0 41' W is more properly expressed as 173^0 19' E. So taking into account both the change in latitude and the change in longitude, the new position is 36^0 40' N 173^0 19' W (option b).

CIRCLES 94 d.

A rhumb line is a line on the surface of the earth cutting all meridians within its length at the same angle (option d). Rhumb lines include all parallels of latitude and all meridians.

CIRCLES 95 a.

The direction of a great circle varies constantly along its length, such that it cuts each meridian at a slightly different angle. If a great circle track and a rhumb line track are drawn between two points, the tracks differ at each end but are parallel in the center. This means that if the average true course of a great circle between two points is 100^0, then the true course of the rhumb line between those points is also 100^0 (option a).

CIRCLES 96 a.

The direction of a great circle track between two points varies due to the convergence of the meridians. The magnitude of this change is equal to the conversion angle, which can be calculated using the equation below. The direction at any point on a great circle is equal to the rhumb line track plus the conversion angle.

Conversion angle = ½ change in longitude x the sin of the mean latitude

The change in longitude in this question is from 120° 00'W to 140° 30'W, which is a change of $+20^0$ 30'.

The latitude in this question is constant at 75° 00'N, so the mean latitude is also 75° 00'N.

Inserting these figures into the conversion angle equation gives:

Conversion angle = ½ x $+20^0$ 30' x sin 75° = $+9.9^0$. or approximately 10^0.

The direction at any point on a great circle track is equal to the rhumb line track plus the conversion angle.

Both points A and B are at the same latitude, so the rhumb line track from point a to point B in this question is 270^0, so the great circle direction at point a is 270^0 + 10^0 = 280^0 (option a).

CIRCLES 97 c.

A rhumb line is a line on the surface of the earth cutting all meridians within its length at the same angle (option b). Rhumb lines are all parallels of latitude and all meridians (option c). It should be noted that the equator is also a Rhumb Line.

CIRCLES 98 a.

The antipodes of any point are 180^0 away from that point in all directions. So the coordinates of the antipodes of any point are the coordinates of that point plus 180^0 N and 180^0 S. Adding these figures to the coordinates given in this question gives S41^0 10' E177^0 43.5 (option a)

CIRCLES 99 a.

A Lamberts chart is produced by projecting the graticule of the Earth onto a cone of paper the inside surface of which touches the surface of the reduced Earth along two parallels of latitude. This causes the parallels of latitude to be represented by curves concave to the nearest pole, and the meridians to be represented by straight lines radiating outwards from the nearest pole. Great circles are circles, the centre of which is that of the earth. So any Great Circle that is not a meridian will appear as a curve concave to the parallel of origin on a Lamberts Conformal conic chart (option a). The closer a Great Circle is to being a meridian the closer it will come to being a straight line on a Lamberts Conformal Conic chart.

CIRCLES 100 d.

A Rhumb Line is one that crosses all meridians in its path at the same angle. On a Direct Mercator chart, the meridians are represented by straight parallel lines. This means that Rhumb Lines on such charts are also represented by straight lines (option d).

CIRCLES 101 b.

On a Polar stereographic chart Great Circles at latitudes of 70^0 or more can be considered to be straight lines. This question can therefore be solved by calculating the conversion angle using the equation below, then applying this to the Rhumb Line track.

Conversion angle = ½ Change in longitude x Sin of mean latitude.

In this question the change in longitude is from 65^0 E to 25^0 W which = 90^0 W

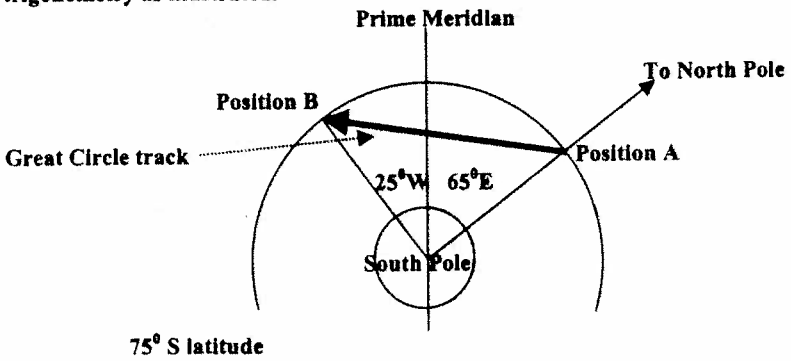
The latitude of both positions of 75^0 S so the mean latitude is 75^0 S.

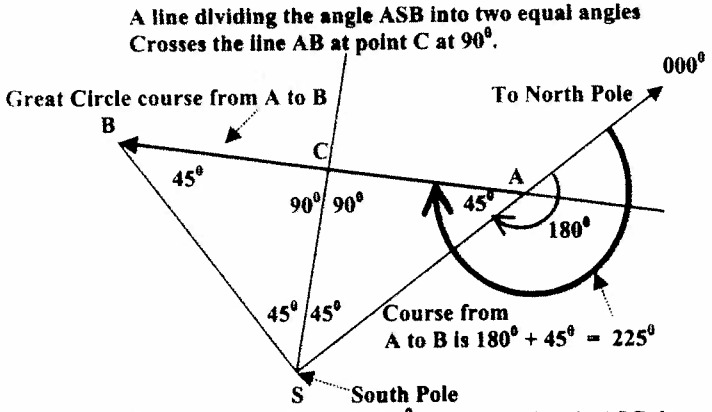
Putting these figures into the above equation gives:

Conversion angle = ½ x 90^0 x Sin 75^0 S = 43.467^0

Both positions are on the same parallel of latitude and position B is West of position A, so the Rhumb Line track is 270^0. Applying the conversion angle gives an initial true Great Circle track of $270^0 - 43.467^0 = 226.53^0$. The option closest to this answer is option b 225^0 (option b).

An approximate answer to this question can also be calculated using trigonometry as illustrated.





The total angle enclosed by any triangle is 180^0, so in the triangle ASC the angle CAS is $180^0 - 90^0 - 45^0 = 45^0$. The direction form point A to the south pole is 180^0, so the direction form point A to point B is $180^0 + 45^0 = 225^0$.

CIRCLES 102 a.

On a Direct Mercator chart, the meridians are represented by straight parallel lines. A Great Circle is a circle the radius of which is the same as that of the Earth and whose centre is the centre of the Earth. This means that Great Circles on such charts are represented by curves concave to the equator (option a).

CIRCLES 103 c.

A Rhumb line is a circle or arc of a circle the radius of which is less than that of the Earth. This means that the centre of the circle of which any Rhumb Line is a part, cannot also be the centre of the Earth. This in turn means that Rhumb lines include all parallels of latitude, with the exception of the Equator which is a great circle (option c).

CIRCLES 104 d.

On a Direct Mercator chart, the meridians are represented by straight parallel lines. A Great Circle is a circle the radius of which is the same as that of the Earth and whose centre is the centre of the Earth. This means that Great Circles on such a chart are represented by curves concave to the equator (option d).

CIRCLES 105 c.

On a Direct Mercator chart, the meridians are represented by straight parallel lines. A Great Circle is a circle the radius of which is the same as that of the Earth and whose centre is the centre of the Earth. This means that With the exception of meridians and the equator, they are curves concave to the equator (option c).

CIRCLES 106 b.

A Rhumb Line is one that crosses all meridians in its path at the same angle. On a Direct Mercator chart, the meridians are represented by straight parallel lines. This means that Rhumb Lines on such a chart are also represented by straight lines (option b).

CIRCLES 107 c.

A polar Stereographic chart is one that is projected onto a flat sheet of paper that is in contact with the nearest pole. This means that only the nearest hemisphere is visible. The parallels of latitude are represented by concentric circles centred on the pole. The meridians are represented by straight lines passing through the nearest Pole.

Great circles are circles the radius of which is the same as that of the earth. The centre of any great circle is the centre of the earth. Great circles include the equator, the meridians, and all circles, the centre of which is the centre of the earth. The higher the latitude of any great circle, the closer it will be to a meridian. This means that the higher the latitude of any great circle, the closer it will become to approximating a straight line on a Polar Stereographic chart (option d).

CIRCLES 108 a.

A Lamberts chart is produced by projecting the graticule of the Earth onto a cone of paper the inside surface of which touches the surface of the reduced Earth. This causes the parallels of latitude to be represented by curves convex to the nearest pole, and the meridians to be represented by straight lines radiating outwards from the nearest pole (option a).

CIRCLES 109 c.

A polar Stereographic chart is one that is projected onto a flat sheet of paper that is in contact with the nearest pole. This means that only the nearest hemisphere is visible. The parallels of latitude are represented by concentric circles centred on the pole. The meridians are represented by straight lines passing through the nearest Pole. A Rhumb Line is one that crosses all meridians in its path at the same angle. Because the meridians on a Polar Stereographic chart radiate outwards from the nearest pole, Rhumb Lines (other than meridians) on such charts are represented by curves concave to the nearest pole (option d).

CIRCLES 110 c.

On a Direct Mercator chart, the meridians are represented by straight parallel lines. A Great Circle is a circle the radius of which is the same as that of the Earth and whose centre is the centre of the Earth. This means that With the exception of meridians and the equator, they are curves convex to the nearest pole (option c).

CIRCLES 111 a.

On a Polar stereographic chart Great Circles at latitudes of 70° or more can be considered to be straight lines. This question can therefore be solved by calculating the conversion angle using the equation below, then applying this to the Rhumb Line track.

Conversion angle = ½ Change in longitude x Sin of mean latitude.

In this question the change in longitude is from 60° W to 60° E which = 120° W

The latitude of both positions of 75° S so the mean latitude is 75° S.

Putting these figures into the above equation gives:

Conversion angle = ½ x 120° x Sin 75° S = 57.96°

Both positions are on the same parallel of latitude and position B is West of position A, so the Rhumb Line track is 090°. Applying the conversion angle gives an initial true Great Circle track of $090^{\circ} - 57.96^{\circ} = 32.044^{\circ}$. The option closest to this answer is option a, 032°.

CIRCLES 112 c.

A Lamberts Conformal Conic projection is produced by projecting the graticule of the Earth onto a cone of paper the inside surface of which touches the surface of the reduced Earth along two parallels of latitude. This causes the parallels of latitude to be represented by curves concave to the nearest pole, and the meridians to be represented by straight lines radiating outwards from the nearest pole. Great circles are circles, the centre of which is that of the earth. So any Great Circle that is not a meridian will appear as a curve concave to the parallel of origin on a Lamberts Conformal conic chart. But the closer a Great Circle is to being a meridian the closer it will come to being a straight line. So straight lines on a lamberts Conformal Conic chart must be either parallels of longitude or approximately great circles (option c).

CIRCLES 113 d.

A Rhumb Line is one that crosses all meridians in its path at the same angle. On a Direct Mercator chart, the meridians are represented by straight parallel lines. This means that Rhumb Lines on such a chart are also represented by straight lines (option d).

CIRCLES 114 b.

A polar Stereographic chart is one that is projected onto a flat sheet of paper that is in contact with the nearest pole. This means that only the nearest hemisphere is visible. The parallels of latitude are represented by concentric circles centred on the pole. The meridians are represented by straight lines

passing through the nearest Pole. A Rhumb Line is one that crosses all meridians in its path at the same angle. Because the meridians on a Polar Stereographic chart radiate outwards from the nearest pole, Rhumb Lines on such charts are represented by curves concave to the nearest pole (option b).

CIRCLES 115 d.

The Parallel of Origin of a Lamberts Chart is midway between the standard parallels. The standard parallels in this chart are at 37° N and 65°N so the Parallel of Origin is at $(37^{\circ} + 65^{\circ})/2 = 51^{\circ}$ N.

Great Circles on Lamberts Charts are represented by straight lines between any two points on the Parallel of Origin. At all other points on the chart, Great Circles are represented by curves concave to the Parallel of origin. The two points in this question are south of the Parallel of Origin, so the Great Circle between them will also be to the South of a straight line between them.

Rhumb lines of Lamberts Charts are curves concave to the pole of origin , which in this case is the North Pole. So the Rhumb Line between points a and B will also be to the South. So both the Great Circle and the Rhumb Line between points A and B will be to the South (option d)

CIRCLES 116 a.

On a Polar stereographic chart Great Circles at latitudes of 75° or more can be considered to be straight lines. This question can therefore be solved by calculating the conversion angle using the equation below, then applying this to the Rhumb Line track.

Conversion angle = ½ Change in longitude x Sin of mean latitude.

In this question the change in longitude is from 45° E to 25° W which = 70° W

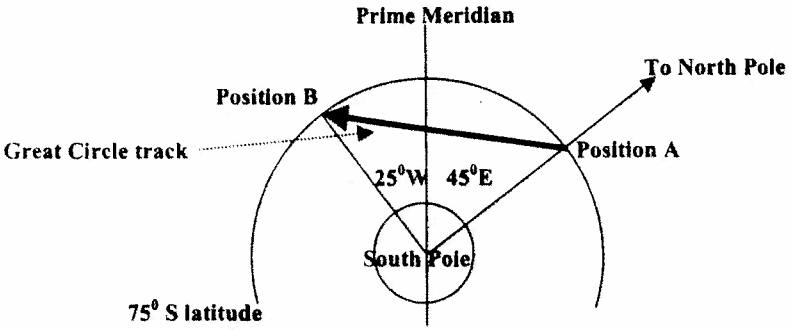
The latitude of both positions of 75° S so the mean latitude is 75° S.

Putting these figures into the above equation gives:

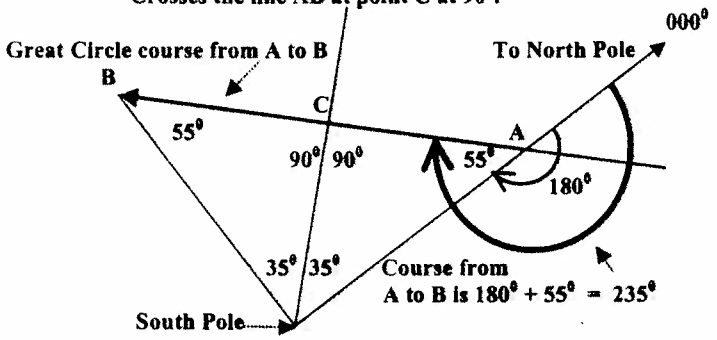
Conversion angle = ½ x 70° x Sin 75° S = 33.81°

Both positions are on the same parallel of latitude and position B is West of position A, so the Rhumb Line track is 270°. Applying the conversion angle gives an initial true Great Circle track of $270^{\circ} - 33.81^{\circ} = 236.19^{\circ}$. The option closest to this answer is option a, 235°.

An approximate answer to this question can also be calculated using trigonometry as illustrated below.



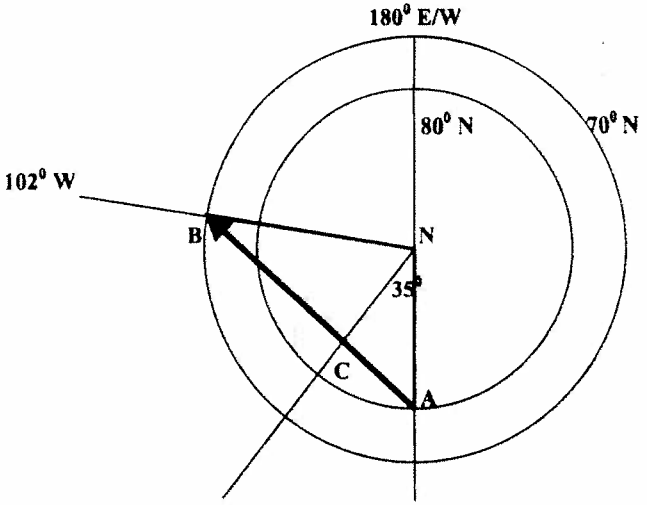
A line dividing the angle ASB into two equal angles
Crosses the line AB at point C at 90°.



The total angle enclosed by any triangle is 180°, so in the triangle ASC the angle CAS is 180° – 90° – 35° = 55°. The direction form point A to the south pole is 180°, so the direction form point A to point B is 180° + 55° = 235°.

CIRCLES 117 b.

To solve this type of problem it is necessary to make a sketch of the situation as illustrated below:

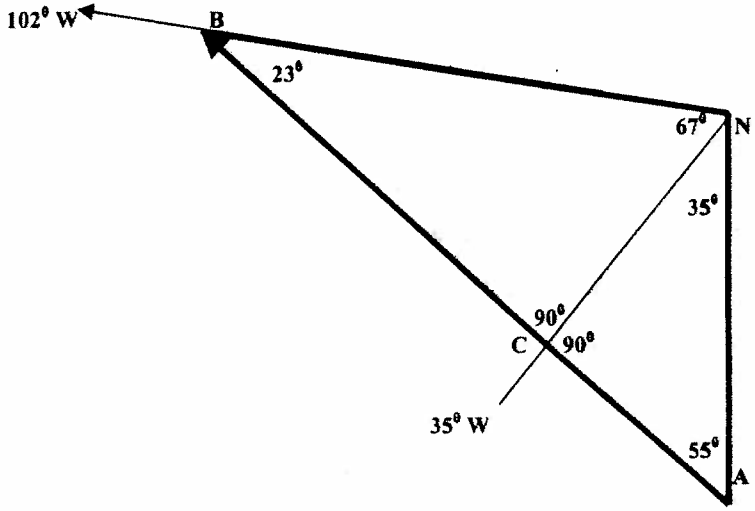


The question states that the highest latitude on the route from a to B is at longitude 35° W. This means that the angle ANC in the above diagram is 35° and that the line from N to 35° W crosses the line AB at 90°. The sum of the angle in any triangle is 180° so angle NAC is 180° – (90° + 35°) = 65°.

Angle ANB is 102° and angle ANC is 35°, so angle CAN is 102° – 35° = 67°.

In triangle CNB, angle CBN is 180° – (90° + 67°) = 23°.

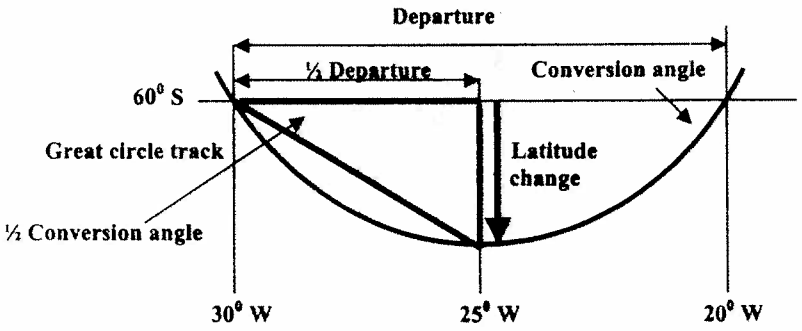
The diagram below illustrates the two triangles with the above results included.



The line from B to N is at 000° so the line from n to B is 180°. Adding to this the angle ABN (23°) give a course of 180° + 23° = 203° (option b)

CIRCLES 118 b.

To solve this type of problem it is helpful to make a sketch of the situation similar to the one below.



An approximate value for the change in latitude at the midway position along a great circle joining two points of longitude, can be calculated using the right angle triangle in the above sketch.

The angle between the parallel of latitude and the great circle is equal to ½ of the conversion angle. The side of the triangle adjacent to this angle is ½ of the departure between the two points. The side of the triangle opposite to the angle is equal to the change in latitude at the midway point along the great circle track between the two points.

From this triangle it can be seen that:

The Tan of ½ conversion angle = change of latitude / ½ departure

This can be rearranged to give:

Change of latitude = Tan ½ conversion angle x ½ departure.

To find the conversion angle use the equation:

Conversion angle = ½ Change in longitude x sin mean latitude

The change of longitude between the two points is 30° W – 20° W = 10°

The latitude of both points is 60° N so the mean latitude is also 60° N

So conversion angle = ½ x 10° x Sin 60° Which = 4.33°

So the angle in the triangle in the above diagram is 2.165°

Departure between the two points = Change in longitude (in minutes) x Cos latitude

Which is Departure = 600' Cos 60° = 300 nm

Inserting these figure into the equation: Change of latitude = Tan ½ conversion angle x ½ departure gives:

Change of latitude = Tan 2.165° x 150 nm which = 5.67nm

Each nm along a meridian equates to 1 minute of latitude, so 5.67 nm equates to a change of latitude of 5.67 minutes.

The initial latitude was 60° S so the new latitude is 60° 5.67' S. Option b, 60° 05.7' S is the closest to this figure.

CIRCLES 119 a.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 45° N, and the departure is 350 nm.

Inserting these figures into the above equation gives:

Change in longitude = 350 nm / Cos 45° = 495' which is 8° 15'.

The question states that point B is to the east of point A so subtracting the above figure from the longitude of b gives: B (45° 15'E) – (8° 15') = 37° (option a).

CIRCLES 120 c.

The distance in nm between any two meridians along a specified parallel of latitude is called the departure. This can calculated using the departure equation:

Departure (in nm) = Change in longitude x Cos latitude

This can be rearranged to give:

Change in longitude = Departure (in nm) / Cos latitude.

In this question the latitude is constant at 45° N, and the departure is 200 nm.

Inserting these figures into the above equation gives:

Change in longitude = 200 nm / Cos 45^0 = 283' which is 6^0 43'.

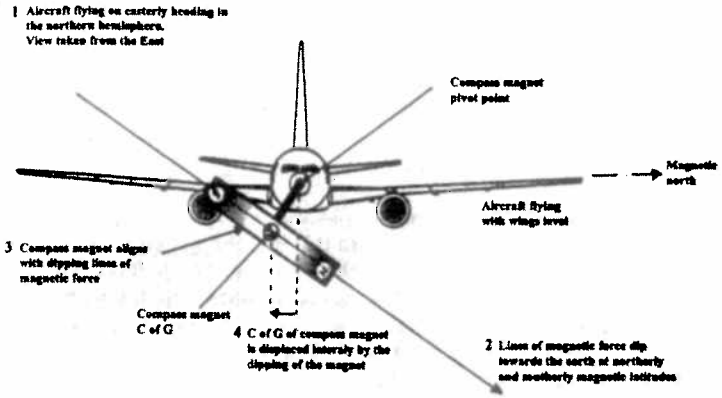
The question states that point B is to the east of point A so subtracting the above figure from the longitude of B gives: B (45° 15'E) – (6^0 43') = 38^0 32' (option c).

MAGNETISM & COMPASSES 1 b.

This question is concerned with the effects of acceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the acceleration rate.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot, as illustrated below.



EFFECT OF DIPPING MAGNETIC LINES OF FORCE ACTING ON PENDULOUSLY SUSPENDED COMPASS MAGNET

This lateral displacement causes the C of G of the compass magnet to lag behind the suspension point, when the aircraft accelerates. This lagging behind causes the compass card to rotate. The compass card is attached to the magnet. So whenever an aircraft accelerates on an Easterly heading, the lateral displacement of the C of G and the inertia its compass magnet, causes the magnet and compass card to rotate. When on an easterly heading this rotation is clockwise giving an apparent turn toward the north (option b).

MAGNETISM & COMPASSES 2 d.

A magnetic compass provides heading information by using a magnetic sensor. This sensor is magnetic and aligns itself with the lines of force that make up the magnetic field of the earth. These lines of force flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy. The accuracy of a magnetic compass is therefore proportional to the horizontal component of the magnetic field of the earth (option d).

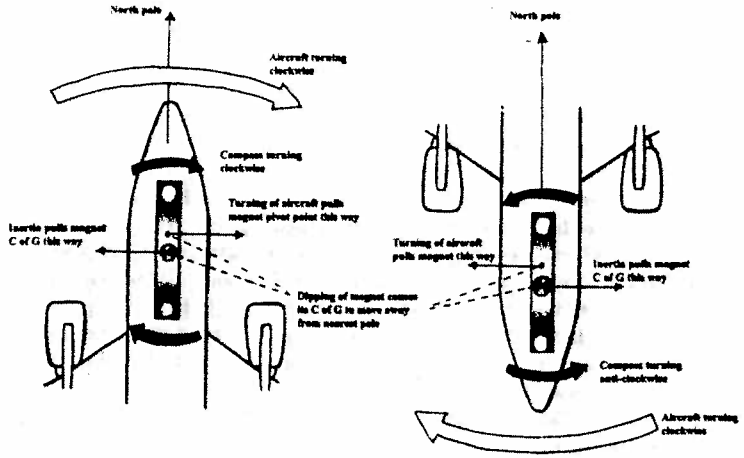
MAGNETISM & COMPASSES 3 a.

This question is concerned with the effects of acceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the acceleration rate.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot, as illustrated below.

When the compass magnet dips to align itself with the lines of magnetic force, its C of G ceases to be directly below its suspension point. The overall effect is that whenever an aircraft is not over the magnetic equator, the C of G of its compass magnet is slightly further from the nearest pole than is its suspension point. Because the C of G of the magnet is no longer directly below its point of suspension, its inertia will cause its C of G to lag behind its suspension point whenever the aircraft turns. The compass card is attached to the magnet. So the effect will be to cause the compass to over-read or under-read depending upon whether the aircraft is turning towards or away from the nearest or furthest pole as illustrated below.



TURNING ERROR WHEN AIRCRAFT IS POINTING TOWARDS NEAREST POLE

TURNING ERROR WHEN AIRCRAFT IS POINTING AWAY FROM NEAREST POLE

This question specifies an aircraft in the Southern hemisphere turning to the right, through the North Pole from 320^{0} to 050^{0}. This situation is illustrated in the right side of the diagram above. The aircraft is turning in a clockwise direction and the compass card is turning in an anti-clockwise direction, so the indicated heading is changing more quickly than the actual heading. This means that the compass will over-indicate.

The compass card is immersed in a liquid. Whenever an aircraft turns, this liquid swirls in the same direction as the aircraft turn. Whenever the aircraft and compass card are turning in opposite directions, the liquid swirl decreases the compass errors. So in this question the compass will over-indicate and the swirl will decrease the error (option a).

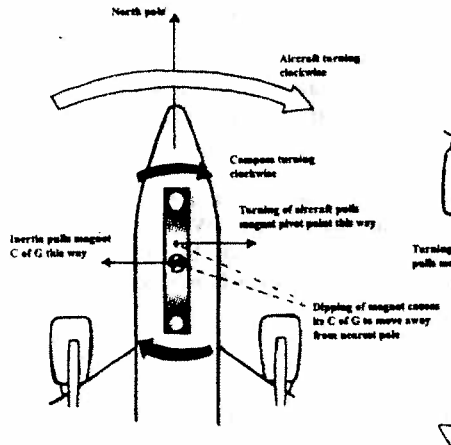
MAGNETISM & COMPASSES 4 c.

This question is concerned with the effects of acceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the acceleration rate.

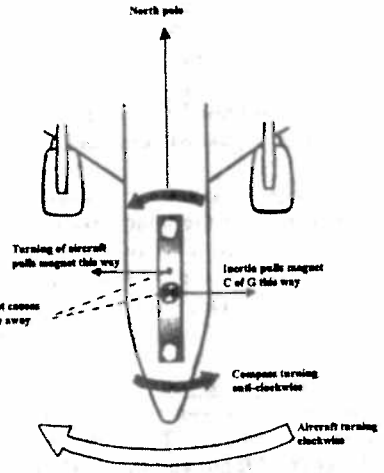
The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot, as illustrated below.

When the compass magnet dips to align itself with the lines of magnetic force, its C of G ceases to be directly below its suspension point. The overall effect is that whenever an aircraft is not over the magnetic equator, the C of G of its compass magnet is slightly further from the nearest pole than is its suspension point. Because the C of G of the magnet is no longer directly below its point of suspension, its inertia will cause its C of G to lag behind its suspension point whenever the aircraft turns. The compass card is attached to the magnet. So the effect will be to cause the compass to over-read or under-read depending upon whether the aircraft is turning towards or away from the nearest or furthest pole as illustrated below.



TURNING ERROR WHEN AIRCRAFT IS POINTING TOWARDS NEAREST POLE



TURNING ERROR WHEN AIRCRAFT IS POINTING AWAY FROM NEAREST POLE

This question specifies an aircraft in the northern hemisphere turning to the right, through the North Pole from 330° to 040°. This situation is illustrated in the left side of the diagram above. Both the aircraft and the compass card are turning in a clockwise direction, so the indicated heading is changing more slowly than the actual heading.

The compass card is immersed in a liquid. Whenever an aircraft turns, this liquid swirls in the same direction as the aircraft turn. Whenever the aircraft

and compass card are turning in the same direction, the liquid swirl increases the compass errors. So in this question the compass will under-read and the swirl will increase the error (option c).

MAGNETISM & COMPASSES 5 a.

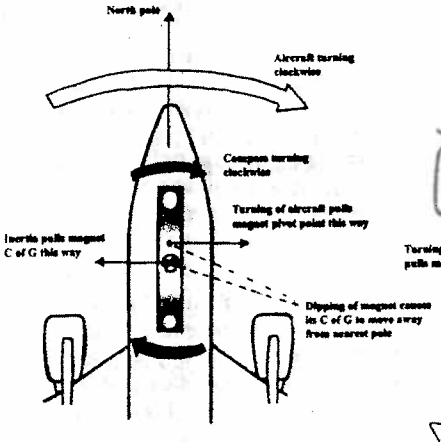
The North and South magnetic poles of the Earth do not coincide exactly with the geographic North and South Poles. The term "magnetic variation" refers to the horizontal angle between the magnetic meridian the true meridian (option a).

MAGNETISM & COMPASSES 6 d.

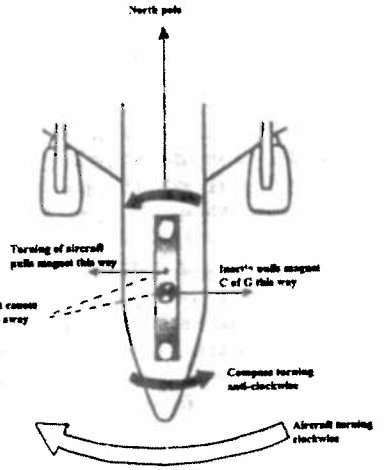
This question is concerned with the effects of acceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the acceleration rate.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot, as illustrated below.



TURNING ERROR WHEN AIRCRAFT IS POINTING TOWARDS NEAREST POLE



TURNING ERROR WHEN AIRCRAFT IS POINTING AWAY FROM NEAREST POLE

This question specifies an aircraft in the northern hemisphere making a rate one turn to the right, through the North Pole from 330°. This situation is illustrated in the left side of the diagram above. Both the aircraft and the compass card are turning in a clockwise direction, so the indicated heading is changing more slowly than the actual heading. . After 30 seconds the aircraft will have turned through 90° so its actual heading will be 060°. So the compass will indicate less than 060° (option d).

MAGNETISM & COMPASSES 7 c.

The dip angle is the angle between the total magnetic field and the earth horizontal. The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The lines of force are horizontal only at the magnetic equator. So at the magnetic equator the dip angle is zero (option c).

MAGNETISM & COMPASSES 8 d.

To answer this type of question it must first be noted that the terms, T = True bearing, V = Variation, M = Magnetic bearing, D = Deviation, and C = Compass bearing.

True bearing can be converted into magnetic bearing by applying the variation. This can most easily be done by using the reminders "If variation is west then magnetic is best" and "If variation is East then magnetic is least". The first of these reminders means that if variation is West, then true bearing can be converted into magnetic bearing by adding the variation. The second reminder means that if variation is East, then True bearing can be converted into Magnetic bearing by subtracting the variation. Applying these methods to the four options in turn gives (in option a) 130 + 2 = 132, (in option b 130 – 2 = 128, (in option c) 130 – 2 = 128, (In option d) 130 + 2 = 132. Comparing these values with those in the column marked M indicates that only option b, and d, are correct up to this point. Options a, and b, can therefore be discarded.

Magnetic bearings in option b, and d, can then be converted into compass bearing by applying the stated deviations, having first reversed the signs of the deviations. In this question all deviations are –1 so conversion from Magnetic bearing, to Compass bearing, is by adding +1. In option b, this gives 128 + 1 = 129 and in option d this gives 132 + 1 = 133. Comparing these values with those in the options reveals that only option d is correct.

MAGNETISM & COMPASSES 9 d.

The dip angle is the angle between the total magnetic field and the earth horizontal. The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. At the magnetic equator the lines are horizontal an the dip is zero. The rate of change of dip is proportional to latitude north or south of the magnetic equator. So the horizontal component of

the earth's magnetic field at any northern latitude is equal to that at the equivalent southern latitude. So for example, the horizontal component is the same at magnetic latitudes 50° N and 50° S (option d). .

MAGNETISM & COMPASSES 10 c.

A magnetic compass provides heading information by using a magnetic sensor. This sensor is magnetic and aligns itself with the lines of force that make up the magnetic field of the earth. These lines of force flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The maxim possible dip value is 90° and occurs at the North and South magnetic poles (option c).

MAGNETISM & COMPASSES 11 a.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. In effect variation indicates the position of Magnetic North relative to true North. So if variation is West then Magnetic North is West of True North. This means that True North is East of magnetic North (option a).

MAGNETISM & COMPASSES 12 a.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal or Isogonic lines are lines on charts, joining points of equal variation. Isogonal lines joining points of zero variation are called Agonic lines (option a).

MAGNETISM & COMPASSES 13 d.

The terms "aperiodic" and "dead beat" mean that the compass must settle down quickly on steady indication following any disturbance such as turbulence or aircraft manoeuvres. This is achieved by including three design factors. Firstly by using several short magnets instead of a single long magnet, the mass of the magnet is brought closer to the compass point. This reduces the inertia of the unit thereby enabling oscillations to be damped out very quickly. Secondly the magnets are immersed in a liquid which acts as a damping fluid. Thirdly by attaching damping wires to the magnets. As the magnets oscillate these wires move back and forth through the fluid. The fluid friction on these wires thereby damps out oscillations. (Option d), therefore gives the best description of the methods used.

MAGNETISM & COMPASSES 14 d.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of

True North, or East, in which case Magnetic North is to the East of True North. Isogonal or Isogonic lines are lines on charts, joining points of equal variation. All Isogonals converge at the North and South geographic and magnetic poles (option d).

MAGNETISM & COMPASSES 15 b.

Magnetic variation at any given point on the Earth is a measure of the angle between the True North pole and the Magnetic North pole, measured from that point. This means that the variation at any point is determined by the locations of the true North and Magnetic north Poles. But the positions of these poles varies with the passing of time, thereby causing the variation at any given point to gradually change (option b).

MAGNETISM & COMPASSES 16 b.

The drift is stated to be 17^0 left when the true track is 348^0. This means that the drift is 17^0 to the West. In order to compensate for this drift, the true heading must be 17^0 East of the true track. This means that the true heading is $348^0 + 17^0$ East, which is 365^0.

The question states that the variation is 32^0 West, which means that magnetic north is 32^0 to the West of True North. This in turn means that if the true heading is 365^0 then the magnetic heading is $365^0 + 32^0 = 397^0$.

Finally the 4^0 East deviation must be applied giving a compass bearing of $397^0 - 4^0 = 393^0$. Subtracting 360^0 fro this figure gives the compass heading of 33^0 (option b).

MAGNETISM & COMPASSES 17 d.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal or Isogonic lines are lines on charts, joining points of equal variation. The greatest possible value of variations is 180^0, which occurs at all point located directly between the Magnetic and True North Poles (option d).

MAGNETISM & COMPASSES 18 d.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy. This means that magnetic compasses are most accurate at the magnetic equator which is midway between the magnetic poles (option d).

MAGNETISM & COMPASSES 19 d.

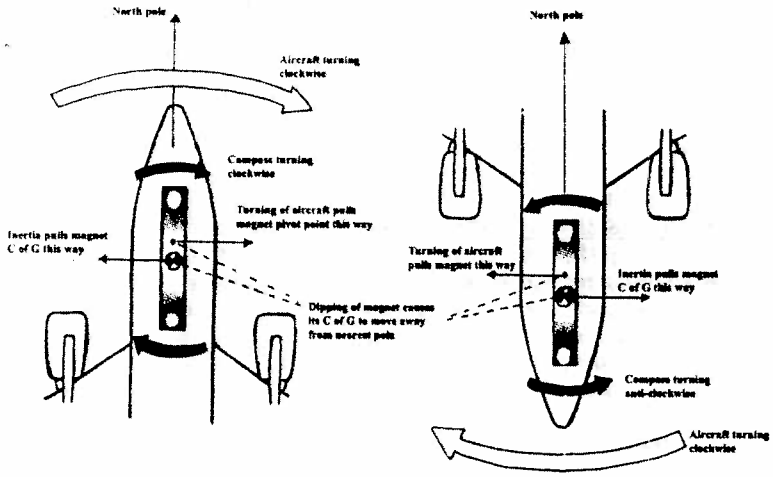
The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal or Isogonic lines are lines on charts, joining points of equal variation. The greatest possible value of variations is 180^0, which occurs at all point located directly between the Magnetic and True North Poles (option d).

MAGNETISM & COMPASSES 20 d.

The lines of magnetic force in the magnetic field of the Earth are horizontal at the magnetic equator and dip down towards the surface as latitude increases to the North and South. This means that the lines of force are horizontal at the magnetic equator and vertical at the North and South magnetic poles. Because the compass magnet aligns itself with these lines of force, the magnet is horizontal only when the aircraft is over the magnetic equator.

In order minimize the effects of this dipping of the lines of force the compass magnet uses a pendulous suspension system, whereby the magnet hangs below its point of suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot.

Because the C of G of the magnet is no longer directly below its point of suspension, its inertia will cause its C of G to lag behind its suspension point whenever the aircraft turns or changes speed. The compass card is attached to the magnet. So the effect will be to cause the compass to over-read or under-read depending upon whether the aircraft is turning towards or away from the nearest or furthest pole as illustrated below.



TURNING ERROR WHEN AIRCRAFT IS POINTING TOWARDS NEAREST POLE

TURNING ERROR WHEN AIRCRAFT IS POINTING AWAY FROM NEAREST POLE

This question specifies an aircraft in the northern hemisphere making a rate one turn to the right, through the South Pole from 135°. This situation is illustrated in the right side of the diagram above. The aircraft is turning clockwise while the compass card is turning anti-clockwise. So the indicated heading is changing more quickly than the actual heading. . After 30 seconds the aircraft will have turned through 90° so its actual heading will be 225°. But the turning errors will cause the compass to indicate more than 225° (option d).

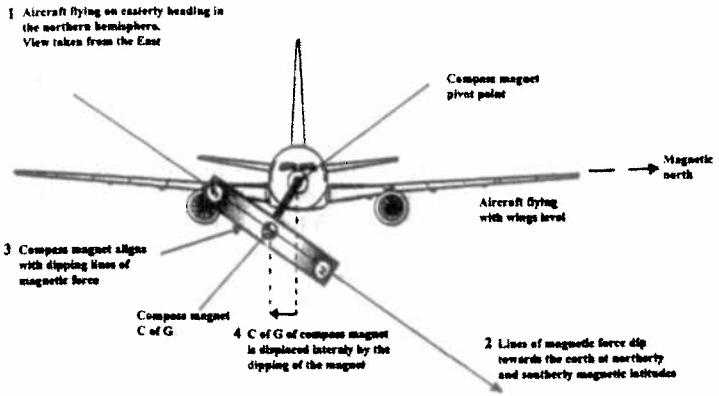
MAGNETISM & COMPASSES 21 b.

This question is concerned with the effects of acceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the acceleration rate.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other

than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot, as illustrated below.



EFFECT OF DIPPING MAGNETIC LINES OF FORCE ACTING ON PENDULOUSLY SUSPENDED COMPASS MAGNET

This lateral displacement causes the C of G of the compass magnet to lag behind the suspension point, when the aircraft accelerates. This lagging behind causes the compass to rotate. So whenever an aircraft accelerates on an Easterly heading, the lateral displacement of the C of G and the inertia its compass magnet, causes the magnet to rotate. When on an easterly heading this rotation is clockwise giving an apparent turn toward the north (option b).

MAGNETISM & COMPASSES 22 d.

The creation of permanent magnetism in an object requires two things. Firstly the object must contain materials capable of supporting permanent magnetism. These materials are said to be "magnetically hard". This term does not refer to the physical hardness of the materials but to the degree of effort required to induce of remove permanent magnetism.

One explanation of the magnetic properties of materials uses the concept of magnetic domains within the material. Each domain can be considered to be a microscopically small magnet, with a North and South Pole. If a majority of these domains become permanently aligned in one direction, the material possesses permanent magnetism.

The second factor required to induce permanent magnetism is some means by which the magnetic domains within the material can be aligned in one direction. Whenever a material is subjected to physical shocks such as when hammering it, the magnetic domains are shaken lose from their alignment. If this process is repeated over a long period of time, such as when riveting together the skin of an

aircraft, the magnetic domains can become aligned with the magnetic field of the earth. This combination of hammering and the effects of the earth's magnetic field during construction is the most common cause of permanent magnetism in aircraft (option d).

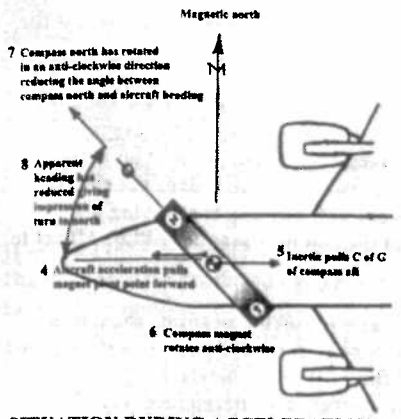
MAGNETISM & COMPASSES 23 c.

This question is concerned with the effects of acceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the deceleration rate.

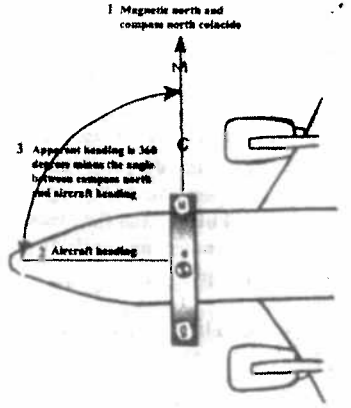
The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot.

Whenever an aircraft accelerates or decelerates on such a heading, the lateral displacement of the C of G and the inertia its compass magnet, causes the magnet to rotate. The magnitude and direction of these rotations are determined by a number of factors. These include the aircraft heading, the hemisphere in which the aircraft is flying, and the acceleration or deceleration rate. This question specifies acceleration on a westerly heading in the northern hemisphere. This will cause the compass magnet to rotate anti-clockwise as illustrated below. So the compass will indicate a turn to the north (option c), as illustrated below. This answer illustrates the more general result that accelerations cause an apparent turn towards the nearest pole.



SITUATION DURING ACCELERATION IN WESTERLY DIRECTION



SITUATION BEFORE ACCELERATION IN WESTERLY DIRECTION

MAGNETISM & COMPASSES 24 d.

In a direct reading magnetic compass the magnet is required to align itself with the magnetic field of the Earth. This alignment process is commonly referred to as seeking the magnetic field. But the seeking process is inevitably subject to errors due to friction losses and inertia within the compass. In a remote indicating compass, the detector unit does not align itself with the Earth's magnetic field, but detects this field. The detector unit then produces an electrical signal proportional to the direction of the magnetic field. This largely eliminates the friction and inertia losses thereby making the remote reading compass more accurate. (option d).

MAGNETISM & COMPASSES 25 b.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal or Isogonic lines are lines on charts, joining points of equal variation. All Isogonals converge at both the North and South Magnetic Poles (option b).

MAGNETISM & COMPASSES 26 b.

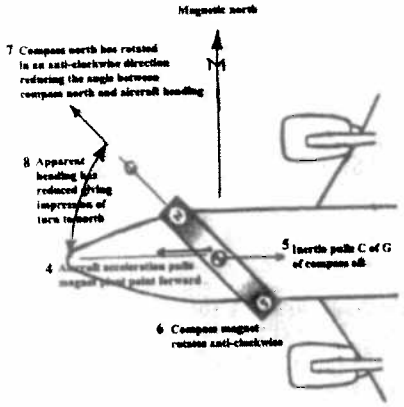
This question is concerned with the effects of deceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the deceleration rate.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic

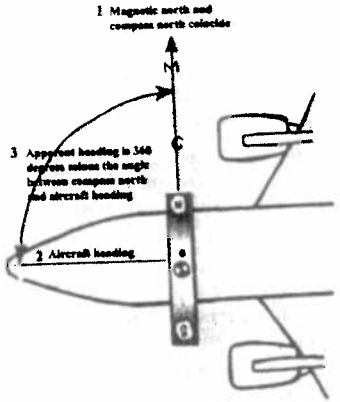
equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot.

Whenever an aircraft accelerates or decelerates on such a heading, the lateral displacement of the C of G and the inertia its compass magnet, causes the magnet to rotate. The magnitude and direction of this rotation is determined by the aircraft heading, the hemisphere and the acceleration or deceleration rate. The overall effect of an acceleration on a westerly heading in the Northern hemisphere is illustrated below.



SITUATION DURING ACCELERATION IN WESTERLY DIRECTION



SITUATION BEFORE ACCELERATION IN WESTERLY DIRECTION

This question specifies deceleration on a westerly heading in the northern hemisphere so the effect will be the opposite to that shown above. This will cause the compass magnet to rotate clockwise, causing the compass to indicate a turn to the South (option b).

MAGNETISM & COMPASSES 27 d.

In a direct reading magnetic compass the magnet must be located within the cockpit area in view of the pilot. This can cause inaccuracies due to the effects of magnetic fields caused by materials and electrical, equipment in the cockpit area. These fields represent additional deviation sources. One of the principal advantages of a remote or slaved gyro compass is that it enables the detector unit to be located in another area such as the wingtips, thereby isolating it from the aircraft deviation sources (option d).

MAGNETISM & COMPASSES 28 c.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. Magnetic fields are conventionally represented by lines of magnetic force flowing out of the North Pole of magnets and into the South Pole. So the North Pole of the earth, with its lines of force flowing into it is effectively the South Pole of a magnet. South Poles of magnets are conventionally painted Blue, so the Earth can be considered as being a magnet with the blue pole in Northern Canada (option c).

MAGNETISM & COMPASSES 29 c.

In a direct reading magnetic compass the magnet must be located within the cockpit area in view of the pilot. This can cause inaccuracies due to the effects of magnetic fields caused by materials and electrical, equipment in the cockpit area. These fields represent additional deviation sources. One of the principal advantages of a remote or slaved gyro compass is that it enables the detector unit to be located in another area such as the wingtips, thereby isolating it from the aircraft deviation sources (option c).

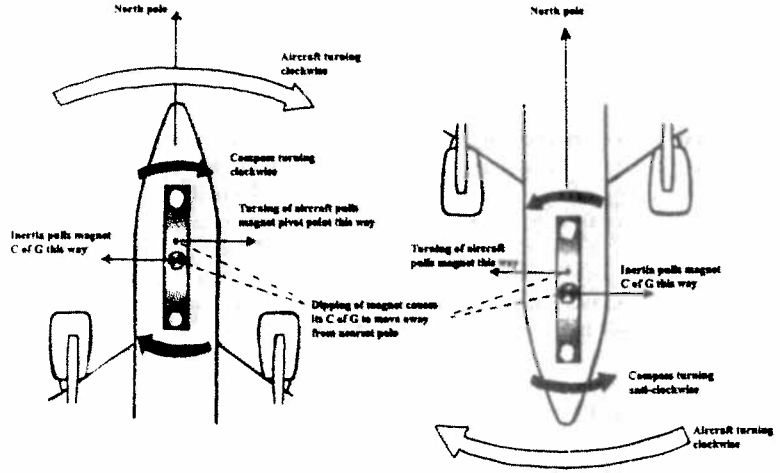
MAGNETISM & COMPASSES 30 b.

The term "variation" refers to the horizontal angle between the True North and Magnetic North (option b). It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal lines are lines on charts, joining points of equal variation.

MAGNETISM & COMPASSES 31 b.

The lines of magnetic force in the magnetic field of the Earth are horizontal at the magnetic equator and dip down towards the surface as latitude increases to the North and South. This means that the lines of force are horizontal at the magnetic equator and vertical at the North and South magnetic poles. Because the compass magnet aligns itself with these lines of force, the magnet is horizontal only when the aircraft is over the magnetic equator. In order minimize the effects of this dipping of the lines of force the compass magnet uses a pendulous suspension system, whereby the magnet hangs below its point of suspension.

Because the C of G of the magnet is no longer directly below its point of suspension, its inertia will cause its C of G to lag behind its suspension point. This will cause the compass to over-read or under-read depending upon whether the aircraft is turning towards or away from the nearest or furthest pole as illustrated below.



TURNING ERROR WHEN AIRCRAFT IS POINTING TOWARDS NEAREST POLE

TURNING ERROR WHEN AIRCRAFT IS POINTING AWAY FROM NEAREST POLE

This question specifies an aircraft in the northern hemisphere turning to the right, through the South Pole (180^0). As illustrated in the right side of the diagram above, the aircraft is turning clockwise while the compass card is turning anti-clockwise. This means that the indicated change of heading will be greater than the actual change of heading, so the compass will to over indicate.

The aircraft is carrying out a rate one turn, which means that it will turn through 360^0 in 2 minutes. So after 30 seconds it will have turned through an angle of 90^0. Its initial heading was 145^0 so its new heading will be 235^0. But because of the effects described above, the compass will indicate more than 235^0 (option b).

MAGNETISM & COMPASSES 32 b.

A magnetic compass gives an indication of direction by aligning itself with the horizontal component of the magnetic field of the Earth. But the lines of force that make up this magnetic field are truly horizontal only at the magnetic equator. As latitudes increase to the North and South of the magnetic equator the magnetic lines of force dip down towards the surface of the Earth. As this dipping angle increases the horizontal component of the magnetic field becomes weaker and the vertical component becomes stronger. Because magnetic compass can derive direction information only from the horizontal component of

the Earth's magnetic field, their accuracy and effectiveness are proportional to the horizontal component of the field (option b).

MAGNETISM & COMPASSES 33 b.

The creation of permanent magnetism in an object requires two things. Firstly the object must contain materials capable of supporting permanent magnetism. These materials are said to be "magnetically hard". This term does not refer to the physical hardness of the materials but to the degree of effort required to induce of remove permanent magnetism.

One explanation of the magnetic properties of materials uses the concept of magnetic domains within the material. Each domain can be considered to be a microscopically small magnet, with a North and South Pole. If a majority of these domains become permanently aligned in one direction, the material possesses permanent magnetism.

The second factor required to induce permanent magnetism is some means by which the magnetic domains within the material can be aligned in one direction. Whenever a material is subjected to physical shocks such as when hammering it, the magnetic domains are shaken lose from their alignment. If this process is repeated over a long period of time, such as when riveting together the skin of an aircraft, the magnetic domains can become aligned with the magnetic field of the earth. This combination of hammering and the effects of the earth's magnetic field during construction is the most common cause of permanent magnetism in aircraft (option b).

MAGNETISM & COMPASSES 34 b.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. So the dip angle at the South magnetic pole is 90^0 (option b).

MAGNETISM & COMPASSES 35 c.

The principal cause of compass acceleration errors is the dipping of the magnets due to dipping of the lines of magnetic force in the Earth's magnetic field. This dipping causes the C of g of the compass magnets to move out of alignment with the suspension point. This misalignment causes the compass magnet to rotate when the aircraft accelerates or decelerates. The magnitude of these errors depends upon the magnitude of the acceleration, the direction of flight and the degree of dip. But at the magnetic equator the lines of magnetic force are horizontal so the dip angle is zero. This means that the C of G of the compass magnet is directly below its suspension point, so there will be no acceleration errors. So the compass will indicate correctly (option c) when accelerating on the magnetic equator.

MAGNETISM & COMPASSES 36 b.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal lines are lines on charts, joining points of equal variation (option b).

MAGNETISM & COMPASSES 37 d.

The term "magnetic variation" refers to the angle between True North Pole and the Magnetic North Pole. Lines on charts joining points of equal variation are called Isogonal lines. Lines joining points of zero variation are called Agonic lines. There are two agonic lines. These follow separate paths out of the North polar regions, one currently running through western Europe and the other through the USA (option d).

MAGNETISM & COMPASSES 38 c.

The term "grivation" refers to the vector sum of the convergence of the meridians and the magnetic variation. An Isogive is a line drawn on a chart to indicate lines of constant grivation (option c).

MAGNETISM & COMPASSES 39 c.

Magnetic variation at any given point on the Earth is a measure of the angle between the True North pole and the Magnetic North pole, measured from that point. Lines on a chart joining points of equal variation are called Isogonal lines. Lines joining points of zero variation are called Agonic lines (option c).

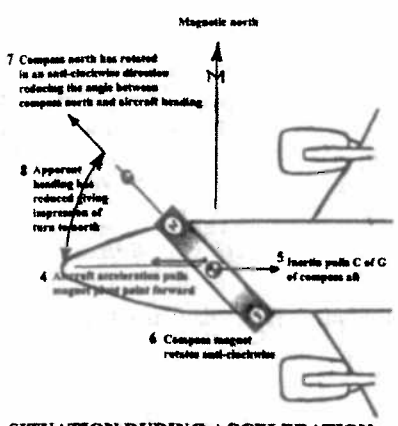
MAGNETISM & COMPASSES 40 a.

This question is concerned with the effects of deceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the deceleration rate.

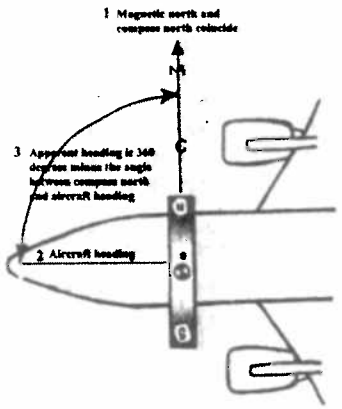
The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot.

Whenever an aircraft accelerates or decelerates on such a heading, the lateral displacement of the C of G and the inertia its compass magnet, causes the magnet to rotate. The magnitude and direction of this rotation is determined by the aircraft heading, the hemisphere and the acceleration or deceleration rate. The overall effect of an acceleration on a westerly heading in the Northern hemisphere is illustrated below.



SITUATION DURING ACCELERATION IN WESTERLY DIRECTION



SITUATION BEFORE ACCELERATION IN WESTERLY DIRECTION

This question specifies an acceleration on a westerly heading in the northern hemisphere so the effect will be as shown above. This will cause the compass magnet to rotate anti-clockwise, causing the compass to over-read and indicate a turn to the North (option a).

MAGNETISM & COMPASSES 41 c.

In a direct reading magnetic compass the magnet is required to align itself with the magnetic field of the Earth. This alignment process is commonly referred to as seeking the magnetic field. But the seeking process is inevitably subject to errors due to friction losses and inertia within the compass. In a remote indicating compass, the detector unit does not align itself with the Earth's magnetic field, but detects this field. The detector unit then produces an electrical signal proportional to the direction of the magnetic field. This largely eliminates the friction and inertia losses thereby making the remote reading compass more accurate. (option c).

MAGNETISM & COMPASSES 42 d.

The term "grivation" refers to the vector sum of the convergence of the meridians and the magnetic variation. An Isogiv is a line drawn on a chart to indicate lines of equal grivation (option d).

MAGNETISM & COMPASSES 43 c.

Certain materials within the structure of an aircraft possess "hard iron" or permanent magnetism. This permanent magnetism causes the compass magnets to align in a direction slightly different to the local magnetic field of the Earth. The term "Compass deviation" refers to the angle between the local magnetic meridian and the direction in which the compass magnets are aligned. Deviation is therefore a measure of the angle between Magnetic North and Compass North (option c).

MAGNETISM & COMPASSES 44 b.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal or Isogonic lines are lines on charts, joining points of equal variation (option b).

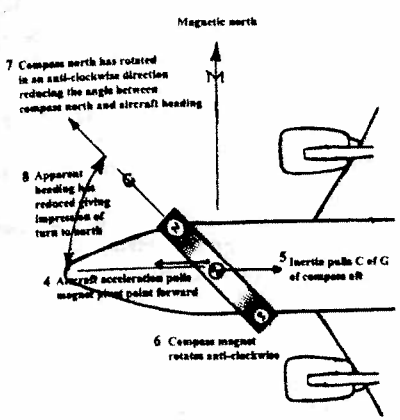
MAGNETISM & COMPASSES 45 d.

This question is concerned with the effects of deceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the deceleration rate.

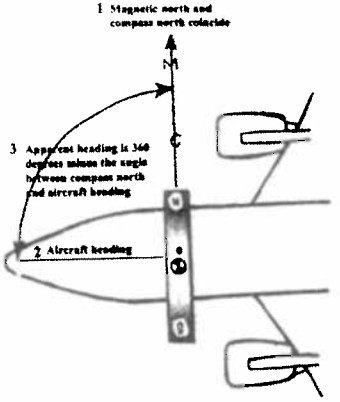
The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot.

Whenever an aircraft accelerates or decelerates on such a heading, the lateral displacement of the C of G and the inertia its compass magnet, causes the magnet to rotate. The magnitude and direction of this rotation is determined by the aircraft heading, the hemisphere and the acceleration or deceleration rate. The overall effect of an acceleration on a westerly heading in the Northern hemisphere is illustrated below.



SITUATION DURING ACCELERATION IN WESTERLY DIRECTION



SITUATION BEFORE ACCELERATION IN WESTERLY DIRECTION

This question specifies an acceleration on a westerly heading in the northern hemisphere so the effect will be as illustrated above. This will cause the compass magnet to rotate anti-clockwise, causing the compass to indicate a turn to the North (option d).

MAGNETISM & COMPASSES 46 c.

Magnetic compasses provide heading indications by aligning themselves with the horizontal component of the Earth's magnetic field. This horizontal component flows from South to North over the surface of the Earth. But the lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude.

At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy. So the accuracy of a magnetic compass is greatest at Approximately midway between the magnetic poles (option d).

MAGNETISM & COMPASSES 47 a.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal lines are lines on charts, joining points of equal variation. Isogonal lines indicating points of 0^0 variation are called Agonic Lines (option a).

MAGNETISM & COMPASSES 48 b.

The term "Compass swing" refers to a process whereby the deviations in a magnetic compass is measured on various headings, and adjustments made to reduce these deviations to within acceptable limits. Residual deviations are then recorded on a compass deviation chart. Compass swings must be carried out before a newly constructed aircraft is brought into service and whenever there is reason to believe that a significant change in deviation has occurred. Examples of such occasions are following lightning strikes or when an aircraft has been left parked on any one heading for very long periods (months or years). Another such occasion is when there has been a large, and permanent, change of magnetic latitude (option b), such as when an aircraft has been transferred from an operating base in one hemisphere to a new base in the other hemisphere.

MAGNETISM & COMPASSES 49 a.

In order to enable a remote indicating compass to be used, the magnet and the gyro compass elements must first be synchronized. The synchronisation state is indicated by an annunciator window, which usually uses two symbols, a small dot and a small cross. Synchronisation is achieved by turning a synchronisation knob until the annunciator window displays a midway position between the dot and cross, or alternating dot and cross indications. The purpose of the annunciator is therefore used when synchronizing the magnets and the gyro compass elements (option a).

MAGNETISM & COMPASSES 50 c.

The terms "aperiodic" and "dead beat" mean that the compass must settle down quickly on steady indication following any disturbance such as turbulence or aircraft manoeuvres. This is achieved by including three design factors. Firstly by using several short magnets instead of a single long magnet, the mass of the magnet is brought closer to the compass point. This reduces the inertia of the unit thereby enabling oscillations to be damped out very quickly. Secondly the magnets are immersed in a liquid which acts as a damping fluid. Thirdly by attaching damping wires to the magnets. As the magnets oscillate these wires move back and forth through the fluid. The fluid friction on these wires thereby damps out oscillations. (Option c), therefore gives the best description of the methods used.

MAGNETISM & COMPASSES 51 d.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. Magnetic fields are conventionally represented by lines of magnetic force flowing out of the North Pole of magnets and into the South Pole. So the North Pole of the earth, with its lines of force flowing into it is effectively the South Pole of a magnet. South Poles of magnets are conventionally painted Blue, so the the Earth can be considered as being a magnet with the blue pole near the North Pole of the earth and the direction of the magnetic force pointing straight down to the earth's surface (option d).

MAGNETISM & COMPASSES 52 b.

Magnetic headings can be converted into compass bearing by applying the compass deviation (option b), using the following reminders. "If deviations in east then compass is least" and "If deviation is West then compass is best". These reminders mean that Magnetic headings can be converted into compass headings by adding West deviations and by subtracting East deviations.

MAGNETISM & COMPASSES 53 a.

Certain materials within the structure of an aircraft possess "hard iron" or permanent magnetism. This permanent magnetism causes the compass magnets to align in a direction slightly different to the local magnetic field of the Earth. The term "Compass deviation" refers to the angle between the local magnetic meridian and the direction in which the compass magnets are aligned. Deviation is therefore a measure of the angle between Magnetic North and Compass North (option a).

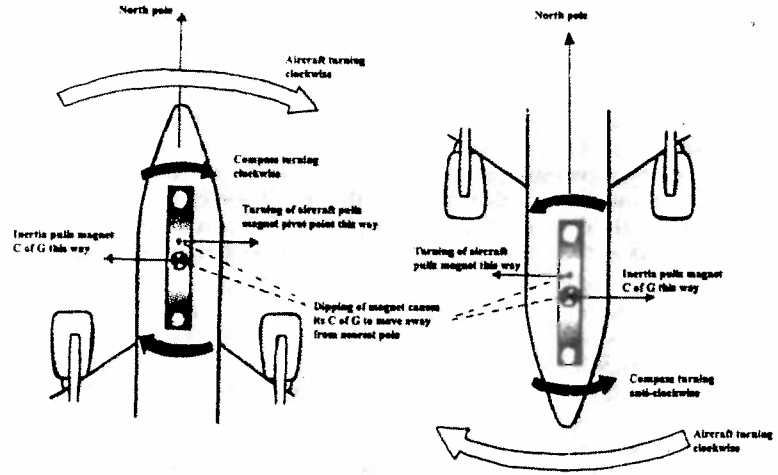
MAGNETISM & COMPASSES 54 d.

The term "Compass swing" refers to a process whereby the deviations in a magnetic compass is measured on various headings, and adjustments made to reduce these deviations to within acceptable limits. Residual deviations are then recorded on a compass deviation chart. Compass swings must be carried out before a newly constructed aircraft is brought into service and whenever there is reason to believe that a significant change in deviation has occurred. Examples of such occasions are following flight through severe electrical storms or lightning strikes (option d), or when an aircraft has been left parked on any one heading for very long periods (months or years). Another such occasion is when there has been a large, and permanent, change of magnetic latitude, such as when an aircraft has been transferred from an operating base in one hemisphere to a new base in the other hemisphere.

MAGNETISM & COMPASSES 55 b.

The lines of magnetic force in the magnetic field of the Earth are horizontal at the magnetic equator and dip down towards the surface as latitude increases to the North and South. This means that the lines of force are horizontal at the magnetic equator and vertical at the North and South magnetic poles. Because the compass magnet aligns itself with these lines of force, the magnet is horizontal only when the aircraft is over the magnetic equator. In order minimize the effects of this dipping of the lines of force the compass magnet uses a pendulous suspension system, whereby the magnet hangs below its point of suspension.

If the aircraft is not over the magnetic equator, its compass magnet will be dipped, due to the dip of the lines of magnetic force around the earth. This will cause the C of G of the magnet to be displaced as illustrated below.



TURNING ERROR WHEN AIRCRAFT IS POINTING TOWARDS NEAREST POLE

TURNING ERROR WHEN AIRCRAFT IS POINTING AWAY FROM NEAREST POLE

Because the C of G of the magnet is no longer directly below its point of suspension, its inertia will cause its C of g to lag behind its suspension point. This will cause the compass to over-read or under-read depending upon whether the aircraft is turning towards or away from the nearest or furthest pole. The magnitude of the errors that are caused by this effect are determined by the degree to which the compass magnet has been dipped. It is therefore greatest on north/south headings, and at high latitudes (option b).

MAGNETISM & COMPASSES 56 c.

In a direct reading magnetic compass the magnet is required to align itself with the magnetic field of the Earth. This alignment process is commonly referred to as seeking the magnetic field. But the seeking process is inevitably subject to errors due to friction losses and inertia within the compass. In a remote indicating compass, the detector unit does not align itself with the Earth's magnetic field, but detects this field. The detector unit then produces an electrical signal proportional to the direction of the magnetic field. This largely eliminates the friction and inertia losses thereby making the remote reading compass more accurate. (option c).

MAGNETISM & COMPASSES 57 a.

Magnetic variation at any given point on the Earth is a measure of the angle between the True North pole and the Magnetic North pole, measured from that point. This means that the variation at any point is determined by the locations of the true North and Magnetic north Poles. But the positions of these poles varies with the passing of time, thereby causing the variation at any given point to gradually change (option a).

MAGNETISM & COMPASSES 58 b.

The magnetic field of the Earth is made up of lines of magnetic force flowing into the Earth at the North Pole and out of the Earth at the South Pole. These lines are vertical at the poles and horizontal at the magnetic equator. A freely suspended magnet will align with these lines of force so such a magnet will stand vertical only at the magnetic North and South Poles (option b).

MAGNETISM & COMPASSES 59 c.

In a direct reading magnetic compass the magnet must be located within the cockpit area in view of the pilot. This can cause inaccuracies due to the effects of magnetic fields caused by materials and electrical, equipment in the cockpit area. These fields represent additional deviation sources. One of the principal advantages of a remote or slaved gyro compass is that it enables the detector unit to be located in another area such as the wingtips, thereby isolating it from the aircraft deviation sources (option c).

MAGNETISM & COMPASSES 60 c.

In a direct reading magnetic compass the magnet is required to align itself with the magnetic field of the Earth. This alignment process is commonly referred to as seeking the magnetic field. But the seeking process is inevitably subject to errors due to friction losses and inertia within the compass. In a remote indicating compass, the detector unit does not align itself with the Earth's magnetic field, but detects this field. The detector unit then produces an electrical signal proportional to the direction of the magnetic field. This largely eliminates the friction and inertia losses thereby making the remote reading compass more accurate. (option c).

MAGNETISM & COMPASSES 61 b.

In a direct reading magnetic compass the magnet must be located within the cockpit area in view of the pilot. This can cause inaccuracies due to the effects of magnetic fields caused by materials and electrical, equipment in the cockpit area. These fields represent additional deviation sources. One of the principal advantages of a remote or slaved gyro compass is that it enables the detector unit to be located in another area such as the wingtips, thereby isolating it from the aircraft deviation sources (option b).

MAGNETISM & COMPASSES 62 c.

The creation of permanent magnetism in an object requires two things. Firstly the object must contain materials capable of supporting permanent magnetism. These materials are said to be "magnetically hard". This term does not refer to the physical hardness of the materials but to the degree of effort required to induce of remove permanent magnetism.

One explanation of the magnetic properties of materials uses the concept of magnetic domains within the material. Each domain can be considered to be a microscopically small magnet, with a North and South Pole. If a majority of these domains become permanently aligned in one direction, the material possesses permanent magnetism.

The second factor required to induce permanent magnetism is some means by which the magnetic domains within the material can be aligned in one direction. Whenever a material is subjected to physical shocks such as when hammering it, the magnetic domains are shaken lose from their alignment. If this process is repeated over a long period of time, such as when riveting together the skin of an aircraft, the magnetic domains can become aligned with the magnetic field of the earth. This combination of hammering and the effects of the earth's magnetic field during construction is the most common cause of permanent magnetism in aircraft (option c).

MAGNETISM & COMPASSES 63 b.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. Magnetic fields are conventionally represented by lines of magnetic force flowing out of the North Pole of magnets and into the South Pole. So the North Pole of the earth, with its lines of force flowing into it is effectively the South Pole of a magnet. South Poles of magnets are conventionally painted Blue, so the the Earth can be considered as being a magnet with the blue pole near the North Pole of the earth which is situated in North Canada (option b).

MAGNETISM & COMPASSES 64 c.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal lines are lines on charts, joining points of equal variation (option c).

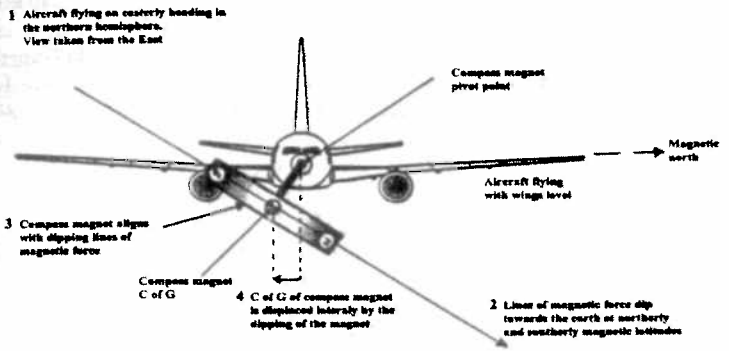
MAGNETISM & COMPASSES 65 d.

This question is concerned with the effects of acceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the acceleration rate.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the

magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot, as illustrated below.



EFFECT OF DIPPING MAGNETIC LINES OF FORCE ACTING ON PENDULOUSLY SUSPENDED COMPASS MAGNET

This lateral displacement causes the C of G of the compass magnet to lag behind the suspension point, when the aircraft accelerates. This lagging behind causes the compass to rotate. So whenever an aircraft accelerates on an Easterly heading, the lateral displacement of the C of G and the inertia its compass magnet, causes the magnet to rotate. When on an easterly heading this rotation is clockwise causing the indicated an apparent turn to the North (option d).

MAGNETISM & COMPASSES 66 d.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Because of the continuous movement of the magnetic materials within the core of the Earth magnetic variation at any point varies slowly with time (option d).

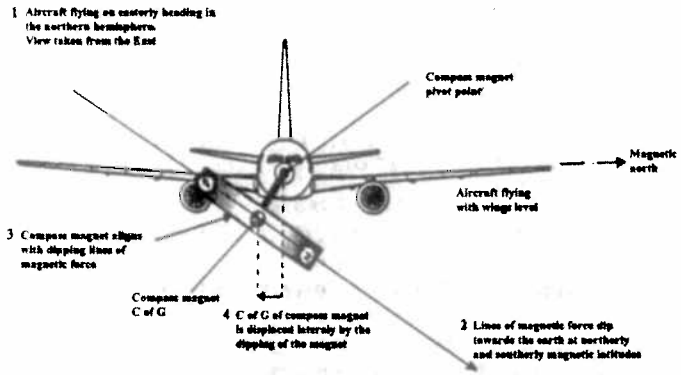
MAGNETISM & COMPASSES 67 b.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal lines are lines on charts, joining points of equal magnetic variation (option b).

MAGNETISM & COMPASSES 68 b.

This question is concerned with the effects of acceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the acceleration rate.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.



EFFECT OF DIPPING MAGNETIC LINES OF FORCE ACTING ON PENDULOUSLY SUSPENDED COMPASS MAGNET

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot, as illustrated above.

This lateral displacement causes the C of G of the compass magnet to lag behind the suspension point, when the aircraft accelerates. This lagging behind causes the compass to rotate. So whenever an aircraft accelerates on an Easterly heading, the lateral displacement of the C of G and the inertia its compass magnet, causes the magnet to rotate. When on an easterly heading this rotation is clockwise causing the indicated heading to decrease (option b).

MAGNETISM & COMPASSES 69 c.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West (or negative) in which case True North is to the East of Magnetic North (option c), or East, in which case True North is to the West of Magnetic North.

MAGNETISM & COMPASSES 70 c.

The term "Compass swing" refers to a process whereby the angle between Magnetic North and Compass North (option c) in a magnetic compass is measured on various headings, and adjustments made to reduce these deviations to within acceptable limits. Residual deviations are then recorded on a compass deviation chart.

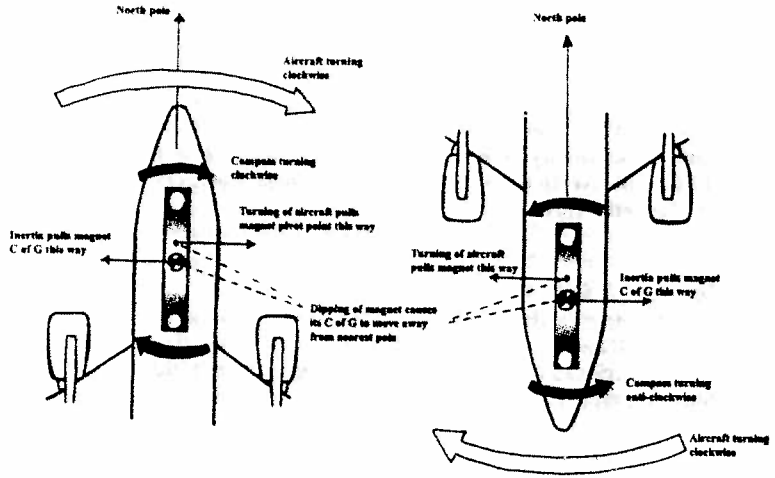
MAGNETISM & COMPASSES 71 d.

The lines of magnetic force in the magnetic field of the Earth are horizontal at the magnetic equator and dip down towards the surface as latitude increases to the North and South. This means that the lines of force are horizontal at the magnetic equator and vertical at the North and South magnetic poles. Because the compass magnet aligns itself with these lines of force, the magnet is horizontal only when the aircraft is over the magnetic equator. In order minimize the effects of this dipping of the lines of force the compass magnet uses a pendulous suspension whereby the magnet hangs below its point of suspension.

Because the C of G of the magnet is no longer directly below its point of suspension, its inertia will cause its C of G to lag behind its suspension point. This will cause the compass to over-read or under-read depending upon whether the aircraft is turning towards or away from the nearest or furthest pole.

This question specifies a turn from 330°C to 040°C in the northern hemisphere. This means that the aircraft is turning through the nearest pole, so the compass will over read as indicated in the left side of the diagram above. Both the aircraft and the compass are turning clockwise so the actual change of heading will be greater than the indicated change of heading. This means that the compass will under-read.

If the aircraft is not over the magnetic equator, its compass magnet will be dipped, due to the dip of the lines of magnetic force around the earth. This will cause the C of G of the magnet to be displaced as illustrated below.



TURNING ERROR WHEN AIRCRAFT IS POINTING TOWARDS NEAREST POLE

TURNING ERROR WHEN AIRCRAFT IS POINTING AWAY FROM NEAREST POLE

In order to reduce oscillations the compass magnet is immersed in a liquid. Whenever the aircraft turns, the liquid swirls in the same direction as the turn. But when the aircraft stops turning the swirling continues for a short time. With both the compass and the aircraft turning in the same direction, the effect of the liquid swirling within the compass will be to increase this error (option d).

MAGNETISM & COMPASSES 72 c.

Magnetic compasses provide heading indications by aligning themselves with the horizontal component of the Earth's magnetic field. This horizontal component flows from South to North over the surface of the Earth. But the lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude.

At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy. So the accuracy of a magnetic compass is proportional to the horizontal component of the Earth's magnetic field (option c).

MAGNETISM & COMPASSES 73 b.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. Variation is greatest when at a point directly between these two poles. At this point the variation is 180^{0} (option b).

MAGNETISM & COMPASSES 74 d.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The dip angle is the angle between the total magnetic field and the earth horizontal (option d).

MAGNETISM & COMPASSES 75 c.

The dip angle is the angle between the total magnetic field and the earth horizontal. The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. So at the magnetic equator the dip angle is zero (option c).

MAGNETISM & COMPASSES 76 b.

The term "variation" refers to the horizontal angle between the Magnetic North and True North (option b). It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal lines are lines on charts, joining points of equal variation.

MAGNETISM & COMPASSES 77 d.

Magnetic compasses provide heading indications by aligning themselves with the horizontal component of the Earth's magnetic field. This horizontal component flows from South to North over the surface of the Earth. But the lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude.

At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy. So the

accuracy of a magnetic compass is greatest at Approximately midway between the magnetic poles (option d).

MAGNETISM & COMPASSES 78 c.

The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic South Pole and vertically into the ground at the magnetic North pole. Magnetic fields are conventionally represented by lines of magnetic force flowing out of the North Pole of magnets and into the South Pole. So the North Pole of the earth, with its lines of force flowing into it is effectively the South Pole of a magnet. South Poles of magnets are conventionally painted Blue, so the the Earth can be considered as being a magnet with the blue pole near the North Pole of the earth which is situated in North Canada (option c).

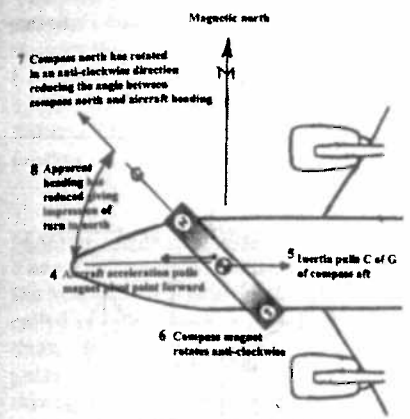
MAGNETISM & COMPASSES 79 b.

This question is concerned with the effects of deceleration on a direct reading magnetic compass. These effects depend upon the magnetic latitude, the direction of flight and the deceleration rate.

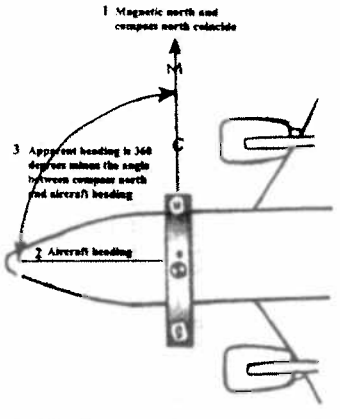
The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. The degree to which they are inclined vertically at all other points on the earth is determined by the magnetic latitude. At the magnetic equator they are horizontal or parallel with the surface. As magnetic latitudes increase towards the magnetic poles the degree of inclination also increases. The inclination of the lines of force causes the magnets in compasses to dip below the horizontal, thereby reducing their accuracy.

In order to minimise this problem, compasses are typically suspended such that their C of G is lower than their pivot. In this way the weight of the magnet is made to oppose the dipping caused by the lines of magnetic force. This is termed pendulous suspension. Although this reduces compass dip, it does not entirely eliminate it. This means that whenever an aircraft heading is anything other than magnetic north or south, the C of G of the compass magnet will be off-set to one side of the pivot.

Whenever an aircraft accelerates or decelerates on such a heading, the lateral displacement of the C of G and the inertia its compass magnet, causes the magnet to rotate. The magnitude and direction of this rotation is determined by the aircraft heading, the hemisphere and the acceleration or deceleration rate. The overall effect of an acceleration on a westerly heading in the Northern hemisphere is illustrated below.



SITUATION DURING ACCELERATION IN WESTERLY DIRECTION



SITUATION BEFORE ACCELERATION IN WESTERLY DIRECTION

This question specifies an acceleration on a westerly heading in the northern hemisphere so the effect will be as illustrated above. This will cause the compass magnet and card to rotate anti-clockwise, causing the compass to over-read, and indicate a turn to the North (option b).

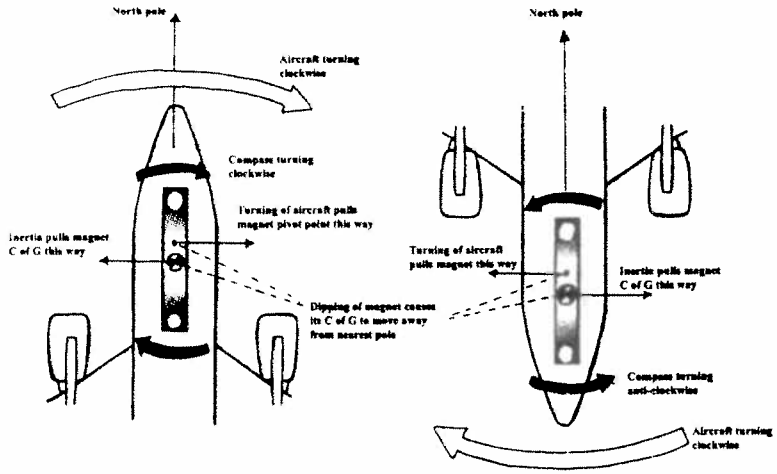
MAGNETISM & COMPASSES 80 d.

In a direct reading magnetic compass the magnet is required to align itself with the magnetic field of the Earth. This alignment process is commonly referred to as seeking the magnetic field. But the seeking process is inevitably subject to errors due to friction losses and inertia within the compass. In a remote indicating compass, the detector unit does not align itself with the Earth's magnetic field, but detects this field. The detector unit then produces an electrical signal proportional to the direction of the magnetic field. This largely eliminates the friction and inertia losses thereby making the remote reading compass more sensitive. (option d).

MAGNETISM & COMPASSES 81 b.

The lines of magnetic force in the magnetic field of the Earth are horizontal at the magnetic equator and dip down towards the surface as latitude increases to the North and South. This means that the lines of force are horizontal at the magnetic equator and vertical at the North and South magnetic poles. Because the compass magnet aligns itself with these lines of force, the magnet is horizontal only when the aircraft is over the magnetic equator. In order minimize the effects of this dipping of the lines of force the compass magnet uses a pendulous suspension system, whereby the magnet hangs below its point of suspension.

Because the C of G of the magnet is no longer directly below its point of suspension, its inertia will cause its C of G to lag behind its suspension point. This will cause the compass to over-read or under-read depending upon whether the aircraft is turning towards or away from the nearest or furthest pole as illustrated below.



TURNING ERROR WHEN AIRCRAFT IS POINTING TOWARDS NEAREST POLE

TURNING ERROR WHEN AIRCRAFT IS POINTING AWAY FROM NEAREST POLE

This question specifies an aircraft in the northern hemisphere turning to the right, through the South Pole (180^0). As illustrated in the right side of the diagram above, the aircraft is turning clockwise while the compass card is turning anti-clockwise. This means that the indicated change of heading will be greater than the actual change of heading, so the compass will to over indicate.

The aircraft is carrying out a rate one turn, which means that it will turn through 360^0 in 2 minutes. So after 30 seconds it will have turned through an angle of 90^0. Its initial heading was 135^0 so its new heading will be 225^0. But because of the effects described above, the compass will indicate more than 225^0 (option b).

MAGNETISM & COMPASSES 82 a.

The term "grivation" refers to the vector sum of the convergence of the meridians and the magnetic variation. An Isogiv is a line drawn on a chart to indicate lines of constant grivation (option a).

MAGNETISM & COMPASSES 83 a.

The variation is stated to be 20^0E, which means that True North is 20^0 to the West of Magnetic North. This means that the true heading is $345^0 + 20^0 = 365^0$. Subtracting 360^0 gives a true heading of 05^0. The island is 30^0 to the left, so its bearing is $05^0 - 30^0 = -25^0$. But bearings must be between 0^0 and 360^0, so adding 360^0 gives the true bearing of 335^0 from the aircraft to the island. Subtracting 180^0 gives a true bearing of 155^0 from the island to the aircraft (option a).

MAGNETISM & COMPASSES 84 b.

The term "magnetic variation" refers to the angle between True North Pole and the Magnetic North Pole. Lines on charts joining points of equal variation are called Isogonal lines. Lines joining points of zero variation are called Agonic lines. There are two agonic lines. These follow separate paths out of the North polar regions, one currently running through western Europe and the other through the USS (option b).

MAGNETISM & COMPASSES 85 d.

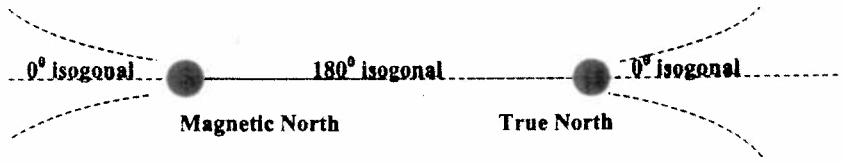
The term "variation" refers to the horizontal angle between the True North and Magnetic North (option d). It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal or Isogonic lines are lines on charts, joining points of equal variation. The greatest possible value of variations is 180^0, which occurs at all point located directly between the Magnetic and True North Poles.

MAGNETISM & COMPASSES 86 b.

Magnetic variation at any given point on the Earth is a measure of the angle between the True North pole and the Magnetic North pole, measured from that point. This means that the variation at any point is determined by the locations of the true North and Magnetic north Poles. But the positions of these poles vary with the passing of time, thereby causing the variation at any given point to gradually change (option b).

MAGNETISM & COMPASSES 87 d.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Isogonal lines are lines on charts, joining points of equal variation. All Isogonal lines converge at North and South Magnetic and Geographical Poles (option d). The sketch below illustrates this effect.



MAGNETISM & COMPASSES 88 b.

In a direct reading magnetic compass the magnet must be located within the cockpit area in view of the pilot. This can cause inaccuracies due to the effects of magnetic fields caused by materials and electrical, equipment in the cockpit area. These fields represent additional deviation sources. One of the principal advantages of a remote or slaved gyro compass is that it enables the detector unit to be located in another area such as the wingtips, thereby isolating it from the aircraft deviation sources (option b).

MAGNETISM & COMPASSES 89 c.

The dip angle is the angle between the total magnetic field and the earth horizontal. The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. So the maximum possible dip angle is 90^0, which occurs at the magnetic poles (option c).

MAGNETISM & COMPASSES 90 c.

The creation of permanent magnetism in an object requires two things. Firstly the object must contain materials capable of supporting permanent magnetism. These materials are said to be "magnetically hard". This term does not refer to the physical hardness of the materials but to the degree of effort required to induce of remove permanent magnetism.

One explanation of the magnetic properties of materials uses the concept of magnetic domains within the material. Each domain can be considered to be a microscopically small magnet, with a North and South Pole. If a majority of these domains become permanently aligned in one direction, the material possesses permanent magnetism.

The second factor required to induce permanent magnetism is some means by which the magnetic domains within the material can be aligned in one direction. Whenever a material is subjected to physical shocks such as when hammering it, the magnetic domains are shaken lose from their alignment. If this process is repeated over a long period of time, such as when riveting together the skin of an aircraft, the magnetic domains can become aligned with the magnetic field of the earth. This combination of hammering and the effects of the earth's magnetic field during construction is the most common cause of permanent magnetism in aircraft (option c).

MAGNETISM & COMPASSES 91 c.

The dip angle is the angle between the total magnetic field and the earth horizontal. The lines of force produced by the earths magnetic field flow vertically upwards, out of the ground at the magnetic north pole and vertically into the ground at the magnetic South Pole. So at the South magnetic equator the dip angle is 90^0 (option c).

MAGNETISM & COMPASSES 92 c.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North. Lines indicating points of equal variation on a chart are called Isogonal lines (option c). They are shown as pecked lines on charts.

MAGNETISM & COMPASSES 93 d.

The terms "aperiodic" and "dead beat" mean that the compass must settle down quickly on steady indication following any disturbance such as turbulence or aircraft manoeuvres. This is achieved by including three design factors. Firstly by using several short magnets instead of a single long magnet, the mass of the magnet is brought closer to the compass point. This reduces the inertia of the unit thereby enabling oscillations to be damped out very quickly. Secondly the magnets are immersed in a liquid, which acts as a damping fluid. Thirdly by attaching damping wires to the magnets. As the magnets oscillate these wires move back and forth through the fluid. The fluid friction on these wires thereby damps out oscillations. (Option d), therefore gives the best description of the methods used.

MAGNETISM & COMPASSES 94 b.

The term "variation" refers to the horizontal angle between the True North and Magnetic North. If variation is West this means that Magnetic North is to the West of True North. This in turn means that True North is East of Magnetic North (option b).

MAGNETISM & COMPASSES 95 a.

To answer this type of question it must first be noted that the terms, T = True bearing, V = Variation, M = Magnetic bearing, D = Deviation, and C = Compass bearing.

True bearing can be converted into magnetic bearing by applying the variation. This can most easily be done by using the reminders "If variation is west then magnetic is best" and "If variation is East then magnetic is least". The first of these reminders means that if variation is West, then true bearing can be converted into magnetic bearing by adding the variation. The second reminder means that if variation is East, then True bearing can be converted into Magnetic bearing by subtracting the variation. Applying these methods to the four options in turn gives (in option a) 130 + 2 = 132, (in option b) 130 – 2 = 128, (in option c) 130 + 2 = 132, (in option d) 130 - 2 = 128. Comparing these values with those in the column marked M indicates that only option a, and c, are correct up to this point. Options b, and d, can therefore be discarded.

Magnetic bearings in option b, and d, can then be converted into compass bearing by applying the stated deviations, having first reversed the signs of the deviations. In this question all deviations are +1 so conversion from Magnetic bearing, to Compass bearing, is by adding -1. In option a, this gives 132 - 1 = 131

and in option c this gives 132 - 1 = 131. Comparing these values with those in the options reveals that only option a, is correct.

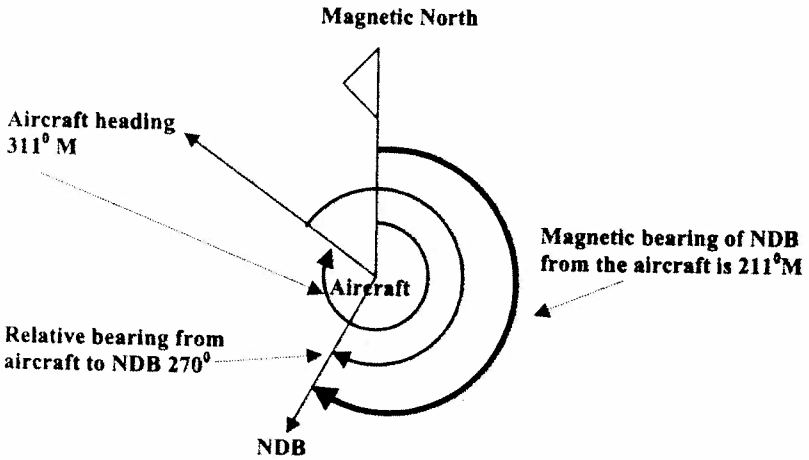
MAGNETISM & COMPASSES 96 a.

The lines of magnetic force in the magnetic field of the Earth are horizontal at the magnetic equator and dip down towards the surface as latitude increases to the North and South. This means that the lines of force are horizontal at the magnetic equator and vertical at the North and South magnetic poles. Because the compass magnet aligns itself with these lines of force, the magnet is horizontal only when the aircraft is over the magnetic equator. In order minimize the effects of this dipping of the lines of force the compass magnet uses a pendulous suspension system, whereby the magnet hangs below its point of suspension.

Because the C of G of the magnet is no longer directly below its point of suspension, its inertia will cause its C of G to lag behind its suspension point. This will cause the compass to over-read or under-read whenever an aircraft turns through the poles or accelerates or decelerates in an easterly or Westerly direction. The magnitude of these errors is proportional to the degree of dip. So at the magnetic equator where the dip angle is zero there will be no acceleration errors. So when an aircraft on the Equator accelerates whilst traveling westwards there will be no change in compass indication (option a).

MAGNETISM & COMPASSES 97 d.

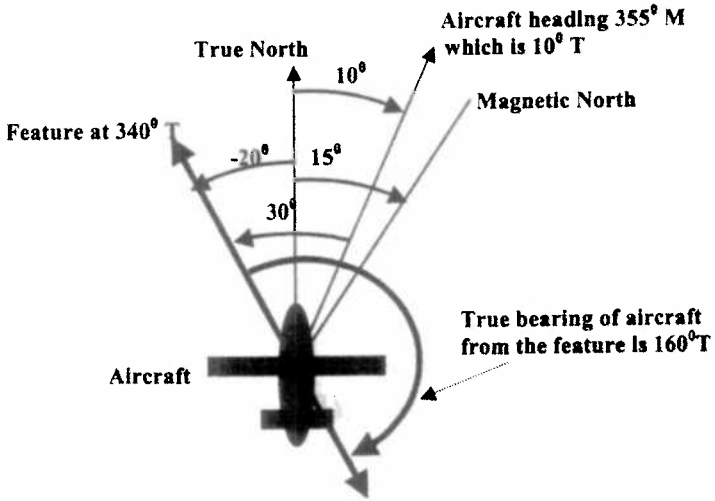
Although the question specifies a drift value this is not relevant to the solution. The aircraft magnetic heading is 311° and relative bearing of the NDB is 270°. Adding these together gives a magnetic bearing from the aircraft to the NDB of 3110 + 270° = 581°. Subtracting 360° gives the magnetic bearing of 221° (option d). This situation is illustrated below.



MAGNETISM & COMPASSES 98 c.

The variation is stated to be 15°E, which means that True North is 15° to the West of Magnetic North. This means that the true heading is Magnetic Heading (355°) + 15° = 370°. Subtracting 360° gives a true heading of 10°.

The feature is 30° to the left, so its True Bearing is 10° – 30° = - 20°. But headings must be between 0° and 360°, so adding 360° gives the true bearing of 340° from the aircraft to the feature. But the question asks for the bearing of the aircraft from the feature. This can be found by subtracting 180° to give 160° (option c).



MAGNETISM & COMPASSES 99 c.

In order to answer this question it must first be noted that VOR radials are expressed as magnetic headings. The two positions specified in this question are on the same meridian (060° 15'W). This means that position HO is due north of the VOR beacon at position YYR. The true bearing from YYR to HO is therefore 000°. To convert from True bearing to Magnetic bearing it is necessary to apply the variation measured at the point from which the bearing is being calculated. At position YYR the variation is 28° W. Using the reminder " If variation is West then Magnetic is best" we must add the (28° W) variation to the true bearing (0000). This gives a magnetic bearing of 28° (option c) for the radial.

MAGNETISM & COMPASSES 100 b.

The term "variation" refers to the horizontal angle between the True North and Magnetic North (option b). It may be West in which case Magnetic North is to the West of True North, or East, in which case Magnetic North is to the East of True North.

DESCENTS 1 b.

The 1 in 60 rule states that in glideslopes at small angles:

The Height change = Range x slope angle / 60

Which can be rearranged to give:

Range = Height change x 60 /slope angle

Inserting the data provided in the question gives:

Range = 2500 ft x 60 /3 = 50000 ft

Dividing this by 6080 ft/nm gives 8.22 nm. (option b 7.8 is closest to this answer)

DESCENTS 2 c.

This type of problem can be solved using the CRP5 or the standard conversion factor 1 Kt = 0.515 m/sec.

This can be derived using:

1 Kt = 1 nm/h, 1 nm = 6080 ft, 1 ft = 3.28 m, 1 h = 3600 seconds

Combining these factors gives

(1 nm/h) x (6080 ft/nm) / (3.28 m/ft) / (3600 s/h) = 0.515 m/sec.

Using this conversion factor 70 m/s / (0.515 m/s/Kt) = 135.92 Kts. (option c).

DESCENTS 3 c.

The 1 in 60 rule states that in glideslopes at small angles:

The rate of descent (ROD) = groundspeed x slope angle / 60

A change in headwind or tailwind will alter the ground speed, so to maintain a constant glideslope in any given change in headwind or tailwind, the pilot must alter the ROD to maintain the same ratio of ROD/GS.

For any given change in headwind or tailwind the required change in ROD can be calculated using the above equation modified as follows:

Change in ROD = Change in groundspeed x slope angle / 60

A 10 Kt headwind represents approximately a 10 Kt decrease in groundspeed.

1 Kt = 101,3 ft/min so 10 Kts = 1013 ft/min. So a decrease of 10 Kts in groundspeed is a change of -1013 ft/min.

Putting this and the required 3^0 glideslope into the equation gives:

Change in ROD = -1013 ft/min x 3 / 60 = -50.65

So required change in ROD = -50.65 ft/min

So the ROD must be decreased by 50.65 ft/min. Option (c) decrease ROD by 50 ft/min is the closest to this figure.

Note: For the specific case of a 3^0 climb angle or glideslope, an approximate value for the required change in ROD for any given headwind can be calculated using the following shortcut:

Change in ROC or ROD required (in ft/min) = 5 x headwind or tailwind (in kts)

So descending in a 10 kt headwind requires 5 x 10 = 50 ft/min decrease in ROD. Descending in a 10 kt tailwind requires a 5 x 10 = 50 ft/min increase in ROD.

DESCENTS 4 c.

The % slope is the tan of the slope angle x 100%.

So in a 12% glideslope the tangent of the slope angle is 12/100 = 0.12

This gives a slope angle of 6.843^0

But the tangent of the slope = ROD/groundspeed

Which can be rearranged to give ROD = Tan slope x groundspeed

Inserting the data provided in the question gives:

ROD = 0.12 x 540 Kts = 64.8 Kts.

This can be converted into ft/min by multiplying by 1 Kt = 101.3 ft/min to give:

ROD = 64.8 Kts x 101.3 ft/min/Kt = 6564.24 ft/min

Option (c) 6550 ft/min is the closest to this answer.

DESCENTS 5 c.

The distance to the threshold = 25 nm, which = 25 nm x 6080 ft/nm = 152000 ft.

The aircraft is to pass 50 ft above the threshold so the initial height at 25 nm range is equal to the height change required plus 50 ft. This can be rearranged to give:

Height change = initial height – 50 ft

The 1 in 60 rule states that:

Height change = Slope angle in degrees/60 x Range.

Inserting the data given in the question gives:

Initial height –50 = 3/60 x 152000 ft = 7600 ft

So the initial height = 7600 + 50 = 7650 ft. (option c).

DESCENTS 6 d.

This type of problem can be solved using the CRP5 or by using the following conversions factors:

1 m = 3.28 ft and 1 minute = 60 seconds

Using these factors:

(730 ft/min) / (3.28 m/ft) / (60 sec/min) = 3.7 m/sec. (option d).

DESCENTS 7 a.

In any glide slope the Tangent of the slope angle = rate of descent (ROD) divided by the Ground Speed (GS).

In a 3^0 glideslope the ROD/GS = Tan 3^0 = 0.52407

A change in headwind or tailwind will alter the ground speed, so to maintain a constant glideslope in any given change in headwind or tailwind, the pilot must alter the ROD to maintain the same ratio of ROD/GS.

For any given change in headwind or tailwind the required change in ROD can be calculated using the equation:

Tan glideslope = Change in ROD / Change in groundspeed.

A 15 Kt headwind represents approximately a 15 Kt decrease in groundspeed.

1 Kt = 101.3 ft/min so 15 Kts = 1519.5 ft/min. So a decrease of 15 Kts in groundspeed is a change of -1519.5 ft/min.

Putting this and the required 3^0 glideslope into the equation gives:

Tan 3^0 = ROD / -1519.5 ft/min

So required ROD = Tan 3^0 x –1519.5 ft/min = -79.63 ft/min

So the ROD must be decreased by 79.63 ft/min. Option (a) decrease ROD by 79 ft/min is the closest to this figure.

DESCENTS 8 d

The 1 in 60 rule states that in glideslopes at small angles, the rate of descent (ROD) is approximately:

ROD = Ground Speed x slope angle / 60

So in 10^0 glideslope at 500 Kts groundspeed the ROD 500 x 10 / 60 = 83.333 Kts

This can be converted into ft/min by multiplying by the standard conversion factor 1 Kt = 101.3 ft/min to give:

ROD = 83.333 Kts x 101.3 ft/min/Kt = 8441.67 ft/min (option d).

DESCENTS 9 a.

The aircraft is to descend from FL370 to FL120.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (120 - 370) x 100 = -25000 ft.

The ground distance available is 100 nm and the ground speed is 396 Kts.

So the time taken to descend will be 100 nm / 396 nm/h = 0.2525 hours, which is 15.15 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 25000 ft / 15.15 m = 1650 ft/min (option a).

DESCENTS 10 c.

This type of problem can be by using the 1 in 60 rule or by noting that:

% slope = (ROD/GS) x 100%

Rearranging this equation gives: ROD = (% x GS) / 100

Inserting the data provided in the question gives:

ROD = (12 x 540 Kts) / 100 = 64.8 Kts.

This can be converted into ft/min by multiplying by the conversion factor 101.3 ft/min = 1 kt to give:

ROD = (64.8 Kts x 101.3 ft/min) / 1 Kt = 6564.24 ft/min, which is closest to option a (6500 ft/min).

DESCENTS 11 a.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 25 kts increase in headwind ROD must change by 5 x 25 = 125 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 25 kt increase in headwind, the ROD must be decreased by 125 ft/min (option a).

DESCENTS 12 c.
The % slope = the Tan of the slope angle x 100% so a 5% slope represents an angle of 2.862^0.

The 1 in 60 rule states that ROD = GS x descent angle / 60

Inserting the data provided in the question gives:

ROD = 450 kts x 2.862 / 60 = 21.467 kts.

This can be converted into ft/min by multiplying by 101.3 ft/min / kt to give:

ROD = 21.467 kts x 101.3 ft/min/kt = 2174.71 ft/min or approximately 2175 ft/min (option c).

DESCENTS 13 c.
The aircraft is to descend from FL370 to FL80. This represents a height change equal to (new FL – Initial FL) x 100 ft, which is (80 – 370) x 100 = -29000 ft.

The time taken to descend = height change = ROD = -29000ft / -1800 ft/min = 16.11 mins which is 0.2685 hours.

But the required ground speed is 232 kts, so the ground distance in the descent is:

Ground distance = Time x groundspeed = 232 nm/h x 0.2685 h = 62.296 nm.

So the descent must start when the aircraft is 62.296 nm from VOR X.

The initial position is 185 nm form VOR X so the distance to be flown before commencing the descent = 185 nm – 62.296 122.704 nm.

At a ground speed of 320 nm/h the time required to reach this position will be 122.703 nm / 320 nm/h = 0.383 hours which is 22.98 mins.

The initial time was 0422 so the time at the start of the descent must be 0422 + 22.98 = 0444.54, or approximately 0445 (option c).

DESCENTS 14 b
This type of problem can be solved using the 1 in 60 rule, which states that:

Height = ground distance / angle /60.

The % gradient is the tangent of the angle x 100% so 5.2% gradient represents an angle of 2.977^0.

Inserting the data provided in the question into the 1 in 60 equation gives:

Height = 7 nm / 2.977/60 = 0.3473 nm.

This can be converted into ft by multiplying by 6080 ft/nm to give ground distance = 2111 ft, which is closest to option b.

DESCENTS 15 c.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (In ft Headwind or tailwind change (in kts).

So for a 10 kts decrease in headwind ROD must change by 5 x 10 = 50 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 10 kt decrease in headwind, the ROD must be increased by 50 ft/min (option c).

DESCENTS 16 a.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in an 8% descent the ROD is 8% or 0.08 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by decimal equivalent of the %, which is the %/100.

So in an 8% descent at 400 Kts:

Groundspeed the ROD = 0.08 x 400 kt x 101.3 ft/min/kt

Which gives ROD = 3241.6 or approximately 3242 (option a).

DESCENTS 17 a.
The aircraft is to descend from FL350 to FL80.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (80 - 350) x 100 = -27000 ft.

The ground distance available is 85 nm and the ground speed is 340 Kts.

So the time taken to descend will be 85 nm / 340 nm/h = 0.25 hours, which is 15 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 27000 ft / 15 m = 1800 ft/min (option a).

DESCENTS 18 d.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 15 kts decrease in headwind ROD must change by 5 x 15 = 75 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 15 kt decrease in headwind, the ROD must be increased by 75 ft/min (option d).

DESCENTS 19 b.
The aircraft is to descend from FL290 to FL80.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (80 - 290) x 100 = -21000 ft.

The ground distance available is 50 nm and the ground speed is 271 Kts.

So the time taken to descend will be 50 nm / 271 nm/h = 0.1845 hours, which is 11.1 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 21000 ft / 11.1 m = 1892 ft/min or approximately 1900 ft/min(option b).

DESCENTS 20 a.
This type of problem can be solved using the CRP5 or by noting that 1 kt is approximately 0.515 m/sec and using the equation:

Kts = m/sec / 0.515 m/sec/kt.

Inserting the data provided gives (70 m/sec) / (0.515 m/sec/kt) = 135.9 kt or approximately 136 kts (option a)

DESCENTS 21 c.
This type of problem can be by using the 1 in 60 rule or by noting that:

% slope = (ROD/GS) x 100%

Rearranging this equation gives: ROD = (% x GS) / 100

Inserting the data provided in the question gives:

ROD = (10 x 350 Kts) / 100 = 35 Kts.

This can be converted into ft/min by multiplying by the conversion factor 101.3 ft/min = 1 kt to give 3545.5 (option c).

DESCENTS 22 b.
The aircraft is to descend from FL330 to FL100.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (100 - 330) x 100 = -23000 ft.

The ground distance available is 65 nm and the ground speed is 330 Kts.

So the time taken to descend will be 65 nm / 330 nm/h = 0.197 hours, which is 11.8 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft / 11.8 m = 1949 ft/min or approximately 1950 ft/min (option b).

DESCENTS 23 c.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 20 kts increase in headwind ROD must change by 5 x 20 = 100 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 20 kt increase in headwind, the ROD must be decreased by 100 ft/min (option c).

DESCENTS 24 b.
The time taken to descend is equal to the height change / ROD

Inserting the data provided in the question gives:

Descent time = 15000 ft / 3000 ft/min = 5 minutes. Which is 5/60 hours

An approximate value for the range can now be estimated by assuming that the groundspeed in still air is approximately equal to the TAS and using the equation:

Range = ground speed x time.

Inserting the data provided gives:

Range = 320 nm/hour x 5/60 hour = 26.67 nm or approximately 26.7 nm (option b).

DESCENTS 25 c.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 7% descent the ROD is 7% or 0.07 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %, which is the %/100.

So in an 7% descent at 250 Kts:

Groundspeed the ROD = 0.07 x 250 kt x 101.3 ft/min/kt

Which gives ROD = 1772.75 or approximately 1773 ft/min (option c).

DESCENTS 26 d.
The aircraft is to descend from FL370 to FL130.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (130 - 370) x 100 = -24000 ft.

The ground distance available is 120 nm and the ground speed is 288 Kts.

So the time taken to descend will be 120 nm / 288 nm/h = 0.42 hours, which is 25 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 24000 ft / 25 m = 960 ft/min (option d).

DESCENTS 27 c.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 20 kts decrease in headwind ROD must change by 5 x 20 = 100 ft/min.

Headwinds increase glideslope angle, so to maintain a 3^0 slope the ROD must be increased if a headwind decreases.

So to maintain a 3^0 glideslope in a 20 kt decrease in headwind, the ROD must be increased by 100 ft/min (option c).

DESCENTS 28 a.
The distance or range required to achieve given height change can be calculated using the 1 in 60 rule as follows:

Height = (glideslope angle/60) x Range

This can be rearranged to give: Range = Height x 60 / glideslope angle

Inserting the data provided in the question gives:

Range = 2500 ft x 60 /3 = 50000 ft

Dividing this by 6080 ft/nm gives range = 8.22 nm or approximately 8.3 nm (option a)

DESCENTS 29 d.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 12% descent the ROD is 12% or 0.12 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 12% descent at 240 Kts:

Groundspeed the ROD = 0.12 x 240 kt x 101.3 ft/min/kt

Which gives ROD = 2917.44 ft/min or approximately 2918 ft/min (option d).

DESCENTS 30 a.
This type of problem can be solved using the 1 in 60 rule in the following form:

ROD = Groundspeed x Glideslope angle /60

Inserting the data provided gives: ROD = 150 Kts x 3.5 / 60 = 8.75 kts

This can be converted into ft/min by multiplying by 101.3 ft/min/kt to give:

ROD = 8.75 kts x 101.3 ft/min/kt = 886 ft/min or approximately 900 ft/min (option a).

DESCENTS 31 c.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 25 kts decrease in headwind ROD must change by 5 x 17 = 85 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be increased if a headwind decreases.

So to maintain a 3^0 glideslope in a 17 kt decrease in headwind, the ROD must be increased by 85 ft/min (option a).

DESCENTS 32 a.
The required change in height can be found by using the equation:

Height change = (Final FL – Initial FL) x 100 ft

Inserting the data provided in the question gives:

Height change = (80 – 350) x 100 = -27000 ft

The time to carry out this descent can now be calculated using the equation:

Descent time = height change / ROD

Inserting the data provided in the question gives:

Descent time = 27000 ft / 1800 ft/min = 15 mins which is 0.25 hour

Range can now be calculated using the equation, Range = groundspeed x time.

Inserting the data provided gives:

Range = 276 nm/h x 0.25 h = 69 nm (option a).

DESCENTS 33 b.
The required change in height can be found by using the equation:

Height change = (Final FL – Initial FL) x 100 ft

Inserting the data provided in the question gives:

Height change = (70 – 390) x 100 = -32000 ft

The time to carry out this descent can now be calculated using the equation:

Descent time = height change / ROD

Inserting the data provided in the question gives:

Descent time = 32000 ft / 2500 ft/min = 12.8 mins which is 12.8/60 hour

Range can now be calculated using the equation, Range = groundspeed x time.

Inserting the data provided gives:

Range = 248 nm/h x 12.8/60 h = 52.9 nm or approximately 53 nm (option b).

DESCENTS 34 c.

The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in an 8% descent the ROD is 8% or 0.08 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in an 8% descent at 340 Kts:

Groundspeed the ROD = 0.08 x 340 kt x 101.3 ft/min/kt

Which gives ROD = 2755 ft/min (option c).

DESCENTS 35 a.

The aircraft is to descend from FL350 to FL110.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (110 - 350) x 100 = -24000 ft.

The ground distance available is 100 nm and the ground speed is 335 Kts.

So the time taken to descend will be 100 nm / 335 nm/h = 0.298 hours, which is 17.9 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

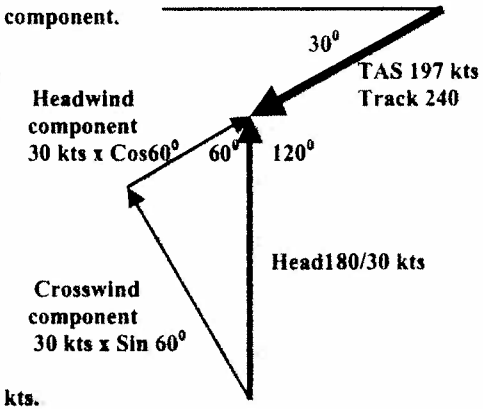
ROD = 24000 ft / 17.9 m = 1340.8 ft/min or approximately 1340 ft/min (option a).

DESCENTS 36 d.

The first stage of solving this type of problem is to calculate the ground speed using the CRP 5 or the following equation:

Groundspeed = TAS – headwind component.

The headwind component can be calculated by making sketch of the situation similar to the one at the right.



This shows that the headwind Component is 30 kts x Cos 60°

Which is 15 Kts

So groundspeed = 197 – 15 = 182 kts.

The second stage is to calculate descent time by dividing the ground distance (39 nm) by the ground speed (182 kts). This gives a time of 12.86 minutes.

The third stage is to calculate the change of height using the equation:

Height change = (Final FL – Initial FL) x 100 ft

Inserting the data provided gives:

Height change = (FL40 – FL220) x 100 = -18000 ft

The final stage is to calculate the ROD using the equation:

ROD = height change/Descent time = 18000 ft/12.86 min = 1400 ft/min (option d)

DESCENTS 37 d.

An approximate value for the change in ROD required to maintain a 3° glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 10 kts increase in headwind ROD must change by 5 x 10 = 50 ft/min.

Headwind increase glideslope angle, so to maintain a 3° slope the ROD must be decreased if a headwind increases.

So to maintain a 3° glideslope in a 10 kt increase in headwind, the ROD must be decreased by 50 ft/min (option d).

DESCENTS 38 a.

The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 12% descent the ROD is 12 or 0.12 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 12% descent at 150 Kts:

Groundspeed the ROD = 0.12 x 150 kt x 101.3 ft/min/kt

Which gives ROD = 1823.4 ft/min (option a).

DESCENTS 39 b.

The aircraft is to descend from FL330 to FL100.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (100 - 330) x 100 = -23000 ft.

The ground distance available is 65 nm and the ground speed is 240 Kts.

So the time taken to descend will be 65 nm / 240 nm/h = 0.27 hours, which is 16.25 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft/16.25 min = 1415 ft/min or approximately 1420 ft/min (option b).

DESCENTS 40 c.

The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a12% descent the ROD is 12% or 0.12 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 12% descent at 540 Kts:

Groundspeed the ROD = 0.12 x 540 kt x 101,3 ft/min/kt

Which gives ROD = 6564.24 or approximately 6550 ft/min (option c).

DESCENTS 41 a.

The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 12% descent the ROD is 12% or 0.12 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in an 12% descent at 175 Kts:

Groundspeed the ROD = 0.12 x 175 kt x 101.3 ft/min/kt

Which gives ROD = 2127.3 (option a).

DESCENTS 42 b.

The aircraft is to descend from FL330 to FL100.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (100 - 330) x 100 = -23000 ft.

The ground distance available is 100 nm and the ground speed is 330 Kts.

So the time taken to descend will be 100 nm / 240 nm/h = 0.42 hours, which is 25 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft / 25 min = 920 ft/min (option b).

DESCENTS 43 c.

The 1 in 60 rule states that the height change = range x slope angle / 60

Inserting the data provided in this question gives:

Height change = 25 nm x 6000 ft/nm x 3 /60 which = 7500 ft

This means that the aircraft descends 7500 ft between the start of the descent and reaching the point 50 ft above the threshold. So the initial height above the threshold is 7500 + 50 = 7550 ft (option c).

DESCENTS 44 c.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 5% descent the ROD is 5% or 0.05 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 5% descent at 540 Kts:

Groundspeed the ROD = 0.05 x 540 kt x 101.3 ft/min/kt

Which gives ROD = 2735.1 (option c).

DESCENTS 45 b.
The distance or range required to achieve given height change can be calculated using the 1 in 60 rule as follows:

Height = (glideslope angle/60) x Range

This can be rearranged to give: Range = Height x 60 / glideslope angle

Inserting the data provided in the question gives:

Range = 2500 ft x 60 /3 = 50000 ft

Dividing this by 6080 ft/nm gives range = 8.22 nm or approximately 8 nm (option b)

DESCENTS 46 c.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 6% descent the ROD is 6% or 0.06 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 6% descent at 500 Kts:

Groundspeed the ROD = 0.06 x 500 kt x 101.3 ft/min/kt

Which gives ROD = 3039 ft/min (option c).

DESCENTS 47 c.
The aircraft is to descend from FL370 to FL80. This represents a height change equal to (new FL – Initial FL) x 100 ft, which is (80 – 370) x 100 = -29000 ft.

The time taken to descend = height change = ROD = -29000ft / -1800 ft/min = 16.11 mins which is 0.2685 hours.

But the required ground speed is 232 kts, so the ground distance in the descent is:

Ground distance = Time x ground speed = 232 nm/h x 0.2685 h = 62.296 nm.

So the descent must start when the aircraft is 62.296 nm from VOR X.

The initial position is 185 nm form VOR X so the distance to be flown before commencing the descent = 185 nm – 62.296 122.704 nm.

At a ground speed of 350 nm/h the time required to reach this position will be 122.703 nm / 350 nm/h = 0.35 hours which is 21.03 mins.

The initial time was 0430 so the time at the start of the descent must be 0430 + 21.03 = 0451.03, or approximately 0451 (option c).

DESCENTS 48 c.
The aircraft is to descend from FL330 to FL100.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (100 - 330) x 100 = -23000 ft.

The ground distance available is 65 nm and the ground speed is 340 Kts.

So the time taken to descend will be 65 nm / 340 nm/h = 0.19 hours, which is 11.5 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft/11.5 min = 2000 ft/min (option c).

DESCENTS 49 b.
The aircraft is to descend from FL350 to FL120.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (120 - 350) x 100 = -23000 ft.

The ground distance available is 65 nm and the ground speed is 250 Kts.

So the time taken to descend will be 65 nm / 250 nm/h = 0.26 hours, which is 15.6 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft/ 15.6 min = 1474 ft/min (option b).

DESCENTS 50 a.
The 1 in 60 rule states that the height change = range x slope angle / 60

Inserting the data provided in this question gives:

Height change = 25 nm x 6000 ft/nm x 3 /60 which = 7500 ft

This means that the aircraft descends 7500 ft between the start of the descent and reaching the point 50 ft above the threshold. So the initial height above the threshold is 7500 + 50 = 7550 ft (option a).

DESCENTS 51 b.
The 1 in 60 rule states that in glideslopes at small angles:

The Height change = Range x slope angle / 60

Which can be rearranged to give:

Range = Height change x 60 /slope angle

Inserting the data provided in the question gives:

Range = 2500 ft x 60 /8 = 18750 ft

Dividing this by 6080 ft/nm gives 3.08 nm. (option b 3.1 is closest to this answer)

DESCENTS 52 c.
This type of problem can be solved using the CRP5 or the standard conversion factor 1 Kt = 0.515 m/sec.

This can be derived using:

1 Kt = 1 nm/h, 1 nm = 6080 ft, 1 ft = 3.28 m, 1 h = 3600 seconds

Combining these factors gives

(1 nm/h) x (6080 ft/nm) / (3.28 m/ft) / (3600 s/h) = 0.515 m/sec.

Using this conversion factor 95 m/s / (0.515 m/s/Kt) = 184.5 Kts or approximately 185 kts. (option c).

DESCENTS 53 c.
The 1 in 60 rule states that in glideslopes at small angles:

The rate of descent (ROD) = groundspeed x slope angle / 60

A change in headwind or tailwind will alter the ground speed, so to maintain a constant glideslope in any given change in headwind or tailwind, the pilot must alter the ROD to maintain the same ratio of ROD/GS.

For any given change in headwind or tailwind the required change in ROD can be calculated using the above equation modified as follows:

Change in ROD = Change in groundspeed x slope angle / 60

A 12 Kt headwind represents approximately a 12 Kt decrease in groundspeed.

1 Kt = 101.3 ft/min so 12 Kts = 1215.6 ft/min. So a decrease of 12 Kts in groundspeed is a change of -1215.6 ft/min.

Putting this and the required 3^0 glideslope into the equation gives:

Change in ROD = -1215.6 ft/min x 3 / 60 = -60.78

So required change in ROD = -60.78 ft/min

So the ROD must be decreased by 60.78 or approximately 61 ft/min. Option (c) decrease ROD by 61 ft/min is the closest to this figure.

Note: For the specific case of a 3^0 climb angle or glideslope, an approximate value for the required change in ROD for any given headwind can be calculated using the following shortcut:

Change in ROC or ROD required (in ft/min) = 5 x headwind or tailwind (in kts)

So descending in a 12 kt headwind requires 5 x 12 = 60 ft/min decrease in ROD. Descending in a 12 kt tailwind requires a 5 x 12 = 60 ft/min increase in ROD.

DESCENTS 54 c.
The % slope is the tan of the slope angle x 100%.

So in a 7% glideslope the tangent of the slope angle is 7/100 = 0.07

This gives a slope angle of 4.004^0

But the tangent of the slope = ROD/groundspeed

Which can be rearranged to give ROD = Tan slope x groundspeed

Inserting the data provided in the question gives:

ROD = 0.07 x 540 Kts = 37.8 Kts.

This can be converted into ft/min by multiplying by 1 Kt = 101.3 ft/min to give:

ROD = 37.8 Kts x 101.3 ft/min/Kt = 3829.14 ft/min

Option (c) 3830 ft/min is the closest to this answer.

DESCENTS 55 c.

The distance to the threshold = 35 nm, which = 35 nm x 6000 ft/nm = 210000 ft.

The aircraft is to pass 50 ft above the threshold so the initial height at 35 nm range is equal to the height change required plus 50 ft. This can be rearranged to give:

Height change = Initial height – 50 ft

The 1 in 60 rule states that:

Height change = Slope angle in degrees/60 x Range.

Inserting the data given in the question gives:

Initial height –50 = 3/60 x 210000 ft = 10500 ft

So the initial height = 10500 + 50 = 10550 ft. (option c).

DESCENTS 56 d.

This type of problem can be solved using the CRP5 or by using the following conversions factors:

1 m = 3.28 ft and 1 minute = 60 seconds

Using these factors:

(850 ft/min) / (3.28 m/ft) / (60 sec/min) = 4.3 m/sec. (option d).

DESCENTS 57 a.

In any glide slope the Tangent of the slope angle = rate of descent (ROD) divided by the Ground Speed (GS).

In a 3^0 glideslope the ROD/GS = Tan 3^0 = 0.52407

A change in headwind or tailwind will alter the ground speed, so to maintain a constant glideslope in any given change in headwind or tailwind, the pilot must alter the ROD to maintain the same ratio of ROD/GS.

For any given change in headwind or tailwind the required change in ROD can be calculated using the equation:

Tan glideslope = Change in ROD / Change in groundspeed.

A 35 Kt headwind represents approximately a 35 Kt decrease in groundspeed.

1 Kt = 101.3 ft/min so 35 Kts = 3545.5 ft/min. So a decrease of 35 Kts in groundspeed is a change of -3545.5 ft/min.

Putting this and the required 3^0 glideslope into the equation gives:

Tan 3^0 = ROD / -3545.5 ft/min

So required ROD = Tan 3^0 x –3545.5 ft/min = -185.8 ft/min

So the ROD must be decreased by 185.8 ft/min. Option (a) decrease ROD by 186 ft/min is the closest to this figure.

DESCENTS 58 d.

The 1 in 60 rule states that in glideslopes at small angles, the rate of descent (ROD) is approximately:

ROD = Ground Speed x slope angle / 60

So in 10^0 glideslope at 400 Kts groundspeed the ROD 400 x 10 / 60 = 66.67 Kts

This can be converted into ft/min by multiplying by the standard conversion factor 1 Kt = 101.3 ft/min to give:

ROD = 66.67 Kts x 101.3 ft/min/Kt = 6753 ft/min (option d).

DESCENTS 59 a.

The aircraft is to descend from FL370 to FL100.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (100 - 370) x 100 = -27000 ft.

The ground distance available is 120 nm and the ground speed is 390 Kts.

So the time taken to descend will be 120 nm / 390 nm/h = 0.308 hours, which is 18.46 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 27000 ft / 18.46 m = 1462.5 or approximately 1460 ft/min (option a).

DESCENTS 60 c.

This type of problem can be by using the 1 in 60 rule or by noting that:

% slope = (ROD/GS) x 100%

Rearranging this equation gives: ROD = (% x GS) / 100

Inserting the data provided in the question gives:

ROD = (10 x 540 Kts) / 100 = 54 Kts.

This can be converted into ft/min by multiplying by the conversion factor 101.3 ft/min = 1 kt to give:

ROD = (54 Kts x 101.3 ft/min) / 1 Kt = 5470 ft/min,(option c).

DESCENTS 61 a.

An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 5 kts increase in headwind ROD must change by 5 x 5 = 25 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 5 kt increase in headwind, the ROD must be decreased by 25 ft/min (option a).

DESCENTS 62 c.

The % slope = the Tan of the slope angle x 100% so a 5.5% slope represents an angle of 3.15^0.

The 1 in 60 rule states that ROD = GS x descent angle / 60

Inserting the data provided in the question gives:

ROD = 450 kts x 3.15 / 60 = 23.6 kts.

This can be converted into ft/min by multiplying by 101.3 ft/min / kt to give:

ROD = 23.6 kts x 101.3 ft/min/kt = 2392 ft/min or approximately 2390 ft/min (option c).

DESCENTS 63 c.

The aircraft is to descend from FL370 to FL80. This represents a height change equal to (new FL – Initial FL) x 100 ft, which is (80 – 370) x 100 = -29000 ft.

The time taken to descend = height change = ROD = -29000ft / -1800 ft/min = 16.11 mins which is 0.2685 hours.

But the required ground speed is 250 kts, so the ground distance in the descent is:

Ground distance = Time x groundspeed = 250 nm/h x 0.2685 h = 67.129nm.

So the descent must start when the aircraft is 67.129 nm from VOR X.

The initial position is 185 nm form VOR X so the distance to be flown before commencing the descent = 185 nm – 67.129 117.87 nm.

At a ground speed of 420 nm/h the time required to reach this position will be 117.87 nm / 420 nm/h = 0.281 hours which is 16.83 mins.

The initial time was 0400 so the time at the start of the descent must be 0400 + 16.83 = 0416.83, or approximately 0417 (option c).

DESCENTS 64 b.

This type of problem can be solved using the 1 in 60 rule, which states that:

Height = ground distance x angle /60.

The % gradient is the tangent of the angle x 100% so 5.5% gradient represents an angle of 3.15^0.

Inserting the data provided in the question into the 1 in 60 equation gives:

Height = 9 nm x 3.15/60 = 0.472nm.

This can be converted into ft by multiplying by 6080 ft/nm to give ground distance = 2871 ft, which is closest to option b (2870).

DESCENTS 65 c.

An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 45 kts decrease in headwind ROD must change by 5 x 45 = 225 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 45 kt decrease in headwind, the ROD must be increased by 225 ft/min (option c).

DESCENTS 66 a.

The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in an 8% descent the ROD is 7.5% or 0.075 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by decimal equivalent of the % , which is the %/100.

So in an 7.5% descent at 400 Kts:

Groundspeed the ROD = 0.075 x 400 kt x 101.3 ft/min/kt

Which gives ROD = 3039 or approximately 3040 ft/min (option a).

DESCENTS 67 a.

The aircraft is to descend from FL350 to FL80.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (80 - 350) x 100 = -27000 ft.

The ground distance available is 85 nm and the ground speed is 370 Kts.

So the time taken to descend will be 85 nm / 370 nm/h = 0.23 hours, which is 13.8 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 27000 ft / 13.8 m = 1956.52 or approximately 1955 ft/min (option a)

DESCENTS 68 d.

An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 65 kts decrease in headwind ROD must change by 5 x 65 = 325 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 65 kt decrease in headwind, the ROD must be increased by 325 ft/min (option d).

DESCENTS 69 b.

The aircraft is to descend from FL290 to FL80.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (80 - 290) x 100 = -21000 ft.

The ground distance available is 75 nm and the ground speed is 290 Kts.

So the time taken to descend will be 75 nm / 290 nm/h = 0.259 hours, which is 15.5 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 21000 ft / 15.5 m = 1354.8 ft/min or approximately 1355 ft/min(option b).

DESCENTS 70 a.

This type of problem can be solved using the CRP5 or by noting that 1 kt is approximately 0.515 m/sec and using the equation:

Kts = m/sec / 0.515 m/sec/kt.

Inserting the data provided gives (170 m/sec) / (0.515 m/sec/kt) = 330 kt (option a)

DESCENTS 65 c.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 45 kts decrease in headwind ROD must change by 5 x 45 = 225 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 45 kt decrease in headwind, the ROD must be increased by 225 ft/min (option c).

DESCENTS 66 a.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in an 8% descent the ROD is 7.5% or 0.075 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by decimal equivalent of the % , which is the %/100.

So in an 7.5% descent at 400 Kts:

Groundspeed the ROD = 0.075 x 400 kt x 101.3 ft/min/kt

Which gives ROD = 3039 or approximately 3040 ft/min (option a).

DESCENTS 67 a.
The aircraft is to descend from FL350 to FL80.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (80 - 350) x 100 = -27000 ft.

The ground distance available is 85 nm and the ground speed is 370 Kts.

So the time taken to descend will be 85 nm / 370 nm/h = 0.23 hours, which is 13.8 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 27000 ft / 13.8 m = 1956.52 or approximately 1955 ft/min (option a).

DESCENTS 68 d.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 65 kts decrease in headwind ROD must change by 5 x 65 = 325 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 65 kt decrease in headwind, the ROD must be increased by 325 ft/min (option d).

DESCENTS 69 b.
The aircraft is to descend from FL290 to FL80.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (80 - 290) x 100 = -21000 ft.

The ground distance available is 75 nm and the ground speed is 290 Kts.

So the time taken to descend will be 75 nm / 290 nm/h = 0.259 hours, which is 15.5 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 21000 ft / 15.5 m = 1354.8 ft/min or approximately 1355 ft/min(option b).

DESCENTS 70 a.
This type of problem can be solved using the CRP5 or by noting that 1 kt is approximately 0.515 m/sec and using the equation:

Kts = m/sec / 0.515 m/sec/kt.

Inserting the data provided gives (170 m/sec) / (0.515 m/sec/kt) = 330 kt (option a)

DESCENTS 71 c.
This type of problem can be by using the 1 in 60 rule or by noting that:

% slope = (ROD/GS) x 100%

Rearranging this equation gives: ROD = (% x GS) / 100

Inserting the data provided in the question gives:

ROD = (10 x 450 Kts) / 100 = 45 Kts.

This can be converted into ft/min by multiplying by the conversion factor 101.3 ft/min = 1 kt to give 4558.5 ft/min or approximately 4560 (option c).

DESCENTS 72 b.
The aircraft is to descend from FL330 to FL100.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (100 - 330) x 100 = -23000 ft.

The ground distance available is 95 nm and the ground speed is 360 Kts.

So the time taken to descend will be 95 nm / 360 nm/h = 0.264 hours, which is 15.8 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft / 15.8 m = 1455 ft/min (option b).

DESCENTS 73 c.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 12 kts increase in headwind ROD must change by 5 x 12 = 60 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased in a headwind and increased in a tailwind.

So to maintain a 3^0 glideslope in a 12 kt increase in headwind, the ROD must be decreased by 60 ft/min (option c).

DESCENTS 74 b.
The time taken to descend is equal to the height change / ROD

Inserting the data provided in the question gives:

Descent time = 15000 ft / 3000 ft/min = 5 minutes. Which is 5/60 hours

An approximate value for the range can now be estimated by assuming that the groundspeed in still air is approximately equal to the TAS and using the equation:

Range = ground speed x time.

Inserting the data provided gives:

Range = 375 nm/hour x 5/60 hour = 31.25 nm (option b).

DESCENTS 75 c.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 7% descent the ROD is 7% or 0.07 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %, which is the %/100.

So in a7% descent at 375 Kts:,

Groundspeed the ROD = 0.07 x 375 kt x 101.3 ft/min/kt

Which gives ROD = 2659 ft/min or approximately 2660 ft/min (option c).

DESCENTS 76 d.
The aircraft is to descend from FL370 to FL130.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (130 - 370) x 100 = -24000 ft.

The ground distance available is 65 nm and the ground speed is 290 Kts.

So the time taken to descend will be 65 nm / 290 nm/h = 0.224 hours, which is 13.4 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 24000 ft / 13.4 m = 1791 ft/min (option d).

DESCENTS 77 c.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 22 kts decrease in headwind ROD must change by 5 x 22 = 110 ft/min.

Headwinds increase glideslope angle, so to maintain a 3^0 slope the ROD must be increased if a headwind decreases.

So to maintain a 3^0 glideslope in a 22 kt decrease in headwind, the ROD must be increased by 110 ft/min (option a).

DESCENTS 78 a.
The distance or range required to achieve given height change can be calculated using the 1 in 60 rule as follows:

Height = (glideslope angle/60) x Range

This can be rearranged to give: Range = Height x 60 / glideslope angle

Inserting the data provided in the question gives:

Range = 3000 ft x 60 /3 = 60000 ft

Dividing this by 6080 ft/nm gives range = 9.87 nm or approximately 9.9 nm (option a)

DESCENTS 79 d.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 12% descent the ROD is 12% or 0.12 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 12% descent at 340 Kts:

Groundspeed the ROD = 0.12 x 340 kt x 101.3 ft/min/kt

Which gives ROD = 4133 ft/min or approximately 4135 ft/min (option d).

DESCENTS 80 a.
This type of problem can be solved using the 1 in 60 rule in the following form:

ROD = Groundspeed x Glideslope angle /60

Inserting the data provided gives: ROD = 250 Kts x 3.5 / 60 = 14.6 kts

This can be converted into ft/min by multiplying by 101.3 ft/min/kt to give:

ROD = 14.6 kts x 101.3 ft/min/kt = 1479 ft/min or approximately 1480 ft/min (option a).

DESCENTS 81 c.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 25 kts decrease in headwind ROD must change by 5 x 27 = 135 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be increased if a headwind decreases.

So to maintain a 3^0 glideslope in a 27 kt decrease in headwind, the ROD must be increased by 135 ft/min (option a).

DESCENTS 82 a.
The required change in height can be found by using the equation:

Height change = (Final FL – Initial FL) x 100 ft

Inserting the data provided in the question gives:

Height change = (80 – 350) x 100 = -27000 ft

The time to carry out this descent can now be calculated using the equation:

Descent time = height change / ROD

Inserting the data provided in the question gives:

Descent time = 27000 ft / 2000 ft/min = 13.5 mins which is 0.225 hour

Range can now be calculated using the equation, Range = groundspeed x time.

Inserting the data provided gives:

Range = 275 nm/h x 0.225 h = 61.87 or approximately 62 nm (option a).

DESCENTS 83 b.

The required change in height can be found by using the equation:

Height change = (Final FL – Initial FL) x 100 ft

Inserting the data provided in the question gives:

Height change = (70 – 390) x 100 = -32000 ft

The time to carry out this descent can now be calculated using the equation:

Descent time = height change / ROD

Inserting the data provided in the question gives:

Descent time = 32000 ft / 2500 ft/min = 12.8 mins which is 0.213 hour

Range can now be calculated using the equation, Range = groundspeed x time.

Inserting the data provided gives:

Range = 290 nm/h x 0.213 h = 61.87nm or approximately 62 nm (option b).

DESCENTS 84 c.

The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in an 8% descent the ROD is 8% or 0.08 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in an 8% descent at 240 Kts:

Groundspeed the ROD = 0.08 x 240 kt x 101.3 ft/min/kt

Which gives ROD = 1945 ft/min (option c).

DESCENTS 85 a.

The aircraft is to descend from FL350 to FL110.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (110 - 350) x 100 = -24000 ft.

The ground distance available is 125 nm and the ground speed is 350 Kts.

So the time taken to descend will be 125 nm / 350 nm/h = 0.357 hours, which is 21.43 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

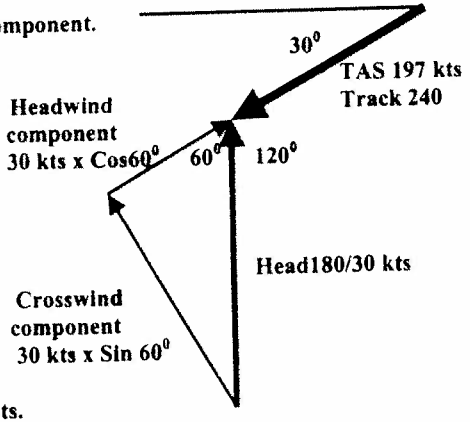
ROD = 24000 ft / 21.43 m = 1120 ft/min (option a).

DESCENTS 86 d.

The first stage of solving this type of problem is to calculate the ground speed using the CRP 5 or the following equation:

Groundspeed = TAS – headwind component.

The headwind component can be calculated by making sketch of the situation similar to the one at the right.



This shows that the headwind Component is 30 kts x Cos 60^0

Which is 15 Kts

So groundspeed = 197 – 15 = 182 kts.

The second stage is to calculate descent time by dividing the ground distance (50 nm) by the ground speed (182 kts). This gives a time of 16.48 minute.

The third stage is to calculate the change of height using the equation:

Height change = (Final FL – Initial FL) x 100 ft

Inserting the data provided gives:

Height change = (FL40 – FL220) x 100 = -18000 ft

The final stage is to calculate the ROD using the equation:

ROD = height change/Descent time = 18000 ft/16.48 min = 1092 ft/min (option d)

DESCENTS 87 d.
An approximate value for the change in ROD required to maintain a 3^0 glideslope for any given change in headwind or tailwind can be calculated using the following equation:

Change required (in ft/min) = 5 x Headwind or tailwind change (in kts).

So for a 14 kts increase in headwind ROD must change by 5 x 14 = 70 ft/min.

Headwind increase glideslope angle, so to maintain a 3^0 slope the ROD must be decreased if a headwind increases.

So to maintain a 3^0 glideslope in a 14 kt increase in headwind, the ROD must be decreased by 70 ft/min (option d).

DESCENTS 88 a.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 12% descent the ROD is 12 or 0.12 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 12% descent at 350 Kts:

Groundspeed the ROD = 0.12 x 350 kt x 101.3 ft/min/kt

Which gives ROD = 4255 ft/min (option a).

DESCENTS 89 b.
The aircraft is to descend from FL330 to FL100.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (100 - 330) x 100 = -23000 ft.

The ground distance available is 95 nm and the ground speed is 250 Kts.

So the time taken to descend will be 95 nm / 250 nm/h = 38 hours, which is 22.8 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft/22.8 min = 1009 ft/min or approximately 1010 ft/min (option b).

DESCENTS 90 c.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in an 12% descent the ROD is 12% or 0.12 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 12% descent at 320 Kts:

Groundspeed the ROD = 0.12 x 320 kt x 101.3 ft/min/kt

Which gives ROD = 3890 ft/min (option c).

DESCENTS 91 a.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 12% descent the ROD is 12% or 0.12 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in an 12% descent at 375 Kts:

Groundspeed the ROD = 0.12 x 375 kt x 101.3 ft/min/kt

Which gives ROD = 4560 (option a).

DESCENTS 92 b.
The aircraft is to descend from FL330 to FL100.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (100 - 330) x 100 = -23000 ft.

The ground distance available is 80 nm and the ground speed is 330 Kts.

So the time taken to descend will be 80 nm / 240 nm/h = 0.33 hours, which is 20minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft / 20 min = 1150 ft/min (option b).

DESCENTS 93 c.
The 1 in 60 rule states that the height change = range x slope angle / 60

Inserting the data provided in this question gives:

Height change = 15 nm x 6000 ft/nm x 3 /60 which = 4500 ft

This means that the aircraft descends 4500 ft between the start of the descent and reaching the point 50 ft above the threshold. So the initial height above the threshold is 4500 + 50 = 4550 ft (option c).

DESCENTS 94 c.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 5% descent the ROD is 5% or 0.05 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 5% descent at 175 Kts:

Groundspeed the ROD = 0.05 x 175 kt x 101.3 ft/min/kt

Which gives ROD = 886.4 ft/min or approximately 886 ft/min (option c).

DESCENTS 95 b.
The distance or range required to achieve given height change can be calculated using the 1 in 60 rule as follows:

Height = (glideslope angle/60) x Range

This can be rearranged to give: Range = Height x 60 / glideslope angle

Inserting the data provided in the question gives:

Range = 1500 ft x 60 /3 = 30000 ft

Dividing this by 6080 ft/nm gives range = 4.9 nm or approximately 5 nm (option b)

DESCENTS 96 c.
The % slope of a climb or descent represents the ROD or ROC as a percentage of the groundspeed. So in a 6% descent the ROD is 6% or 0.06 x the groundspeed.

So the ROD in ft/min can be calculated by converting the ground speed into ft/min then multiplying by the decimal equivalent of the %.

So in a 6% descent at 250 Kts:

Groundspeed the ROD = 0.06 x 250 kt x 101.3 ft/min/kt

Which gives ROD = 1520 ft/min (option c).

DESCENTS 97 c.
The aircraft is to descend from FL370 to FL80. This represents a height change equal to (new FL – Initial FL) x 100 ft, which is (80 – 370) x 100 = -29000 ft.

The time taken to descend = height change = ROD = -29000ft / -1800 ft/min = 16.11 mins which is 0.2685 hours.

But the required ground speed is 200 kts, so the ground distance in the descent is:

Ground distance = Time x groundspeed = 200 nm/h x 0.2685 h = 53.7 nm.

So the descent must start when the aircraft is 53.7 nm from VOR X.

The initial position is 165 nm form VOR X so the distance to be flown before commencing the descent = 165 nm – 53.7 = 111.3 nm.

At a ground speed of 350 nm/h the time required to reach this position will be 111.3 nm / 350 nm/h = 0.318 hours which is 19.08 mins.

The initial time was 0430 so the time at the start of the descent must be 0430 + 19.08 = 0449.08, or approximately 0449 (option c).

DESCENTS 98 c.
The aircraft is to descend from FL330 to FL100.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (100 - 330) x 100 = -23000 ft.

The ground distance available is 85 nm and the ground speed is 340 Kts.

So the time taken to descend will be 85 nm / 340 nm/h = 0.25 hours, which is 15 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft/15 min = 1533 ft/min (option b).

DESCENTS 99 b.
The aircraft is to descend from FL350 to FL120.

The required height change can be calculated using the equation:

Required change = (New FL – Initial FL) x 100 ft

Which is (120 - 350) x 100 = -23000 ft.

The ground distance available is 105 nm and the ground speed is 250 Kts.

So the time taken to descend will be 105 nm / 250 nm/h = 0.42 hours, which is 25.2 minutes.

ROD can now be calculated using the equation: ROD = height change / time taken.

Inserting the figures calculated above gives:

ROD = 23000 ft/ 25.2 min = 912.7 or approximately 913 ft/min (option b).

DESCENTS 100 a.
The 1 in 60 rule states that over any given range, the height change = range x slope angle / 60

Inserting the data provided in this question gives:

Height change between the ILS beam at the threshold and the aircraft is = 18 nm x 6080 ft/nm x 3 /60 which = 5472 ft

But the ILS beam passes 50 ft above the threshold, so the height of the aircraft relative to the threshold is 5472 + 50 = 5522 ft (option a).

INS IRS FMS EFIS 1 a.
The term "gyro compassing" refers to the process whereby an IRS or INS system aligns itself with True North prior to flight. It is achieved with the aircraft stationary on the ground and the "ALIGN" selected on the controller (option a).

INS IRS FMS EFIS 2 b.
Each manufacturer of electronic equipment provides the range of facilities considered to be most appropriate at the time that the equipment is being designed. The methods available for the input of created waypoints in, depends upon the type of system being used. In the case of the B737-400 EFIS, these are methods are identifier bearing/distance; place bearing/place bearing; along-track displacement; latitude and longitude, (option b).

INS IRS FMS EFIS 3 c.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. The term "strapdown" refers to the IRS method, in which the gyroscopes and accelerometers become part of the unit's fixture to the aircraft structure (option c).

INS IRS FMS EFIS 4 b.
An INS system is not able to detect longitude errors when receiving manually inputted data. The system will simply accept the input longitude as if it were correct. Having accepted the input error the system will then add the same error to all subsequent calculations of longitude. In this case 139^0 46.3' W was inserted instead of the correct figure of 139^0 46.3' E. This means that the input longitude is 279^0 32.6' West of the actual longitude. All subsequently calculated longitude will therefore be 279^0 32.6' West of the actual longitude at the time of calculation. So when the aircraft is at 180^0 W, the INS will indicate a longitude of 180^0 W + 279^0 32.6' W, which is 459^0 32.6'W. Subtracting 360^0 from this figure gives the indicated longitude of 99^0 32.6' W (option b).

INS IRS FMS EFIS 5 a.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. Both types of system are subject to oscillation errors as the unit is transported around the earth. The term "Schuler tuning" refers to a process by which such errors are reduced or eliminated. The Schuler tuning process is based on an oscillation period of 84.4 minutes (option a).

INS IRS FMS EFIS 6 a.
The principal advantage of an IRS compared to an INS is that because the IRS does not use a gyro-stabilised platform, it is less complicated and has fewer

moving parts. This makes the IRS more reliable and more accurate that the INS. A further advantage of the IRS is that it uses laser ring gyros rather than conventional spinning mass gyros as used in the INS. Because IRS systems have no moving gyroscopes, they require a much shorter spin-up time than an INS with rotating gyros. One disadvantage of laser gyros however is the fact that they are susceptible to errors due to a phenomenon termed laser lock. So an IRS has a sorter spin-up time and suffers from laser lock (option a).

INS IRS FMS EFIS 7 a.

Ring laser gyros, do not employ spinning rotors, but use variations in the length of travel of beams of light within a triangular housing. Because there is no spinning mass to be accelerated to operating RPM, laser gyros can be erected more quickly than conventional gyros. Laser gyros are employed in Inertial Reference systems (IRS). Unlike an INS, an IRS does not use a gyro-stabilised platform, but uses a platform mounted directly onto the aircraft structure. Although the platform pitches and rolls with the aircraft, the IRS computers continuously calculate the true north, and vertical directions. The signals from the various gyros and accelerometers are then modified to take account of the actual alignment relative to true north and vertical. This means that the laser gyros do not need to be aligned with true north. So a ring laser gyro it is not necessarily fixed to true north and is quick to erect (option a).

INS IRS FMS EFIS 8 b.

The principal advantage of an IRS compared to an INS is that because the IRS does not use a gyro-stabilised platform, it is less complicated and has fewer moving parts. Instead of a gyro stabilized platform the accelerometers and gyros in an IRS are strapped directly to the aircraft structure (option b). This makes the IRS more reliable and more accurate that the INS. A further advantage of the IRS is that it uses laser ring gyros rather than conventional spinning mass gyros as used in the INS. Because IRS systems have no moving gyroscopes, they require a much shorter spin-up time than an INS with rotating gyros.

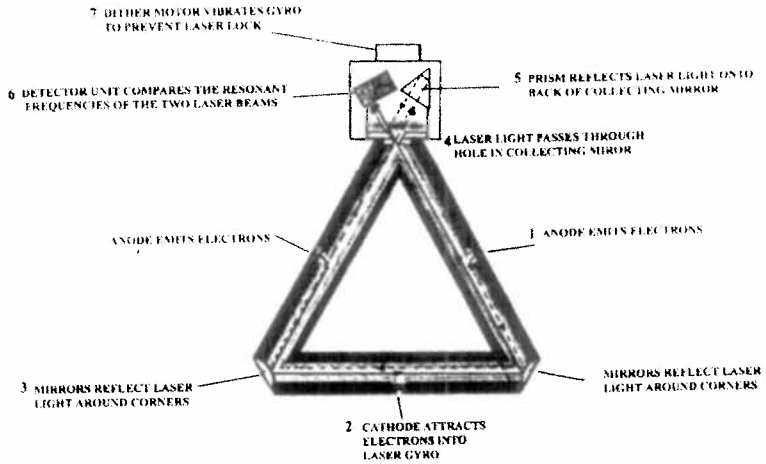
INS IRS FMS EFIS 9 d.

The ring laser gyro senses rates of rotation by measuring the difference between the resonant frequencies of two laser beams. The two beams travel in opposite directions around the triangle and are captured by a collecting mirror and detector unit. The detector unit then compares the resonant frequencies of the two beams to measure the difference between the two. These resonant frequencies are proportional to the length of the resonant structure through which they have passed. If the gyro is stationary the path taken by the two beams and hence the resonant frequencies are identical.

If however the aircraft yaws, the gyro will rotate with it. This means that the path of the beam travelling in the same direction as the gyro becomes slightly longer, whilst that of the other beam becomes slightly shorter. This difference in path length will cause a difference in resonant frequency that is proportional to the rate and direction of rotation. But when the gyro is rotating scatter from the

mirrored surfaces sometimes causes the beams to lock together making the detection of small yaw rates impossible. To prevent this laser lock, a piezo-electric dither motor vibrates the gyro at a resonant frequency, thereby causing the beams to unlock (option d).

A simple ring laser gyro is illustrated below.



LASER RING GYRO

INS IRS FMS EFIS 10 d.

The principal of operation of an IRS is that the platform is mathematically aligned to a known position and orientation prior to flight, then continuously recalculates its position and orientation by sensing all accelerations experienced by the aircraft during the subsequent flight. These accelerations are integrated once to give velocities and again to give distance moved. The ability of an IRS to provide accurate navigation information at any point during a flight is therefore dependent upon its having sensed all accelerations throughout all of the previous stages of the flight. Whenever an IRS is switched off its memory retains details of the situation at the time of shutdown, but it is unable to detect accelerations that occur throughout the period during which it is left shut down. If the IRS is then switched on again, all subsequent navigation calculations will be based upon the position at the instant at which the shutdown occurred. Such calculations will therefore be inaccurate.

A further problem is that the platform will move out of alignment as the aircraft pitches rolls and yaws during the period of shutdown. Under normal circumstances after shut down on the ground, the platform would re-align itself prior the start of the next flight. But during the period of this alignment process the aircraft must not be moved. So if an IRS is switched off in the air it cannot

re-align itself accurately until it has landed. The system will however be able to detect any changes of attitude that occur after this system is switched back on. So if an IRS is temporarily off during flight, it cannot be used for navigation, but can be used to provide attitude information throughout the remainder of the flight (option d).

INS IRS FMS EFIS 11 b.
The term "gyro compassing" refers to the process whereby an IRS or INS system aligns itself with True North prior to flight. It is achieved with the aircraft stationary on the ground and the "ALIGN" selected on the controller (option b).

INS IRS FMS EFIS 12 c.
If the spin axis of a gyro departs from its initial orientation it is said to wander. If this change of orientation is in the horizontal plane then this wander is termed drift. If the change of orientation is in the vertical plane it is termed topple. So gyro drift occurs in the horizontal plane (option c).

INS IRS FMS EFIS 13 a.
The sensors in an INS are called accelerometers. Their purpose is to measure accelerations in the direction in which they are aligned (option a). The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved.

INS IRS FMS EFIS 14 d.
In considering this type of question its should be noted that the IRS position and the FMS position are two different things. The INS position can be updated only on the ground during the alignment process (option d). But the FMS position is continuously using data from the IRS and various radio navigation aids. The FMS position is also update when the TOGA button is pushed at the start of the take-off roll.

INS IRS FMS EFIS 15 c.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabiiised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. The term "strapdown" refers to the IRS method, in which the system is mounted and fixed to the aircraft structure (option c).

INS IRS FMS EFIS 16 b.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved. So the second integration of the output from an East/west accelerometer is distance east/west (option b).

INS IRS FMS EFIS 17 b.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. Both types of system are subject to oscillation errors as the unit is transported around the earth. The term "Schuler tuning" refers to a process by which such errors are reduced or eliminated. The Schuler tuning process is applicable to both the gyro-stabilised platform and the strapdown systems (option b).

INS IRS FMS EFIS 18 a.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved. So the output of the first stage integrator of the north/south accelerometer is velocity along the local meridian (option a).

INS IRS FMS EFIS 19 d.
In most INS and IRS systems the alignment process can be carried out only in the ALING mode. But in the Boeing 737-400 aircraft allgnment can be carried out either in ALIGN or In NAV modes (option d), provided the aircraft is stationary on the ground at the time.

INS IRS FMS EFIS 20 a.
On a triple fit IRS system the positions calculated by each IRS will be subject to its own individual minor errors. So because each of the three IRS positions is derived from different IRS systems with different error rates, the three positions will inevitably be slightly different (option a).

INS IRS FMS EFIS 21 b.
IRS modes are usually selected by means of a rotary switch. On the Boeing 737-400 IRS Mode Selector Unit (MSU) the switch positions listed from left to right (clockwise) are in the order OFF, ALIGN, NAV, ATT (option b)

INS IRS FMS EFIS 22 a.

The term "Gyro compassing" refers to the process whereby an INS platform is aligned in azimuth. To achieve this, the gyro normally used to stabilize the platform about the East/West axis is connected to the azimuth gimbal motor. When the platform is correctly aligned in azimuth the East gyro will not be subject to rotation of its axis by Earth rotation. But when the platform is out of alignment the East gyro will detect a component of earth rotation the produce an output signal. This signal is then used to apply torque to the azimuth motor until the platform is aligned. But when the aircraft is in flight, the stabilizing gyro is used to stabilise the platform, by sensing accelerations caused by the motion of the aircraft. Gyro compassing is not therefore possible in flight because the gyros cannot differentiate between acceleration due to aircraft movement and initial alignment errors (option a).

INS IRS FMS EFIS 23 a.

The drifting of an azimuth gyro may be caused by a number of factors. The first of these is Earth Rate wander. This is caused by the rotation of the Earth. The drift caused by Earth Rate (in degrees per hour) is equal to 15 times the sine of the latitude. The second possible cause is Transport Wander. This is caused by the movement of the aircraft across the surface of the earth. This (in degrees per hour) is equal to the 1/60 of the ground speed multiplied by the tangent of the latitude. The third possible cause is due to mechanical imperfections in the gyros. All three of these causes of drift are directly proportional to the elapsed time since the system was switched from ALIGN to NAV (option a).

INS IRS FMS EFIS 24 c.

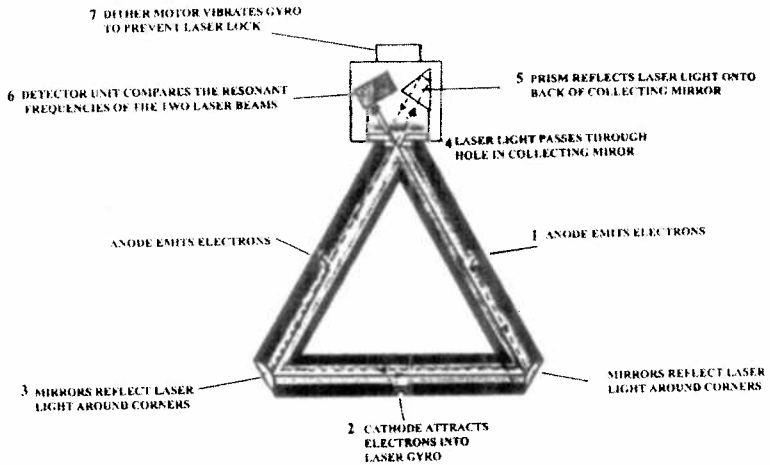
The ATT selection is normally used following a computer/processing failure. With ATT selected all of the navigation computations are disabled but the system is still able to provide pitch, roll and heading information. Option c is therefore the most accurate in this question.

INS IRS FMS EFIS 25 c.

Because they do not use mechanical gyros with spinning masses and do not physically level the platform, an IRS is able to complete the alignment process much more quickly than an INS. A modern IRS can complete alignment within 10 minutes (option c).

INS IRS FMS EFIS 26 a.

A simple ring laser gyro is illustrated below.



LASER RING GYRO

The ring laser gyro senses rates of rotation by measuring the difference between the resonant frequencies of two laser beams. The two beams travel in opposite directions around the triangle and are captured by a collecting mirror and detector unit. The detector unit then compares the resonant frequencies of the two beams to measure the difference between the two. These resonant frequencies are proportional to the length of the resonant structure through which they have passed. If the gyro is stationary the path taken by the two beams and hence the resonant frequencies are identical.

If however the aircraft yaws, the gyro will rotate with it. This means that the path of the beam travelling in the same direction as the gyro becomes slightly longer, whilst that of the other beam becomes slightly shorter. This difference in path length will cause a difference in resonant frequency that is proportional to the rate and direction of rotation. But when the gyro is rotating scatter from the mirrored surfaces sometimes causes the beams to lock together making the detection of small yaw rates impossible. To prevent this laser lock, a piezo-electric dither motor vibrates the gyro at a resonant frequency, thereby causing the beams to unlock (option a).

INS IRS FMS EFIS 27 c.

The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. Both types of system are subject to oscillation errors as the unit is transported around the earth. The term "Schuler tuning"

refers to a process by which such errors are reduced or eliminated. The Schuler tuning process is based on a damping period of 84.4 minutes (option c).

INS IRS FMS EFIS 28 a.
In order to ensure that the accelerometers in an INS sense only accelerations in their required directions, it is essential that the platform remains level throughout all phases of flight. In order to achieve this, it is necessary to apply corrects to counter the effects of a number of factors. The first of these is the pitching, rolling and yawing of the aircraft as it manoeuvres in flight. The second and third factors are Earth Rate Wander, caused by the rotation of the Earth and Transport Wanders caused by the movement of the aircraft above the surface of the earth. The fourth factor is coriolis effect which is caused by the fact that the aircraft takes a curved path around the world. Option a, is therefore the most accurate in this question.

INS IRS FMS EFIS 29 c.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved. So ground speed is calculated by integrating measured accelerations (option c).

INS IRS FMS EFIS 30 b.
The display for INS 1 indicates that the aircraft is on the correct track, but that for INS2 indicates that it is drifting 8^0 to the left of the intended track. This discrepancy is far greater than the normal tolerances of INS, so one of the systems must be drifting (option b). It is not however possible to determine which system is in error based on the information available.

INS IRS FMS EFIS 31 a.
The principal of operation of an IRS is that the platform is mathematically aligned to a known position and orientation prior to flight, then continuously recalculates its position and orientation by sensing all accelerations experienced by the aircraft during the subsequent flight. These accelerations are integrated once to give velocities and again to give distance moved. The ability of an IRS to provide accurate navigation information at any point during a flight is therefore dependent upon its having sensed all accelerations throughout all of the previous stages of the flight. Whenever an IRS is switched off its memory retains details of the situation at the time of shutdown, but it is unable to detect accelerations that occur throughout the period during which it is left shut down. The system will therefore lose its position as the flight progresses. If the IRS is then switched on again, all subsequent navigation calculations will be based upon the position at the instant at which the shutdown occurred. Such calculations will therefore

be inaccurate. So if an IRS loses its position in flight it cannot be used in the NAV made for the remainder of the flight (option a).

INS IRS FMS EFIS 32 b.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The difference between ground speed and TAS is the wind speed, so to carry out wind calculations the INS requires an input of TAS information (option b).

INS IRS FMS EFIS 33 d.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. This fixed system used in IRS is termed the "strapdown" platform (option d).

INS IRS FMS EFIS 34 b.
Prior to the commencement of each flight the INS/IRS systems must be aligned. This must be carried out with the aircraft stationary on the ground at the gate (or ramp). During the alignment process the pilot inputs the geographical coordinates of the gate. The system then uses these coordinates as the starting point for all subsequent calculations. The system is then set to NAV, which causes it to continuously calculate accelerations, velocities and distances moved from the ramp. In order for these calculations to be accurate the system must be set to NAV immediately prior to push back from the gate (option b). Selecting NAV at any later time will inevitably reduce the accuracy of the system, by an amount equal to the distance from the gate at the time that NAV is actually selected.

INS IRS FMS EFIS 35 a.
Although INS systems designed by different manufacturers will inevitably differ in some respects, certain aspects are common to all systems. For example, positions are entered into all INS systems in the form of geographical coordinates (option a).

INS IRS FMS EFIS 36 b.
An INS is capable of displaying various types of information depending upon what setting has been selected on the Control Display Unit (CDU). In order for an INS to display the initial great circle track it is necessary to select DSRT\STS. These letters are an abbreviation of the term "Desired Track status" (option b).

INS IRS FMS EFIS 37 d.

The principal advantage of an IRS compared to an INS is that because the IRS does not use a gyro-stabilised platform, it is less complicated and has fewer moving parts. This makes the IRS more reliable and more accurate that the INS. A further advantage of the IRS is that it uses laser ring gyros rather than conventional spinning mass gyros as used in the INS. Because IRS systems have no moving gyroscopes, they require a much shorter spin-up time than an INS with rotating gyros. One disadvantage of laser gyros however is the fact that they are susceptible to errors due to a phenomenon termed laser lock. So an IRS has a sorter spin-up time and suffers from laser lock (option d).

INS IRS FMS EFIS 38 c.

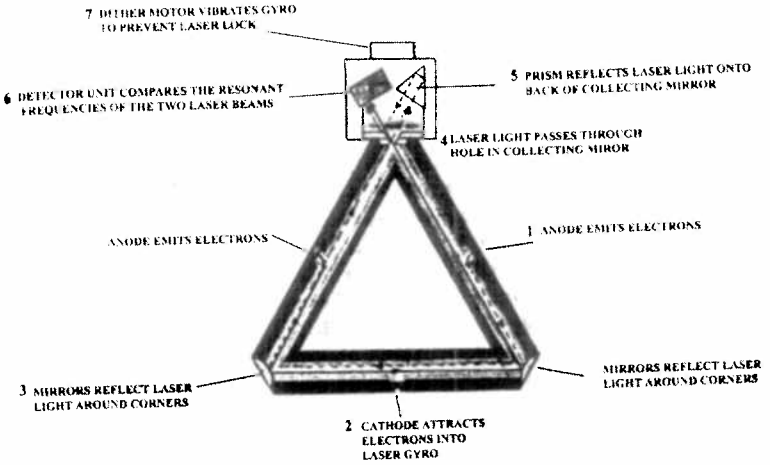
Ring laser gyros, do not employ spinning rotors, but use variations in the length of travel of beams of light within a triangular housing. Because there is no spinning mass to be accelerated to operating RPM, laser gyros can be erected more quickly than conventional gyros. Laser gyros are employed in Inertial Reference systems (IRS). Unlike an INS, an IRS does not use a gyro stabilised platform, but uses a platform mounted directly onto the aircraft structure. Although the platform pitches and rolls with the aircraft, the IRS computers continuously calculate the true north, and vertical directions. The signals from the various gyros and accelerometers are then modified to take account of the actual alignment relative to true north and vertical. This means that the laser gyros do not need to be aligned with true north. So a ring laser gyro it is not necessarily fixed to true north and is quick to erect (option c).

INS IRS FMS EFIS 39 b.

The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. So in an IRS the accelerometers and platform are both strapped down (option b).

INS IRS FMS EFIS 40 d.

A simple ring laser gyro is illustrated below.



LASER RING GYRO

The ring laser gyro senses rates of rotation by measuring the difference between the resonant frequencies of two laser beams. The two beams travel in opposite directions around the triangle and are captured by a collecting mirror and detector unit. The detector unit then compares the resonant frequencies of the two beams to measure the difference between the two. These resonant frequencies are proportional to the length of the resonant structure through which they have passed. If the gyro is stationary the path taken by the two beams and hence the resonant frequencies are identical.

If however the aircraft yaws, the gyro will rotate with it. This means that the path of the beam travelling in the same direction as the gyro becomes slightly longer, whilst that of the other beam becomes slightly shorter. This difference in path length will cause a difference in resonant frequency that is proportional to the rate and direction of rotation. But when the gyro is rotating scatter from the mirrored surfaces sometimes causes the beams to lock together making the detection of small yaw rates impossible. To prevent this laser lock, a piezo-electric dither motor vibrates the gyro at a resonant frequency, thereby causing the beams to unlock (option d).

INS IRS FMS EFIS 41 d.

The principal of operation of an IRS is that the platform is mathematically aligned to a known position and orientation prior to flight. then continuously recalculates its position and orientation by sensing all accelerations experienced by the aircraft during the subsequent flight. These accelerations are integrated once to give velocities and again to give distance moved. The ability of an IRS to provide accurate navigation information at any point during a flight is therefore

dependent upon its having sensed all accelerations throughout all of the previous stages of the flight. Whenever an IRS is switched off its memory retains details of the situation at the time of shutdown, but it is unable to detect accelerations that occur throughout the period during which it is left shut down. If the IRS is then switched on again, all subsequent navigation calculations will be based upon the position at the instant at which the shutdown occurred. Such calculations will therefore be inaccurate.

A further problem is that the platform will move out of alignment as the aircraft pitches rolls and yaws during the period of shutdown. Under normal circumstances after shut down on the ground, the platform would re-align itself prior the start of the next flight. But during the period of this alignment process the aircraft must not be moved. So if an IRS is switched off in the air it cannot re-align itself accurately until it has landed. The system will however be able to detect any changes of attitude that occur after this system is switched back on. So if an IRS is temporarily off during flight, it cannot be used for navigation, but can be used to provide attitude information throughout the remainder of the flight (option d).

INS IRS FMS EFIS 42 b.
The term "gyro compassing" refers to the process by which an INS/IRS initially aligns itself with True North. It is carried out on the ground at the ramp with the system set to ALIGN (option b).

INS IRS FMS EFIS 43 c.
If the spin axis of a gyro departs from its initial orientation it is said to wander. If this change of orientation is in the horizontal plane then this wander is termed drift. If the change of orientation is in the vertical plane it is termed topple. So gyro drift occurs in the horizontal plane (option c).

INS IRS FMS EFIS 44 a.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. The accelerometers in an INS or IRS produce an output signal that is proportional to acceleration in the direction of its alignment (option a). The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved.

INS IRS FMS EFIS 45 b.
In considering this type of question its should be noted that the IRS position and the FMS position are two different things. The INS position can be updated only on the ground during the alignment process (option b). But the FMS position is continuously using data from the IRS and various radio navigation aids. The FMS position is also update when the TOGA button is pushed at the start of the take-off roll.

INS IRS FMS EFIS 46 c.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. The IRS system mounted and fixed to the aircraft structure is termed "strapdown" (option c).

INS IRS FMS EFIS 47 d.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved. So the second integration of the output from an East/west accelerometer is distance east/west (option d).

INS IRS FMS EFIS 48 d.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. Both types of system are subject to oscillation errors as the unit is transported around the earth. The term "Schuler tuning" refers to a process by which such errors are reduced or eliminated. The Schuler tuning process is applicable to both the gyro-stabilised platform and the strapdown systems (option d).

INS IRS FMS EFIS 49 a.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved. So first stage integration of the output from the north/south accelerometer is velocity north/south along the local meridian (option a).

INS IRS FMS EFIS 50 b.
In most INS and IRS systems the alignment process can be carried out only in the ALING mode. But in the Boeing 737-400 aircraft alignment can be carried out either in ALIGN or in NAV modes (option b), provided the aircraft is stationary on the ground at the time.

INS IRS FMS EFIS 51 c.

On a triple fit IRS system the positions calculated by each IRS will be subject to its own individual minor errors. So because each of the three IRS positions are derived from different IRS systems with different error rates, the three positions are likely to be slightly different (option c).

INS IRS FMS EFIS 52 d.

IRS modes are usually selected by means of a rotary switch. On the Boeing 737-400 IRS Mode Selector Unit (MSU) the switch positions listed from left to right (clockwise) are in the order OFF, ALIGN, NAV, ATT (option d)

INS IRS FMS EFIS 53 a.

The term "Gyro compassing" refers to the process whereby an INS platform is aligned in azimuth. To achieve this, the gyro normally used to stabilize the platform about the Eats/West axis is connected to the azimuth gimbal motor. When the platform is correctly aligned in azimuth the East gyro will not be subject to rotation of its axis by Earth rotation. But when the platform is out of alignment the East gyro will detect a component of earth rotation the produce an output signal. This signal is then used to apply torque to the azimuth motor until the platform is aligned. But when the aircraft is in flight, the stabilizing gyro is used to stabilise the platform, by sensing accelerations caused by the motion of the aircraft. Gyro compassing is not therefore possible in flight because the gyros cannot differentiate between acceleration due to aircraft movement and initial alignment errors (option a).

INS IRS FMS EFIS 54 c.

The drifting of an azimuth gyro may be caused by a number of factors. The first of these is Earth Rate wander. This is caused by the rotation of the Earth. The drift caused by Earth Rate (in degrees per hour) is equal to 15 times the sine of the latitude. The second possible cause is Transport Wander. This is caused by the movement of the aircraft across the surface of the earth. This (in degrees per hour) is equal to the 1/60 of the ground speed multiplied by the tangent of the latitude. The third possible cause is due to mechanical imperfections in the gyros. All three of these causes of drift are directly proportional to the elapsed time since the system was switched from ALIGN to NAV (option c).

INS IRS FMS EFIS 55 c.

The ATT selection is normally used following a computer/processing failure. With ATT selected all of the navigation computations are disabled but the system is still able to provide pitch, roll and heading information. Option c is therefore the most accurate in this question.

INS IRS FMS EFIS 56 a.

Because they do not use mechanical gyros with spinning masses and do not physically level the platform, an IRS is able to complete the alignment process

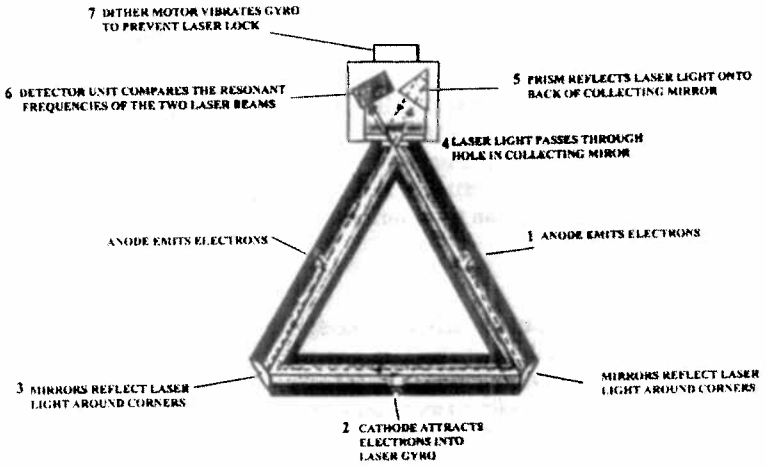
much more quickly than an INS. A modern IRS can complete alignment within 10 minutes (option a).

INS IRS FMS EFIS 57 c.

The ring laser gyro senses rates of rotation by measuring the difference between the resonant frequencies of two laser beams. The two beams travel in opposite directions around the triangle and are captured by a collecting mirror and detector unit. The detector unit then compares the resonant frequencies of the two beams to measure the difference between the two. These resonant frequencies are proportional to the length of the resonant structure through which they have passed. If the gyro is stationary the path taken by the two beams and hence the resonant frequencies are identical.

If however the aircraft yaws, the gyro will rotate with it. This means that the path of the beam travelling in the same direction as the gyro becomes slightly longer, whilst that of the other beam becomes slightly shorter. This difference in path length will cause a difference in resonant frequency that is proportional to the rate and direction of rotation. But when the gyro is rotating scatter from the mirrored surfaces sometimes causes the beams to lock together making the detection of small yaw rates impossible. To prevent this laser lock, a piezo-electric dither motor vibrates the gyro at a resonant frequency, thereby causing the beams to unlock. This process is called dither and the motor is a dither motor (option c).

A simple ring laser gyro is illustrated below.



LASER RING GYRO

INS IRS FMS EFIS 58 a.

The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. Both types of system are subject to oscillation errors as the unit is transported around the earth. The term "Schuler tuning" refers to a process by which such errors are reduced or eliminated. The Schuler tuning process is based on an oscillation period of 84.4 minutes (option a).

INS IRS FMS EFIS 59 c.

In order to ensure that the accelerometers in an INS sense only accelerations in their required directions, it is essential that the platform remains level throughout all phases of flight. In order to achieve this, it is necessary to apply corrects to counter the effects of a number of factors. The first of these is the pitching, rolling and yawing of the aircraft as it manoeuvres in flight. The second and third factors are Earth Rate Wander, caused by the rotation of the Earth and Transport Wanders caused by the movement of the aircraft above the surface of the earth. The fourth factor is coriolis effect, which is caused by the fact that the aircraft takes a curved path around the world. Option c, is therefore the most accurate in this question.

INS IRS FMS EFIS 60 c.

The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. So ground speed is calculated by integrating measured acceleration (option c).

INS IRS FMS EFIS 61 d.

The display for INS 1 indicates that the aircraft is on the correct track, but that for INS2 indicates that it is drifting 15° to the left of the intended track. This discrepancy is far greater than the normal tolerances of INS, so one of the systems must be drifting (option d). It is not however possible to determine which system is in error based on the information available.

INS IRS FMS EFIS 62 a.

Prior to flight an IRS must be aligned, with the aircraft stationary on the ground at the gate. This is essential to enable the system to accurately interpret information provided by its accelerometers. The system then continuously calculates velocities, distances flown and positions, based upon the initial conditions at the gate. Because these calculations are cumulative, it is essential that the system retains details of its position throughout flight. So if an IRS loses its position during flight it cannot be used in the NAV mode throughout the remainder of the flight (option a).

INS IRS FMS EFIS 63 b.

The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity relative to the Earth. So ground speed is calculated by integrating acceleration. The difference between ground speed and TAS is the wind speed. So in order to calculate wind speed the INS also uses TAS (option b).

INS IRS FMS EFIS 64 d.

The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. The IRS system in which the gyros and accelerometers are fixed to the aircraft is termed "strapdown" (option d).

INS IRS FMS EFIS 65 d.

Prior to the commencement of each flight the INS/IRS systems must be aligned. This must be carried out with the aircraft stationary on the ground at the gate (or ramp). During the alignment process the pilot inputs the geographical coordinates of the gate. The system then uses these coordinates as the starting point for all subsequent calculations. The system is then set to NAV, which causes it to continuously calculate accelerations, velocities and distances moved from the ramp. In order for these calculations to be accurate the system must be set to NAV immediately prior to push back from the gate (option d). Selecting NAV at any later time will inevitably reduce the accuracy of the system, by an amount equal to the distance from the gate at the time that NAV is actually selected.

INS IRS FMS EFIS 66 d.

Although INS systems designed by different manufacturers will inevitably differ in some respects, certain aspects are common to all systems. For example, positions are entered into all INS systems in the form of geographical coordinates (option d).

INS IRS FMS EFIS 67 a.

An INS is capable of displaying various types of information depending upon what setting has been selected on the Control Display Unit (CDU). In order for an INS to display the initial great circle track it is necessary to select DSRT\STS. These letters are an abbreviation of the term "Desired Track status" (option a).

INS IRS FMS EFIS 68 d.

The FMS database contains two sets of data each of which is valid for 28 days. Prior to each flight the pilot is able to select which set of data will be used.

Maintenance personnel update the database regularly to ensure that it remains valid for all flights. From the viewpoint of the pilot, the FMS database is read only and can never be updated (option d).

INS IRS FMS EFIS 69 d.
The position calculated by the IRS is most accurate immediately after alignment at the gate. As the flight progresses minor errors in detecting accelerations and integrating the results, cause the accuracy of the IRS position to gradual degrade. In order to compensate for this gradual degradation, the Flight Management Computer (FMC) continuously calculates aircraft position using information provided by the IRS and various radio navigation aids (option d). Because the information from radio aids is not cumulative, its accuracy does not degrade as the flight progresses. So by combining inputs from the IRS and the radio navigation aids, the FMC is able to maintain a more accurate estimate of aircraft position.

INS IRS FMS EFIS 70 c.
An IRS system includes a memory in which it holds extensive records concerning the earth, together with the algorithms employed in making navigation computations. These records include details of Magnetic variation at various points on the Earth. These details of Magnetic variation are applied to the true heading calculated by the respective IRS in order to calculate magnetic headings (option c).

INS IRS FMS EFIS 71 a.
Messages provided by the CDU of a Boeing 737-400 EFIS fall into three categories. The highest priority massages are Warnings. These relate to situations or events requiring immediate corrective action on the part of the crew. The second priority messages are Cautions. These refer to situations or events, which do not require immediate corrective action, but which may affect the performance or operation of the aircraft. The lowest category is Advisory messages, which inform the crew of routine changes in the status of the aircraft and its systems, which do not require corrective action. Option a, is therefore the most accurate in this question.

INS IRS FMS EFIS 72 a.
In the Boeing 737-400 aircraft the MCDU is used for a number of functions including inserting data into the FMS and IRS. Prior to the start of a flight, the MCDU is used to initialize the IRSs such that the carry out their initial alignment processes. In addition to this the MCDU is used to insert dispatch information such as destination, waypoints and cost index values, into the FMS. It should be noted that the MCDU is not used to input data directly into the Flight Director nor Autothrottle because these systems get their information via the FMS. Option a, is therefore the most accurate in this question.

INS IRS FMS EFIS 73 b.
The Boeing 737-400 Flight Management System (FMS) takes inputs from a wide range of sources including the IRS, Air Data Computers, MCDU, radio navigation aids, Autopilot, Flight Director, and Autothrottle system. By combining the data from these sources it is able to provide a range of services. These include automatic navigation and automatic performance management (option b). As an example of this letter function, the pilot can control the trade-off between fuel costs and flight duration, by inputting various cost index values into the FMS MCDU.

INS IRS FMS EFIS 74 b.
The first page used after powering up the system is IDENT, which allows the crew to confirm the details of the aircraft. This in turn causes the system to produce a series of prompts to guide the crew through the route procedures that need to be generated for the flight. The second page is POS INIT, which enables the crew to confirm that the FMS clock and the aircraft clock are synchronised. This page is then used to align the IRS. The third page is RTE, which appears after the tasks on the POS INIT page have been completed. The RTE page is used to input details such as destination airport and route to be flown. Option b is therefore the most accurate in this question.

INS IRS FMS EFIS 75 d.
FMC positions can be updated using information form various radio navigation aids. The most accurate of those used in the Boeing 737-400 is DME/DME (option d)

INS IRS FMS EFIS 76 c.
The Boeing 737-400 FMS is coupled to an Inertial reference System (IRS). This includes a back up battery and memory, which is able to remember the position of the aircraft at the time of shut down at the end of a flight. When the system is switched on in preparation for the next flight the pilot is required to input the geographical coordinates of its position. The IRS then compares these with the coordinates stored in IRS memory and warns the pilot if they are not the same. In this way the system is able to reject initial latitude and longitude errors (option c). This is an improvement on the older INS systems, which were only able to detect latitude errors.

INS IRS FMS EFIS 77 c.
The FMS database contains two sets of data each of which is valid for 28 days (option c). Prior to each flight the pilot is able to select which set of data will be used. Maintenance personnel update the database regularly to ensure that it remains valid for all flights. From the viewpoint of the pilot, the FMS database is read only and can never be updated.

INS IRS FMS EFIS 78 c.
In designing their systems, each manufacturer determines the range of functions that will be provided and the means by which these functions can be accessed. This inevitably means that different systems will provide different functions, which will be activated by different methods. In the case of the Boeing 737- 400 aircraft, the Weather Radar Display is available on the EFIS EHSI in the MAP, EXP VOR/ILS, and EXP NAV modes (option c).

INS IRS FMS EFIS 79 a.
Each manufacturer of electronic equipment provides the range of facilities considered to be most appropriate at the time that the equipment is being designed. The methods available for the input of created waypoints in, depends upon the type of system being used. In the case of the B737-400 EFIS, these are methods are identifier bearing/distance; place bearing/place bearing; along-track displacement; latitude and longitude, (option a).

INS IRS FMS EFIS 80 b.
Selected course is represented on EFIS by a rectangular box with a triangle attached, plus a dashed line (option b).

INS IRS FMS EFIS 81 c.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity relative to the ground. So to carry out ground speed calculations the FMS uses inputs from the IRS (option c).

INS IRS FMS EFIS 82 b.
The FMS database contains two sets of data each of which is valid for 28 days. Prior to each flight the pilot is able to select which set of data will be used. Maintenance personnel update the database regularly to ensure that it remains valid for all flights. From the viewpoint of the pilot, the FMS database is read only and can never be updated (option b).

INS IRS FMS EFIS 83 b.
The position calculated by the IRS is most accurate immediately after alignment at the gate. As the flight progresses minor errors in detecting accelerations and integrating the results, cause the accuracy of the IRS position to gradual degrade. In order to compensate for this gradual degradation, the Filght Management Computer (FMC) continuously calculates aircraft position using information provided by the IRS and various radio navigation aids (option b). Because the information from radio aids is not cumulative, its accuracy does not degrade as the flight progresses. So by combining inputs from the IRS and the

radio navigation aids, the FMC is able to maintain a more accurate estimate of aircraft position.

INS IRS FMS EFIS 84 a.
An IRS system includes a memory in which it holds extensive records concerning the earth, together with the algorithms employed in making navigation computations. These records include details of Magnetic variation at various points on the Earth. These details of Magnetic variation are applied to the true heading calculated by the respective IRS in order to calculate magnetic headings (option a).

INS IRS FMS EFIS 85 d.
Messages provided by the CDU of a Boeing 737-400 EFIS fall into three categories. The highest priority massages are Warnings. These relate to situations or events requiring immediate corrective action on the part of the crew. The second priority messages are Cautions. These refer to situations or events, which do not require immediate corrective action, but which may affect the performance or operation of the aircraft. The lowest category is Advisory messages, which inform the crew of routine changes in the status of the aircraft and its systems, which do not require corrective action. Option d, is therefore the most accurate in this question.

INS IRS FMS EFIS 86 a.
In the Boeing 737-400 aircraft the MCDU is used for a number of functions including inserting data into the FMS and IRS. Prior to the start of a flight, the MCDU is used to initialize the IRSs such that the carry out their initial alignment processes. In addition to this the MCDU is used to insert dispatch information such as destination, waypoints and cost index values, into the FMS. It should be noted that the MCDU is not used to input data directly into the Flight Director nor Autothrottle because these systems get their information via the FMS. Option a, is therefore the most accurate in this question.

INS IRS FMS EFIS 87 d.
The Boeing 737-400 Flight Management System (FMS) takes inputs from a wide range of sources including the IRS, Air Data Computers, MCDU, radio navigation aids, Autopilot, Flight Director, and Autothrottle system. By combining the data from these sources it is able to provide a range of services. These include automatic navigation and automatic performance management (option d). As an example of this letter function, the pilot can control the trade-off between fuel costs and flight duration, by inputting various cost index values into the FMS MCDU.

INS IRS FMS EFIS 88 a.
The first page used after powering up the system is IDENT, which allows the crew to confirm the details of the aircraft. This in turn causes the system to

produce a series of prompts to guide the crew through the route procedures that need to be generated for the flight. The second page is POS INIT, which enables the crew to confirm that the FMS clock and the aircraft clock are synchronised. This page is then used to align the IRS. The third page is RTE, which appears after the tasks on the POS INIT page have been completed. The RTE page is used to input details such as destination airport and route to be flown. Option a, is therefore the most accurate in this question.

INS IRS FMS EFIS 89 a.
FMC positions can be updated using information form various radio navigation aids. The most accurate of those used in the Boeing 737-400 is DME/DME (option a)

INS IRS FMS EFIS 90 a.
The Boeing 737-400 FMS is coupled to an Inertial reference System (IRS). This includes a back up battery and memory, which is able to remember the position of the aircraft at the time of shut down at the end of a flight. When the system is switched on in preparation for the next flight the pilot is required to input the geographical coordinates of its position. The IRS then compares these with the coordinates stored in IRS memory and warns the pilot if they are not the same. In this way the system is able to reject initial latitude and longitude errors (option a). This is an improvement on the older INS systems, which were only able to detect latitude errors.

INS IRS FMS EFIS 91 c.
The FMS database contains two sets of data each of which is valid for 28 days (option c). Prior to each flight the pilot is able to select which set of data will be used. Maintenance personnel update the database regularly to ensure that it remains valid for all flights. From the viewpoint of the pilot, the FMS database is read only and can never be updated.

INS IRS FMS EFIS 92 a.
In designing their systems, each manufacturer determines the range of functions that will be provided and the means by which these functions can be accessed. This inevitably means that different systems will provide different functions, which will be activated by different methods. In the case of the Boeing 737- 400 aircraft, the Weather Radar Display is available on the EFIS EHSI in the MAP, EXP VOR/ILS, and EXP NAV modes (option a).

INS IRS FMS EFIS 93 d.
Each manufacturer of electronic equipment provides the range of facilities considered to be most appropriate at the time that the equipment is being designed. The methods available for the input of created waypoints in, depends upon the type of system being used. In the case of the B737-400 EFIS, these are

methods are identifier bearing/distance; place bearing/place bearing; along-track displacement; latitude and longitude, (option d).

INS IRS FMS EFIS 94 d.
The trend vector is represented on EFIS by a triangle with a series of dashed lines running from it in the direction of the trend (option d).

INS IRS FMS EFIS 95 a.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity relative to the ground. So to carry out ground speed calculations the FMS uses inputs from the IRS (option a).

INS IRS FMS EFIS 96 a.
When first powered up the Boeing 737-400 EFIS CDU displays the IDENT page (option a).

INS IRS FMS EFIS 97 c.
The first page used after powering up the system is IDENT, which allows the crew to confirm the details of the aircraft. This in turn causes the system to produce a series of prompts to guide the crew through the route procedures that need to be generated for the flight. The second page is POS INIT, which enables the crew to confirm that the FMS clock and the aircraft clock are synchronised. This page is then used to align the IRS. The third page is RTE, which appears after the tasks on the POS INIT page have been completed. The RTE page is used to input details such as destination airport and route to be flown. Option c is therefore the most accurate in this question.

INS IRS FMS EFIS 98 b.
The principal of operation of an IRS is that the platform is mathematically aligned to a known position and orientation prior to flight, then continuously recalculates its position and orientation by sensing all accelerations experienced by the aircraft during the subsequent flight. These accelerations are integrated once to give velocities and again to give distance moved. The ability of an IRS to provide accurate navigation information at any point during a flight is therefore dependent upon its having sensed all accelerations throughout all of the previous stages of the flight. Whenever an IRS is switched off its memory retains details of the situation at the time of shutdown, but it is unable to detect accelerations that occur throughout the period during which it is left shut down. The system will therefore lose its position as the flight progresses. If the IRS is then switched on again, all subsequent navigation calculations will be based upon the position at the instant at which the shutdown occurred. Such calculations will therefore

be inaccurate. So if an IRS is temporarily switched off in flight it can only be used in the attitude mode (option b).

INS IRS FMS EFIS 99 d.
The principal of operation of an IRS is that the platform is mathematically aligned to a known position and orientation prior to flight, then continuously recalculates its position and orientation by sensing all accelerations experienced by the aircraft during the subsequent flight. These accelerations are integrated once to give velocities and again to give distance moved. The abiilty of an IRS to provide accurate navigation information at any point during a flight is therefore dependent upon its having sensed all accelerations throughout all of the previous stages of the flight. Whenever an IRS is switched off its memory retains details of the situation at the time of shutdown, but it is unable to detect accelerations that occur throughout the period during which it is left shut down. The system will therefore lose its position as the flight progresses. If the IRS is then switched on again, all subsequent navigation calculations will be based upon the position at the instant at which the shutdown occurred. Such calculations will therefore be inaccurate. So if an IRS loses its power supply in flight it can then be used only in the attitude mode for the remainder of the flight (option d).

INS IRS FMS EFIS 100 b.
The term "Integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS are converted into velocities and distances. The sensors in an INS measure acceleration in the direction of its alignment (option b). The first integration of the accelerometer output signal produces another signal that is proportional to velocity relative to the ground. The second integration produces a signal that is proportional to distance moved over the ground.

INS IRS FMS EFIS 101 c.
Although INS systems designed by different manufacturers will inevitably differ in some respects, certain aspects are common to all systems. For example, positions are entered into all INS systems in the form of geographical coordinates (option c).

INS IRS FMS EFIS 102 d.
The display for INS 1 indicates that the aircraft is on the correct track, but that for INS2 indicates that it is drifting 10^0 to the left of the intended track. This discrepancy is far greater than the normal tolerances of INS, so one of the systems must be drifting (option d). It is not however possible to determine which system is in error based on the information available.

INS IRS FMS EFIS 103 d.
The FMS database contains two sets of data each of which is valid for 28 days. Prior to each flight the pilot is able to select which set of data will be used.

Maintenance personnel update the database regularly to ensure that it remains valid for all flights. From the viewpoint of the pilot, the FMS database is read only and can never be updated (option d).

INS IRS FMS EFIS 104 a.
The position calculated by the IRS is most accurate immediately after alignment at the gate. As the flight progresses minor errors in detecting accelerations and integrating the results, cause the accuracy of the IRS position to gradual degrade. In order to compensate for this gradual degradation, the Flight Management Computer (FMC) continuously calculates aircraft position using information provided by the IRS and various radio navigation aids (option a). Because the information from radio aids is not cumulative, its accuracy does not degrade as the flight progresses. So by combining inputs from the IRS and the radio navigation aids, the FMC is able to maintain a more accurate estimate of aircraft position.

INS IRS FMS EFIS 105 d.
An IRS system includes a memory in which it holds extensive records concerning the earth, together with the algorithms employed in making navigation computations. These records include details of Magnetic variation at various points on the Earth. These details of Magnetic variation are applied to the true heading calculated by the respective IRS in order to calculate magnetic headings (option d).

INS IRS FMS EFIS 106 b.
Messages provided by the CDU of a Boeing 737-400 EFIS fall into three categories. The highest priority massages are Warnings. These relate to situations or events requiring immediate corrective action on the part of the crew. The second priority messages are Cautions. These refer to situations or events, which do not require immediate corrective action, but which may affect the performance or operation of the aircraft. The lowest category is Advisory messages, which inform the crew of routine changes in the status of the aircraft and its systems, which do not require
corrective action. Option b, is therefore the most accurate in this question.

INS IRS FMS EFIS 107 d.
In the Boeing 737-400 aircraft the MCDU is used for a number of functions including inserting data into the FMS and IRS. Prior to the start of a flight, the MCDU is used to initialize the IRSs such that the carry out their initial alignment processes. In addition to this the MCDU is used to insert dispatch information such as destination, waypoints and cost index values, into the FMS. It should be noted that the MCDU is not used to input data directly into the Flight Director nor Autothrottle because these systems get their information via the FMS. Option d, is therefore the most accurate in this question.

INS IRS FMS EFIS 108 a.

The Boeing 737-400 Flight Management System (FMS) takes inputs from a wide range of sources including the IRS, Air Data Computers, MCDU, radio navigation aids, Autopilot, Flight Director, and Autothrottle system. By combining the data from these sources it is able to provide a range of services. These include automatic navigation and automatic performance management (option a). As an example of this letter function, the pilot can control the trade-off between fuel costs and flight duration, by inputting various cost index values into the FMS MCDU.

INS IRS FMS EFIS 109 b.

The first page used after powering up the system is IDENT, which allows the crew to confirm the details of the aircraft. This in turn causes the system to produce a series of prompts to guide the crew through the route procedures that need to be generated for the flight. The second page is POS INIT, which enables the crew to confirm that the FMS clock and the aircraft clock are synchronised. This page is then used to align the IRS. The third page is RTE, which appears after the tasks on the POS INIT page have been completed. The RTE page is used to input details such as destination airport and route to be flown. Option b is therefore the most accurate in this question.

INS IRS FMS EFIS 110 b.

FMC positions can be updated using information form various radio navigation aids. The most accurate of those used in the Boeing 737-400 is DME/DME (option b)

INS IRS FMS EFIS 111 d.

The Boeing 737-400 FMS is coupled to an Inertial reference System (IRS). This includes a back up battery and memory, which is able to remember the position of the aircraft at the time of shut down at the end of a flight. When the system is switched on in preparation for the next flight the pilot is required to input the geographical coordinates of its position. The IRS then compares these with the coordinates stored in IRS memory and warns the pilot if they are not the same. In this way the system is able to reject initial latitude and longitude errors (option d). This is an improvement on the older INS systems, which were only able to detect latitude errors.

INS IRS FMS EFIS 112 c.

The FMS database contains two sets of data each of which is valid for 28 days (option c). Prior to each flight the pilot is able to select which set of data will be used. Maintenance personnel update the database regularly to ensure that it remains valid for all flights. From the viewpoint of the pilot, the FMS database is read only and can never be updated.

INS IRS FMS EFIS 113 c.

In designing their systems, each manufacturer determines the range of functions that will be provided and the means by which these functions can be accessed. This inevitably means that different systems will provide different functions, which will be activated by different methods. In the case of the Boeing 737- 400 aircraft, the Weather Radar Display is available on the EFIS EHSI in the MAP, EXP VOR/ILS, and EXP NAV modes (option c).

INS IRS FMS EFIS 114 c.

Each manufacturer of electronic equipment provides the range of facilities considered to be most appropriate at the time that the equipment is being designed. The methods available for the input of created waypoints in, depends upon the type of system being used. In the case of the B737-400 EFIS, these are methods are identifier bearing/distance; place bearing/place bearing; along-track displacement; latitude and longitude, (option c).

INS IRS FMS EFIS 115 a.

The Aircraft is represented on EFIS by a white triangle (option a).

INS IRS FMS EFIS 116 a.

The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity relative to the ground. So to carry out ground speed calculations the FMS uses inputs from the IRS (option a).

INS IRS FMS EFIS 117 c.

The principal advantage of an IRS compared to an INS is that because the IRS does not use a gyro-stabilised platform, it is less complicated and has fewer moving parts. This makes the IRS more reliable and more accurate that the INS. A further advantage of the IRS is that it uses laser ring gyros rather than conventional spinning mass gyros as used in the INS. Because IRS systems have no moving gyroscopes, they require a much shorter spin-up time than an INS with rotating gyros. One disadvantage of laser gyros however is the fact that they are susceptible to errors due to a phenomenon termed laser lock. So an IRS has a sorter spin-up time and suffers from laser lock (option c).

INS IRS FMS EFIS 118 d.

Ring laser gyros, do not employ spinning rotors, but use variations in the length of travel of beams of light within a triangular housing. Because there is no spinning mass to be accelerated to operating RPM, laser gyros can be erected more quickly than conventional gyros. Laser gyros are employed in Inertial Reference systems (IRS). Unlike an INS, an IRS does not use a gyro stabilised platform, but uses a platform mounted directly onto the aircraft structure.

Although the platform pitches and rolls with the aircraft, the IRS computers continuously calculate the true north, and vertical directions. The signals from the various gyros and accelerometers are then modified to take account of the actual alignment relative to true north and vertical. This means that the laser gyros do not need to be aligned with true north. So a ring laser gyro it is not necessarily fixed to true north and is quick to erect (option d).

INS IRS FMS EFIS 119 b.

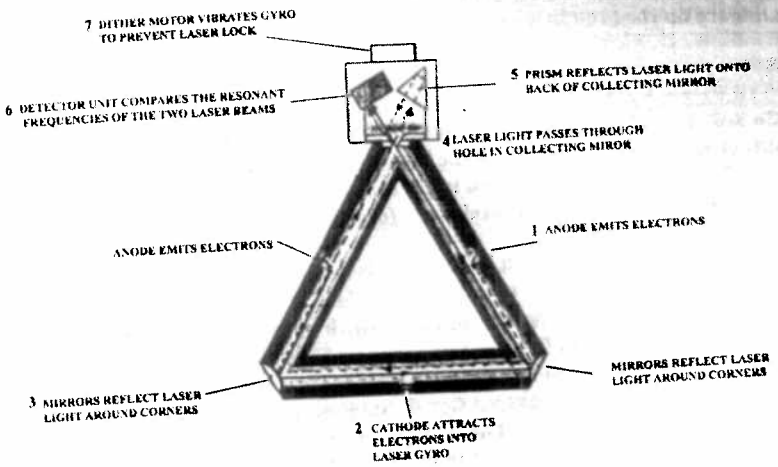
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. So in the IRS system the gyros and accelerometers are both strapped down (option b).

INS IRS FMS EFIS 120 d.

The ring laser gyro senses rates of rotation by measuring the difference between the resonant frequencies of two laser beams. The two beams travel in opposite directions around the triangle and are captured by a collecting mirror and detector unit. The detector unit then compares the resonant frequencies of the two beams to measure the difference between the two. These resonant frequencies are proportional to the length of the resonant structure through which they have passed. If the gyro is stationary the path taken by the two beams and hence the resonant frequencies are identical.

If however the aircraft yaws, the gyro will rotate with it. This means that the path of the beam travelling in the same direction as the gyro becomes slightly longer, whilst that of the other beam becomes slightly shorter. This difference in path length will cause a difference in resonant frequency that is proportional to the rate and direction of rotation. But when the gyro is rotating scatter from the mirrored surfaces sometimes causes the beams to lock together making the detection of small yaw rates impossible. To prevent this laser lock, a dither motor vibrates the gyro at a resonant frequency, thereby causing the beams to unlock. So the purpose of the dither motor is to overcome laser locking (option d).

A simple ring laser gyro is illustrated below.



LASER RING GYRO

INS IRS FMS EFIS 121 a.

The principal of operation of an IRS is that the platform is mathematically aligned to a known position and orientation prior to flight, then continuously recalculates its position and orientation by sensing all accelerations experienced by the aircraft during the subsequent flight. These accelerations are integrated once to give velocities and again to give distance moved. The ability of an IRS to provide accurate navigation information at any point during a flight is therefore dependent upon its having sensed all accelerations throughout all of the previous stages of the flight. Whenever an IRS is switched off its memory retains details of the situation at the time of shutdown, but it is unable to detect accelerations that occur throughout the period during which it is left shut down. If the IRS is then switched on again, all subsequent navigation calculations will be based upon the position at the instant at which the shutdown occurred. Such calculations will therefore be inaccurate.

A further problem is that the platform will move out of alignment as the aircraft pitches rolls and yaws during the period of shutdown. Under normal circumstances after shut down on the ground, the platform would re-align itself prior the start of the next flight. But during the period of this alignment process the aircraft must not be moved. So if an IRS is switched off in the air it cannot re-align itself accurately until it has landed. The system will however be able to detect any changes of attitude that occur after this system is switched back on. So if an IRS is temporarily off during flight, it cannot be used for navigation, but can be used to provide attitude information throughout the remainder of the flight (option a).

The term "gyro compassing" refers to the process whereby an IRS or INS system aligns itself with True North prior to flight. It is achieved with the aircraft stationary on the ground and the "ALIGN" selected on the controller (option b).

INS IRS FMS EFIS 123 a.
If the spin axis of a gyro departs from its initial orientation it is said to wander. If this change of orientation is in the horizontal plane then this wander is termed drift. If the change of orientation is in the vertical plane it is termed topple. So gyro drift occurs in the horizontal plane (option a).

INS IRS FMS EFIS 124 a.
The sensors in an INS are accelerometers, which measure accelerations (option a). The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity relative to the ground.

INS IRS FMS EFIS 125 a.
In considering this type of question its should be noted that the IRS position and the FMS position are two different things. The INS position can be updated only on the ground during the alignment process (option a). But the FMS position is continuously using data from the IRS and various radio navigation aids. The FMS position is also update when the TOGA button is pushed at the start of the take-off roll.

INS IRS FMS EFIS 126 c.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. Where the system is mounted and fixed to the aircraft structure is it termed "strapdown" (option c).

INS IRS FMS EFIS 127 b.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved. So the second integration of the output from an East/west accelerometer is distance east/west (option b).

INS IRS FMS EFIS 128 b.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. Both types of system are subject to oscillation errors as the unit is transported around the earth. The term "Schuler tuning" refers to a process by which such errors are reduced or eliminated. The Schuler tuning process is applicable to the gyro-stabilised platform and the strapdown systems (option b).

INS IRS FMS EFIS 129 a.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved. So the first stage integrator of the output from a North/South accelerometer is velocity in a North/South direction along the local meridian (option a).

INS IRS FMS EFIS 130 b.
In most INS and IRS systems the alignment process can be carried out only in the ALING mode. But in the Boeing 737-400 aircraft alignment can be carried out either in ALIGN or in NAV modes (option b), provided the aircraft is stationary on
the ground.

INS IRS FMS EFIS 131 a.
On a triple fit IRS system the positions calculated by each IRS will be subject to its own individual minor errors. So because each of the three IRS positions are derived from different IRS systems with different error rates, the three positions are likely to be slightly different (option a).

INS IRS FMS EFIS 132 a.
IRS modes are usually selected by means of a rotary switch. On the Boeing 737-400 IRS Mode Selector Unit (MSU) the switch positions listed from left to right (clockwise) are in the order OFF, ALIGN, NAV, ATT (option a)

INS IRS FMS EFIS 133 c.
The term "Gyro compassing" refers to the process whereby an INS platform is aligned in azimuth. To achieve this, the gyro normally used to stabilize the platform about the Eats/West axis is connected to the azimuth gimbal motor. When the platform is correctly aligned in azimuth the East gyro will not be subject to rotation of its axis by Earth rotation. But when the platform is out of alignment the East gyro will detect a component of earth rotation the produce an

the platform is aligned. But when the aircraft is in flight, the stabilizing gyro is used to stabilise the platform, by sensing accelerations caused by the motion of the aircraft. Gyro compassing is not therefore possible in flight because the gyros cannot differentiate between acceleration due to aircraft movement and initial alignment errors (option c).

INS IRS FMS EFIS 134 d.

The drifting of an azimuth gyro may be caused by a number of factors. The first of these is Earth Rate wander. This is caused by the rotation of the Earth. The drift caused by Earth Rate (in degrees per hour) is equal to 15 times the sine of the latitude. The second possible cause is Transport Wander. This is caused by the movement of the aircraft across the surface of the earth. This (in degrees per hour) is equal to the 1/60 of the ground speed multiplied by the tangent of the latitude. The third possible cause is due to mechanical imperfections in the gyros. All three of these causes of drift are directly proportional to the elapsed time since the system was switched from ALIGN to NAV (option d).

INS IRS FMS EFIS 135 d.

The ATT selection is normally used following a computer/processing failure. With ATT selected all of the navigation computations are disabled but the system is still able to provide pitch, roll and heading information. Option d is therefore the most accurate in this question.

INS IRS FMS EFIS 136 c.

Because they do not use mechanical gyros with spinning masses and do not physically level the platform, an IRS is able to complete the alignment process much more quickly than an INS. A modern IRS can complete alignment within 10 minutes (option c).

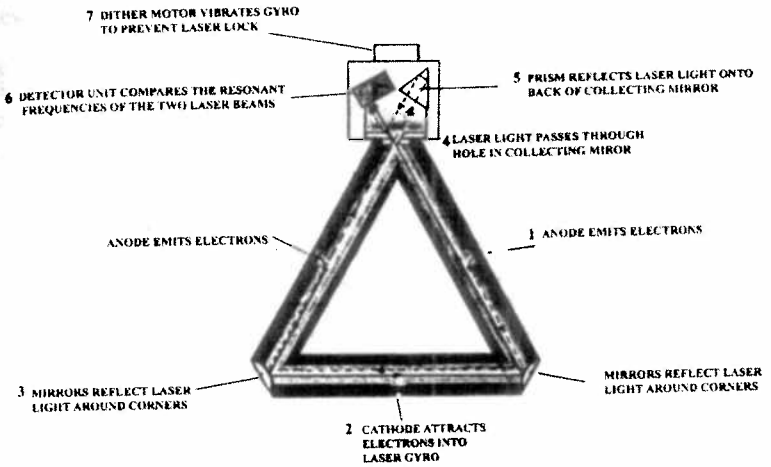
INS IRS FMS EFIS 137 c.

The ring laser gyro senses rates of rotation by measuring the difference between the resonant frequencies of two laser beams. The two beams travel in opposite directions around the triangle and are captured by a collecting mirror and detector unit. The detector unit then compares the resonant frequencies of the two beams to measure the difference between the two. These resonant frequencies are proportional to the length of the resonant structure through which they have passed. If the gyro is stationary the path taken by the two beams and hence the resonant frequencies are identical.

If however the aircraft yaws, the gyro will rotate with it. This means that the path of the beam travelling in the same direction as the gyro becomes slightly longer, whilst that of the other beam becomes slightly shorter. This difference in path length will cause a difference in resonant frequency that is proportional to the rate and direction of rotation. But when the gyro is rotating scatter from the mirrored surfaces sometimes causes the beams to lock together making the

detection of small yaw rates impossible. To prevent this laser lock, a piezo-electric dither motor vibrates the gyro at a resonant frequency, thereby causing the beams to unlock (option c).

A simple ring laser gyro is illustrated below.



LASER RING GYRO

INS IRS FMS EFIS 138 c.

The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. Both types of system are subject to oscillation errors as the unit is transported around the earth. The term "Schuler tuning" refers to a process by which such errors are reduced or eliminated. The Schuler tuning process is based on an oscillation period of 84.4 minutes (option c).

INS IRS FMS EFIS 139 a.

In order to ensure that the accelerometers in an INS sense only accelerations in their required directions, it is essential that the platform remains level throughout all phases of flight. In order to achieve this, it is necessary to apply corrects to counter the effects of a number of factors. The first of these is the pitching, rolling and yawing of the aircraft as it manoeuvres in flight. The second and third factors are Earth Rate Wander, caused by the rotation of the Earth and Transport Wanders caused by the movement of the aircraft above the surface of the earth. The fourth factor is coriolis effect, which is caused by the

fact that the aircraft takes a curved path around the world. Option a, is therefore the most accurate in this question.

INS IRS FMS EFIS 140 c.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity. The second integration gives a signal that is proportional to distance moved. So the ground speed is calculated by integrating measured accelerations (option c).

INS IRS FMS EFIS 141 b.
The display for INS 1 indicates that the aircraft is drifting 12^0 to the left of the desired track, but that for INS2 indicates that the aircraft is on track. This discrepancy is far greater than the normal tolerances of INS, so one of the systems must be drifting (option b). It is not however possible to determine which system is in error based on the information available.

INS IRS FMS EFIS 142 a.
The principal of operation of an IRS is that the platform is mathematically aligned to a known position and orientation prior to flight, then continuously recalculates its position and orientation by sensing all accelerations experienced by the aircraft during the subsequent flight. These accelerations are integrated once to give velocities and again to give distance moved. The ability of an IRS to provide accurate navigation information at any point during a flight is therefore dependent upon its having sensed all accelerations throughout all of the previous stages of the flight. Whenever an IRS is switched off its memory retains details of the situation at the time of shutdown, but it is unable to detect accelerations that occur throughout the period during which it is left shut down. The system will therefore lose its position as the flight progresses. If the IRS is then switched on again, all subsequent navigation calculations will be based upon the position at the instant at which the shutdown occurred. Such calculations will therefore be inaccurate. So if an IRS loses its position in flight it cannot be used in the NAV mode for the remainder of the flight (option a).

INS IRS FMS EFIS 143 b.
The term "integration" refers to a mathematical process whereby the outputs of the accelerometers in an IRS or INS are converted into velocities and distances. An accelerometer produces an output signal that is proportional to acceleration in the direction of its alignment. The first integration of this signal produces another signal that is proportional to velocity relative to the ground. The difference between ground speed and TAS is the wind speed. So for wind calculations an INS must also have TAS information (option b).

INS IRS FMS EFIS 144 d.
The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. The IRS system where the gyros and accelerometers are fixed to the aircraft structure is called "strapdown" (option d).

INS IRS FMS EFIS 145 b.
Prior to the commencement of each flight the INS/IRS systems must be aligned. This must be carried out with the aircraft stationary on the ground at the gate (or ramp). During the alignment process the pilot inputs the geographical coordinates of the gate. The system then uses these coordinates as the starting point for all subsequent calculations. The system is then set to NAV, which causes it to continuously calculate accelerations, velocities and distances moved from the ramp. In order for these calculations to be accurate the system must be set to NAV immediately prior to push back from the gate (option d). Selecting NAV at any later time will inevitably reduce the accuracy of the system, by an amount equal to the distance from the gate at the time that NAV is actually selected.

INS IRS FMS EFIS 146 c.
Although INS systems designed by different manufacturers will inevitably differ in some respects, certain aspects are common to all systems. For example, positions are entered into all INS systems in the form of geographical coordinates (option c).

INS IRS FMS EFIS 147 d.
An INS is capable of displaying various types of information depending upon what setting has been selected on the Control Display Unit (CDU). In order for an INS to display the initial great circle track it is necessary to select DSRTK\STS. These letters are an abbreviation of the term "Desired Track status" (option d).

INS IRS FMS EFIS 148 a.
The Aircraft is represented on EFIS by a cyan triangle (option a).

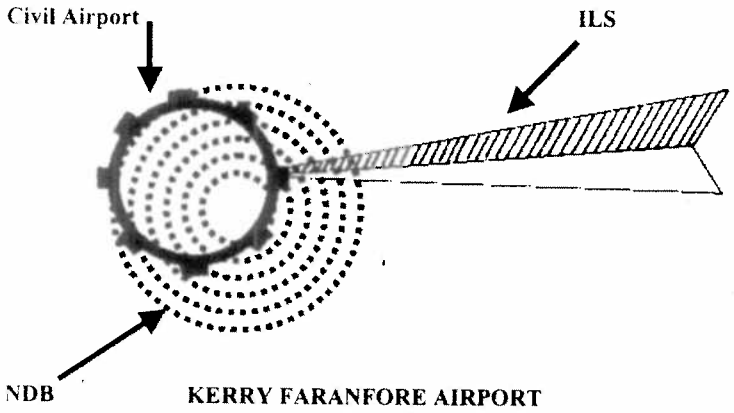
INS IRS FMS EFIS 149 d.
Each manufacturer of electronic equipment provides the range of facilities considered to be most appropriate at the time that the equipment is being designed. The methods available for the input of created waypoints in, depends upon the type of system being used. In the case of the B737-400 EFIS, these are methods are identifier bearing/distance; place bearing/place bearing; along-track displacement; latitude and longitude, (option d).

INS IRS FMS EFIS 150 a.

The principal difference between Inertial Navigation Systems (INS) and Inertial Reference systems (IRS) is that INS uses accelerometers mounted on gyro-stabilised platforms, whereas IRS platforms are not stabilised, but are fixed rigidly to the aircraft structure. The term "strapdown" refers to the IRS method, in which the gyroscopes and accelerometers become part of the unit's fixture to the aircraft structure (option a).

PLOTTING 1 a.

The position specified in this question is Kerry Farranfore Airport. The symbols at this position are illustrated below. These indicate a Civil airport, with ILS and NDB (option a).



PLOTTING 2 d.

To solve this type of problem it is necessary to:

a. **Identify the two positions on the chart.**
b. **Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.95 inches, which equates to 39 nm.**
c. **Measure the radial from the first point to the second using a protractor, taking care to align the base of the protractor with the Magnetic North ticks on the chart. In this case the radial is angle 330^0.**

So the required radial is 330^0 M 39 nm (option d).

PLOTTING 3 a.

To solve this type of problem it is necessary to:

a. **Identify the two positions on the chart.**

b. **Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 2.1 inches, which equates to 42 nm.**
c. **Measure the radial from the first point to the second using a protractor, taking care to align the base of the protractor with the Magnetic North ticks on the chart. In this case the radial is angle 068^0.**

So the required radial is 068^0 M 42 nm (option a).

PLOTTING 4 c.

To solve this type of problem it is necessary to:

a. **Identify the first position on the chart.**
b. **Draw in the specified radial to the second position, using a protractor aligned with the Magnetic North ticks on the chart.**
c. **Using a straight edge and the lines of latitude and meridians, identify the longitude and latitude of the second position.**

In this case the second point is at N52 20 W009 37 (option c).

PLOTTING 5 c.

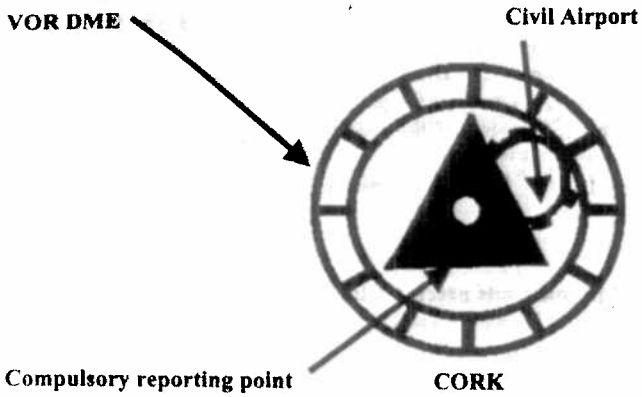
To solve this type of problem it is necessary to:

a. **Identify the two positions on the chart.**
b. **Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 4.45 inches, which equates to 89 nm.**
c. **Measure the radial from the first position to the second using a protractor, taking care to align the base of the protractor with the nearest meridian on the chart. In this case the radial is angle 270^0.**

So the required radial is 270^0 M 89 nm (option c).

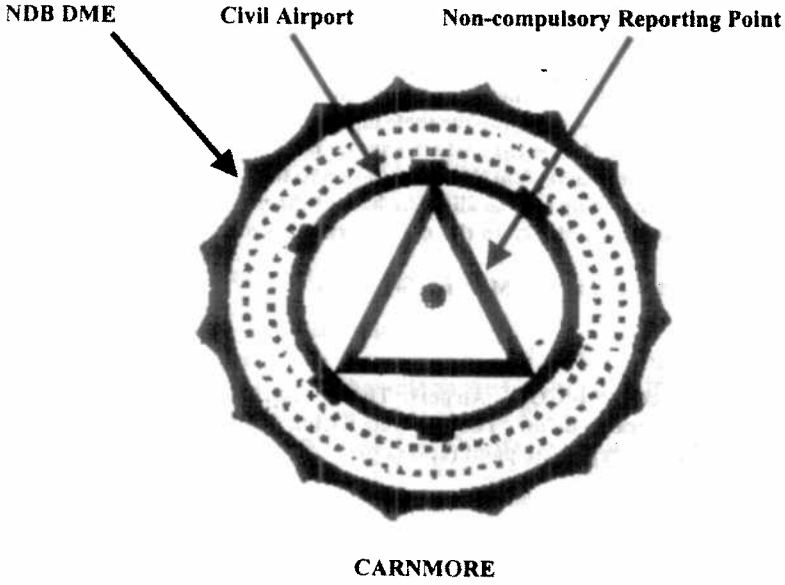
PLOTTING 6 b.

The position specified is CORK Airport. The symbols on the chart at this location are illustrated below. They indicate a Civil Airport with VOR, DME, and a Compulsory reporting point (option b).



PLOTTING 7

The position specified is Galway Carnmore Airport. The symbols on the chart indicate a Civil Airport with NDB, DME, and a Non-compulsory reporting point (option d).



PLOTTING 8 c.

To solve this type of problem it is necessary to:

a. Locate the first position on the chart and draw in the required radial from it.
b. Locate the second position on the chart and draw in the required radial from it.
c. Using a straight edge and the meridians and lines of longitude on the chat identify the coordinates of the position where the two radial cross.

In this case it is N52 10 W009 10 (option c).

PLOTTING 9 c.

To solve this type of problem it is necessary to:

a. Locate the two specified positions (CRN and SHA) on the chart.
b. Using a compass scribe a circle equivalent to the specified ranges from each location. The scale of the chart is 1 inch = 20 nm, so the circle around CRN should be 18/20 = 0.9 inches radius. That around SHA should be 20/20 = 1 inch radius.
c. The aircraft is at one of the two points at which these two circles cross each other. In this case the heading is 270° M and both DME ranges are decreasing, so the aircraft is to the East of both positions. This means that the aircraft is at the eastern point at which the two circles cross. This is position N53 02 W008 43 (option c).

PLOTTING 10 b.

To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 6.25 inches, which equates to 125 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the radial is angle 328°T.

So the required mean true track is 328° M 125 nm (option b).

PLOTTING 11 b.

To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the radial from the first position to the second using a protractor. The question specifies magnetic bearing, so the protractor must be aligned with the Magnetic North ticks on the chart. In this case the bearing is 037° M (option b).

PLOTTING 12 c.
To solve this type of problem it is necessary to:

a. Locate the first position on the chart and draw in the required radial from it.
b. Locate the second position on the chart and draw in the required radial from it.
c. Using a straight edge and the meridians and lines of latitude on the chat identify the coordinates of the position where the two radial cross.

In this case it is N52 30 W008 00 (option c).

PLOTTING 13 c.
To solve this type of problem it is necessary to:

a. Locate the two specified positions (SHA VOR and CRK VOR) on the chart.
b. Using a compass scribe a circle equivalent to the specified ranges from each location. The scale of the chart is 1 inch = 20 nm, so the circle around SHA should be 41/20 = 2.05 inches radius. That around CRK should be 30/20 = 1.5 inch radius.
c. The aircraft is at one of the two points at which these two circles cross each other. In this case the heading is 270° M and both DME ranges are decreasing, so the aircraft is to the East of both positions. This means that the aircraft is at the eastern point at which the two circles cross.
d. The coordinates of this position can be found using a straight edge and the meridians and lines of latitude on the chart.

In this case the position is N52 15 W008 05 (option c).

PLOTTING 14 a.
To solve this type of problem it is necessary to:

a. Locate the three positions on the chart.
b. Draw straight lines between the aircraft position and the two other positions.
c. Using a protractor measure the bearings from the two VORs to the position of the aircraft.

In this case the radial from SHA is 042° and that from CON is 138° (option a).

PLOTTING 15 c.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.

b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 4.05 inches, which equates to 81 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the radial is angle 286°T.

So the required mean true track is 286° M 81 nm (option c).

PLOTTING 16 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 2.35 inches, which equates to 47 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies magnetic track, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the magnetic track is 124°M.

So the required mean true track is 124° M 47 nm (option a).

PLOTTING 17 b.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 3.5 inches, which equates to 70 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies magnetic track, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the magnetic track is 025°T.

So the required mean true track is 025° M 70 nm (option b).

PLOTTING 18 c.
To answer this type of question it is necessary to use the lines of latitude and the meridians on the chart to locate the position of the coordinates specified. In this case the coordinates indicate the Kerry Farranfore airport (option c)

PLOTTING 19 c.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 6.85 inches, which equates to 137 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the track is approximately 336°T.

So the required mean true track is 336° T 137 nm (option c).

PLOTTING 20 c.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.9 inches, which equates to 38 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 113°M.

So the required radial is 113° M 38 nm (option c).

PLOTTING 21 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Using a protractor draw a line starting at the first position, at the angle specified for the radial in the question. VOR radials are specified as magnetic values, so the protractor must be aligned with the nearest magnetic tick on the chart.
c. Using the scale bar at the edge of the chart, adjust a set of compasses to the distance equating to 49 nm. Transfer this distance onto the radial previously drawn.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the position.

In this case the above process gives coordinates of N53 29 W008 30 (option a).

PLOTTING 22 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.

b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.65 inches, which equates to 33 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 030°M.

So the required radial is 030° M 33 nm (option a).

PLOTTING 23 b.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.9 inches, which equates to 38 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 311°M.

So the required radial is 311° M 38 nm (option b).

PLOTTING 24 d.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 2.4 inches, which equates to 48 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 039°M.

So the required radial is 039° M 48 nm (option d).

PLOTTING 25 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.9 inches, which equates to 38 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the

protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 113°M.

So the required radial is 113° M 38 nm (option a).

PLOTTING 26 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.65 inches, which equates to 33 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 309°M.

So the required radial is 309° M 33 nm (option a).

PLOTTING 27 d.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.5 inches, which equates to 30 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 035°M.

So the required radial is 035° M 30 nm (option d).

PLOTTING 28 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.75 inches, which equates to 35 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 139°M.

So the required radial is 139° M 35 nm (option a).

PLOTTING 29 c.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.85 inches, which equates to 37 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 214°M.

So the required radial is 214° M 37 nm (option c).

PLOTTING 30 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.8 inches, which equates to 36 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 358°M.

So the required radial is 358° M 36 nm (option a).

PLOTTING 31 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.45 inches, which equates to 29 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 088°M.

So the required radial is 088° M 29 nm (option a).

PLOTTING 32 b.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.

b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.15 inches, which equates to 23 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 140°M.

So the required radial is 140° M 23 nm (option b).

PLOTTING 33 d.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.75 inches, which equates to 35 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 233°M.

So the required radial is 233° M 35 nm (option d).

PLOTTING 34 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 2.2 inches, which equates to 44 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 236°M.

So the required radial is 236° M 44 nm (option a).

PLOTTING 35 c.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 2.2 inches, which equates to 44 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the

protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 278°M.

So the required radial is 278° M 44 nm (option c).

PLOTTING 36 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 1.7 inches, which equates to 34 nm.
c. Measure the radial from the first position to the second using a protractor. VOR radials are specified relative to Magnetic North, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the radial is angle 315°M.

So the required radial is 315° M 34 nm (option a).

PLOTTING 37 b.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 4.5 inches, which equates to 90 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies magnetic track, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the magnetic track is 278°M.

So the required mean true track is 278° M 90 nm (option b).

PLOTTING 38 a.
To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 4.45 inches, which equates to 89 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies magnetic track, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the magnetic track is 357°M.

So the required mean true track is 357° M 89 nm (option a).

PLOTTING 39 d.

To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 4.75 inches, which equates to 95 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies magnetic track, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the magnetic track is 142°M.

So the required mean true track is 142° M 95 nm (option d).

PLOTTING 40 a.

To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 3.55 inches, which equates to 71 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies magnetic track, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the magnetic track is 026°M.

So the required mean true track is 026° M 71 nm (option a).

PLOTTING 41 c.

To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 3.5 inches, which equates to 70 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies magnetic track, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the magnetic track is 025°M.

So the required mean true track is 025° M 70 nm (option c).

PLOTTING 42 a.

To solve this type of problem:

a. Identify the two positions on the chart.

b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 4.8 inches, which equates to 96 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies magnetic track, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the magnetic track is 316°M.

So the required mean true track is 316° M 96 nm (option a).

PLOTTING 43 c.

To solve this type of problem:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 6.3 inches, which equates to 126 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies magnetic track, so the protractor must be aligned with the magnetic north ticks on the chart. In this case the magnetic track is 057°M.

So the required mean true track is 057° M 126 nm (option c).

PLOTTING 44 a.

To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 5.05 inches, which equates to 101 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the radial is angle 063°T.

So the required mean true track is 063° T 101 nm (option a).

PLOTTING 45 c.

To solve this type of problem it is necessary to:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 2.35 inches, which equates to 47 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be

aligned with the meridians on the chart. In this case the radial is angle 011°T.

So the required mean true track is 011° T 47 nm (option c).

PLOTTING 46 a.
To solve this type of problem:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 4.05 inches, which equates to 81 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the radial is angle 286°T.

So the required mean true track is 286° T 81 nm (option a).

PLOTTING 47 c.
To solve this type of problem:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 6.85 inches, which equates to 137 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the radial is angle 036°T.

So the required mean true track is 036° T 137 nm (option c).

PLOTTING 48 a.
To solve this type of problem:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 3.6 inches, which equates to 72 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the radial is angle 002°T.

So the required mean true track is 002° T 72 nm (option a).

PLOTTING 49 b.
To solve this type of problem:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 4.5 inches, which equates to 90 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the radial is angle 270°T.

So the required mean true track is 270° T 90 nm (option b).

PLOTTING 50 a.
To solve this type of problem:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 6.2 inches, which equates to 124nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the radial is angle 327°T.

So the required mean true track is 327° T 124 nm (option a).

PLOTTING 51 d.
To solve this type of problem:

a. Identify the two positions on the chart.
b. Measure the distance between the two positions using dividers then convert this into nm using the scale on the edge of the chart. In this case the distance is 4 inches, which equates to 80 nm.
c. Measure the radial from the first position to the second using a protractor. The question specifies true track, so the protractor must be aligned with the meridians on the chart. In this case the radial is angle 035°T.

So the required mean true track is 035° T 80 nm (option d).

PLOTTING 52 a.
To solve this type of problem:

align the protractor with the magnetic north ticks on the chart.

b. Locate the second position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
c. The position of the aircraft is where these two radials cross.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5220 W00920 (option a).

PLOTTING 53 c.
To solve this type of problem:

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Locate the second position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
c. The position of the aircraft is where these two radials cross.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5210 W00910 (option c).

PLOTTING 54 d.
To solve this type of problem:

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Locate the second position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
c. The position of the aircraft is where these two radials cross.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5230 W00800 (option d).

PLOTTING 55 a.
To solve this type of problem:

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Locate the second position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
c. The position of the aircraft is where these two radials cross.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5220 W00750 (option a).

PLOTTING 56 d.
a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Locate the second position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
c. The position of the aircraft is where these two radials cross.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5210 W00800 (option d).

PLOTTING 57 a.
To solve this type of problem:

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5230 W00800 (option a).

PLOTTING 58 b.
To solve this type of problem:

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5210 W00830 (option b).

PLOTTING 59 a.
To solve this type of problem:

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.

b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5220 W00930 (option a).

PLOTTING 60 c.
To solve this type of problem:

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5330 W00830 (option c).

PLOTTING 61 b.
To solve this type of problem:

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge and the meridians and lines of latitude on the chart, estimate the coordinates of the aircraft position.

In this case it is N5300 W00830 (option b).

PLOTTING 62 a.
To solve this type of problem:

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge draw radial to the two locations specified in the options specified in the question.
e. Using a protractor aligned with the magnetic north ticks on the chart, measure the directions of these radials.

In this case it is SHA 212° CRK 328° (option a).

PLOTTING 63 d.
a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge draw radial to the two locations specified in the options specified in the question.
e. Using a protractor aligned with the magnetic north ticks on the chart, measure the directions of these radials.

In this case it is SHA 131° CRK 017° (option d).

PLOTTING 64 b.
a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge draw radial to the two locations specified in the options specified in the question.
e. Using a protractor aligned with the magnetic north ticks on the chart, measure the directions of these radials.

In this case it is SHA 248° CRK 325° (option b).

PLOTTING 65 a.
a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge draw radial to the two locations specified in the options specified in the question.
e. Using a protractor aligned with the magnetic north ticks on the chart, measure the directions of these radials.

In this case it is SHA 042° CON 138° (option a).

PLOTTING 66 c.

a. Locate the first position and draw in the radial specified taking care to align the protractor with the magnetic north ticks on the chart.
b. Using the scale bar at the edge of the chart set the point of a set of dividers at the distance specified in the questions.
c. Use the dividers to transfer this distance onto the radial to give the position of the aircraft.
d. Using a straight edge draw radial to the two locations specified in the options specified in the question.
e. Using a protractor aligned with the magnetic north ticks on the chart, measure the directions of these radials.

In this case it is SHA 325° CON 235° (option c).

PLOTTING 67 b.

To solve this type of problem:

a. Locate the two specified positions (SHA and CRK) on the chart.
b. Using a compass scribe a circle equivalent to the specified ranges from each location. The scale of the chart is 1 inch = 20 nm, so the circle around SHA should be 50/20 = 2.5 inches radius. That around CRK should be 41/20 = 2.05 inch radius. These distances can be obtained directly from the scale bar at the edge of the chart.
c. The aircraft is at one of the two points at which these two circles cross each other. In this case the heading is 270° M and both DME ranges are increasing, so the aircraft is to the west of both positions. This means that the aircraft is at the eastern point at which the two circles cross. This is position N5200 W00935 (option b).

PLOTTING 68 b.

To solve this type of problem:

a. Locate the two specified positions (SHA and CRK) on the chart.
b. Using a compass scribe a circle equivalent to the specified ranges from each location. The scale of the chart is 1 inch = 20 nm, so the circle around SHA should be 41/20 = 2.05 inches radius. That around CRK should be 30/20 = 1.5 inch radius. These distances can be obtained directly from the scale bar at the edge of the chart.
c. The aircraft is at one of the two points at which these two circles cross each other. In this case the heading is 270° M and both DME ranges are decreasing, so the aircraft is to the east of both positions. This means that the aircraft is at the eastern point at which the two circles cross. This is position N5215 W00805 (option b).

PLOTTING 69 c.

To solve this type of problem:

a. Locate the two specified positions (CRN and SHA) on the chart.
b. Using a compass scribe a circle equivalent to the specified ranges from each location. The scale of the chart is 1 inch = 20 nm, so the circle around CRN should be 18/20 = 0.9 inches radius. That around SHA should be 30/20 = 1.5 inch radius. These distances can be obtained directly from the scale bar at the edge of the chart.
c. The aircraft is at one of the two points at which these two circles cross each other. In this case the heading is 270° M and both DME ranges are decreasing, so the aircraft is to the east of both positions. This means that the aircraft is at the eastern point at which the two circles cross. This is position N5310 W00830 (option c).

PLOTTING 70 a.

To solve this type of problem:

a. Locate the two specified positions (CRN and SHA) on the chart.
b. Using a compass scribe a circle equivalent to the specified ranges from each location. The scale of the chart is 1 inch = 20 nm, so the circle around CRN should be 34/20 = 1.7 inches radius. That around SHA should be 26/20 = 1.3 inch radius. These distances can be obtained directly from the scale bar at the edge of the chart.
c. The aircraft is at one of the two points at which these two circles cross each other. In this case the heading is 090° M and both DME ranges are increasing, so the aircraft is to the west of both positions. This means that the aircraft is at the western point at which the two circles cross. This is position N5255 W00815 (option a).

PLOTTING 71 a.

To solve this type of problem:

a. Locate the two specified positions (CON and CRN) on the chart.
b Using a compass scribe a circle equivalent to the specified ranges from each location. The scale of the chart is 1 inch = 20 nm, so the circle around CON should be 30/20 = 1.5 inches radius. That around CRN should be 25/20 = 1.25 inch radius. These distances can be obtained directly from the scale bar at the edge of the chart.
d. The aircraft is at one of the two points at which these two circles cross each other. In this case the heading is 270° M and both DME ranges are decreasing, so the aircraft is to the east of both positions. This means that the aircraft is at the western point at which the two circles cross. This is position N5330 W00820 (option a).

PLOTTING 72 a.

To solve this type of problem:

a. Locate the two positions on the chart.
b. Using a straight edge draw a line between the two positions.
c. Using a protractor aligned with the magnetic north ticks on the chart, measure the radial from Kerry aerodrome to CRK VOR.
d. Using dividers and the scale bar at the edge of the chart, measure the distance between Kerry aerodrome and CRK VOR.

In this case the radial and distance are 307° 43 nm (option a).

PLOTTING 73 b.
To solve this type of problem:

a. Locate the two positions on the chart.
b. Using a straight edge draw a line between the two positions.
c. Using a protractor aligned with the magnetic north ticks on the chart, measure the radial from Birr aerodrome to SHA VOR/DME.
d. Using dividers and the scale bar at the edge of the chart, measure the distance between Birr aerodrome and SHA VOR/DME.

In this case the radial and distance are 068° 41 nm (option b).

PLOTTING 74 d.
To solve this type of problem:

a. Locate the two positions on the chart.
b. Using a straight edge draw a line between the two positions.
c. Using a protractor aligned with the magnetic north ticks on the chart, measure the radial from Connemara aerodrome to SHA VOR/DME.
d. Using dividers and the scale bar at the edge of the chart, measure the distance between Connemara aerodrome and SHA VOR/DME.

In this case the radial and distance are 333° 37 nm (option d).

PLOTTING 75 a.
To solve this type of problem:

a. Locate the two positions on the chart.
b. Using a straight edge draw a line between the two positions.
c. Using a protractor aligned with the magnetic north ticks on the chart, measure the radial from Castlebar aerodrome to CON VOR/DME.
d. Using dividers and the scale bar at the edge of the chart, measure the distance between Castlebar aerodrome and CON VOR/DME.

In this case the radial and distance are 265° 17 nm (option a).

PLOTTING 76 c.
To solve this type of problem:

a. Locate the two positions on the chart.
b. Using a straight edge draw a line between the two positions.
c. Using a protractor aligned with the magnetic north ticks on the chart, measure the radial from Abbey Shrule aerodrome to CON VOR/DME.
d. Using dividers and the scale bar at the edge of the chart, measure the distance between Abbey Shrule aerodrome and CON VOR/DME.

In this case the radial and distance are 124° 46 nm (option c).

PLOTTING 77 a.
To solve this type of problem:

a. Using a straight edge and the meridians and lines of latitude on the chart, locate the position specified by the coordinates given in the question.
b. Read off the title of the position from the chart.
c. In this case the position is Kerry/Farranfore aerodrome (option a).

PLOTTING 78 d.
To solve this type of problem:

a. Using a straight edge and the meridians and lines of latitude on the chart, locate the position specified by the coordinates given in the question.
b. Read off the title of the position from the chart.
c. In this case the position is TUSKAR ROCK LT.H (option d).

PLOTTING 79 b.
To solve this type of problem:

a. Using a straight edge and the meridians and lines of latitude on the chart, locate the position specified by the coordinates given in the question.
b. Read off the title of the position from the chart.
c. In this case the position is PUNCHTOWN Aerodrome (option b).

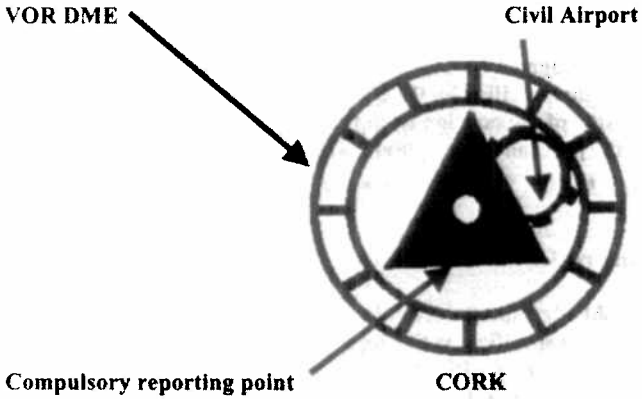
PLOTTING 80 c.
To solve this type of problem:

a. Using a straight edge and the meridians and lines of latitude on the chart, locate the position specified by the coordinates given in the question.
b. Read off the title of the position from the chart.
c. In this case the position is CASTLEBAR Aerodrome (option c).

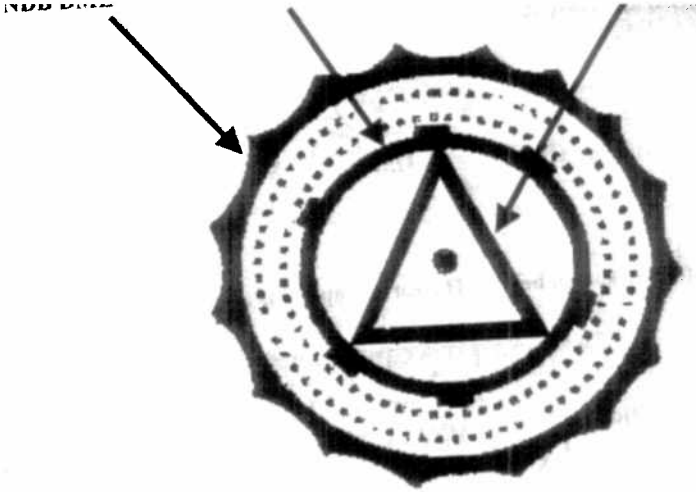
PLOTTING 81 b.
To solve this type of problem:

a. Using a straight edge and the meridians and lines of latitude on the chart, locate the position specified by the coordinates given in the question.
b. Read off the title of the position from the chart.
c. In this case the position is EAGLE ISLAND LT.H NDB (option b).

PLOTTING 82 a.
The position specified is CORK Airport. The symbols on the chart at this location are illustrated below. They indicate a Civil Airport with VOR, DME, and a Compulsory reporting point (option a).

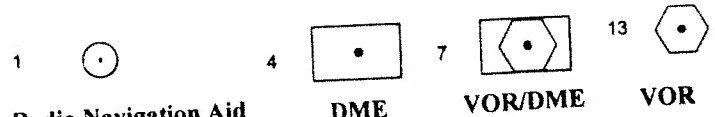


PLOTTING 83 a.
The position specified is Galway Carnmore Airport. The symbols on the chart indicate a Civil Airport with NDB, DME, and a Non-compulsory reporting point (option a).

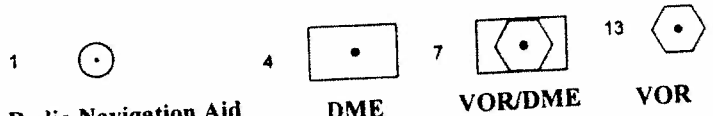


CARNMORE

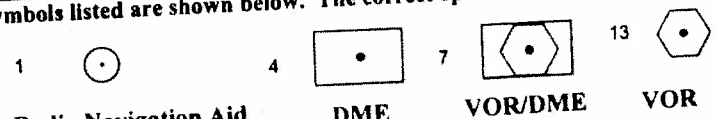
PLOTTING 84 c.
The symbols listed are shown below. The correct option is c.



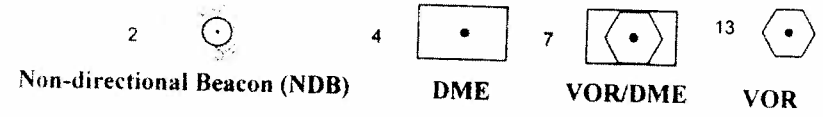
PLOTTING 85 b.
The symbols listed are shown below. The correct option is b.



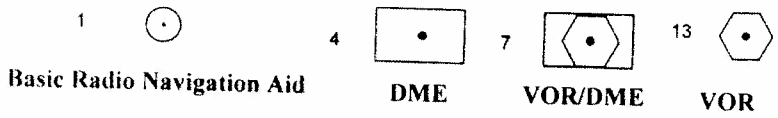
PLOTTING 86 d.
The symbols listed are shown below. The correct option is d.



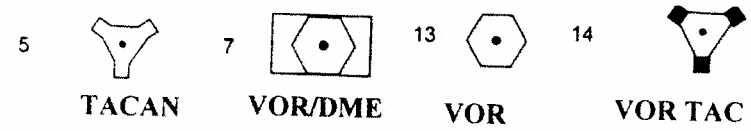
PLOTTING 87 a.
The symbols listed are shown below. The correct option is a.



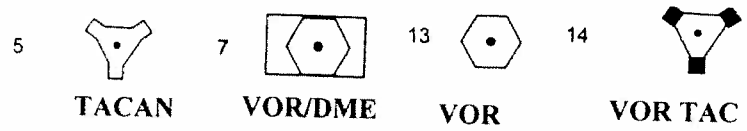
PLOTTING 88 a.
The symbols listed are shown below. The correct option is a.



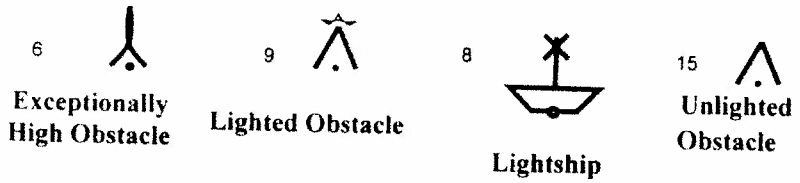
PLOTTING 89 a.
The symbols listed are shown below. The correct option is a.



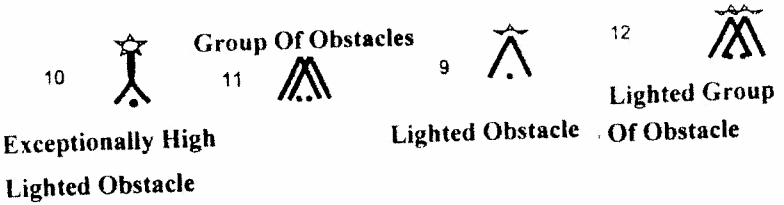
PLOTTING 90 d.
The symbols listed are shown below. The correct option is d



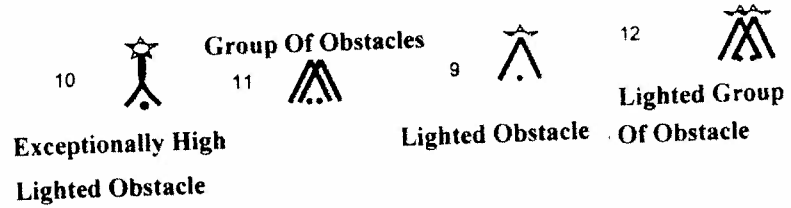
PLOTTING 91.
The symbols listed are shown below. The correct option is a



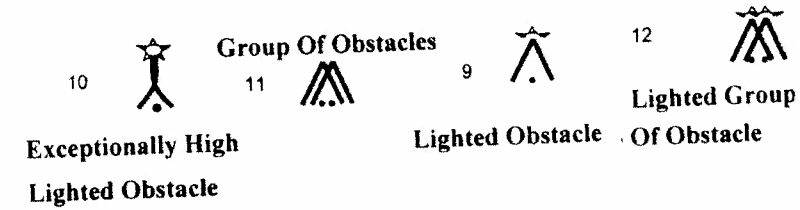
PLOTTING 92 a.
The symbols listed are shown below. The correct option is a



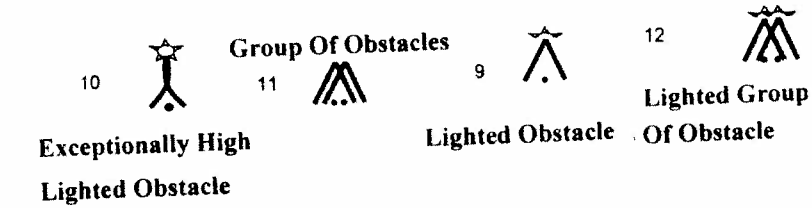
PLOTTING 93 c.
The symbols listed are shown below. The correct option is c.



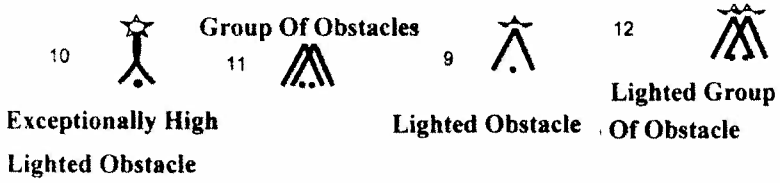
PLOTTING 94 d.
The symbols listed are shown below. The correct option is a.



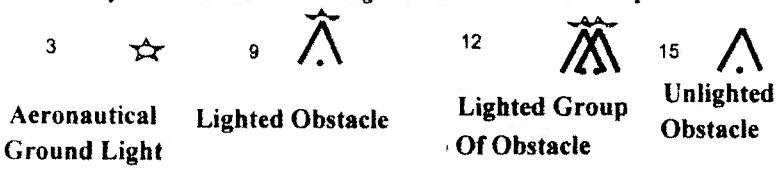
PLOTTING 95 b.
The symbols listed are shown below. The correct option is b



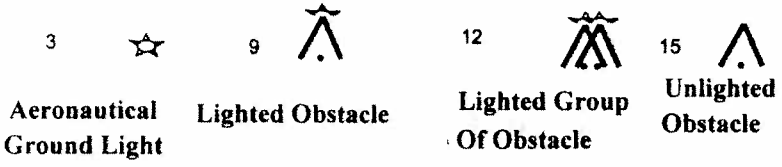
PLOTTING 96 b.
The symbols listed are shown below. The correct option is b.



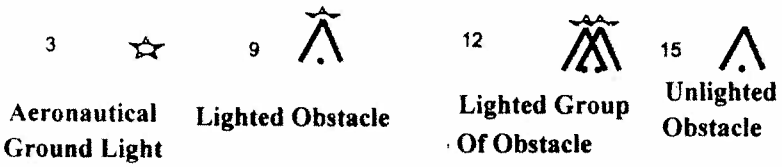
PLOTTING 97 a.
The above symbols and their meanings are illustrated below. Option a is correct.



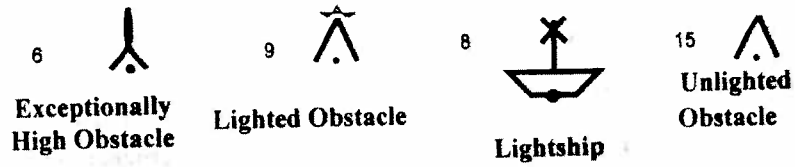
PLOTTING 98 c.
The above symbols and their meanings are illustrated below. Option c is correct.



PLOTTING 99 a.
The above symbols and their meanings a re illustrated below. Option a is correct.



PLOTTING 100 b.
The above symbols and their meanings are illustrated below. Option b is correct.



PSR & PET 1 a.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (300 kts – 50 kts headwind) = 250 kts.

The homebound groundspeed is (300 kts + 50 kts tailwind) = 350 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 350 nm/h) / (350 nm/h + 250 nm/h) = 5.83 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 250 nm/h x 5.83 h = 1458 nm (option a).

PSR & PET 2 d.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The endurance of 8 hours and 30 minutes is equal to 510 minutes

Inserting these figures into the equation gives:

PSR = (510 min x 480 nm/h) / (365 nm/h + 480 nm/h) = 289 or approximately 290 minutes (option d).

It should be noted that the distance between A and B is not relevant to the solution of this problem.

PSR & PET 3 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (480 kts – 90 kts headwind) = 390 kts.

The homebound groundspeed is (480 kts + 75 kts tailwind) = 555 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 555 nm/h) / (390 nm/h + 555 nm/h) = 5.87 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 390 nm/h x 5.87 h = 2290 nm (option c).

PSR & PET 4 a.
This type of problem can be solved using the standard equation below to find the distance to PSR then subtracting this from the distance to point B:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 360 nm

Outward groundspeed = (TAS – headwind) = (180 kts – 15 kts) = 165 kts.

Homebound groundspeed = (TAS + tailwind) = (180 kts + 15 kts) = 195 kts

Inserting these figures into the equation gives:

PET = (360 nm x 195 nm/h) / (165 nm/h + 195 nm/h) = 195 nm.

The distance from PET to point B is distance from A to B (360 nm) - PET (195 nm) = 165 nm, (option a).

PSR & PET 5 d.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 500 nm

Outward groundspeed = (TAS – headwind) = (300 kts – 60 kts) = 240 kts.
Homebound groundspeed = (TAS + tailwind) = (300 kts + 60 kts) = 360 kts

Inserting these figures into the equation gives:

PET = (500 nm x 360 nm/h) / (240 nm/h + 360 nm/h) = 300 nm (option d).

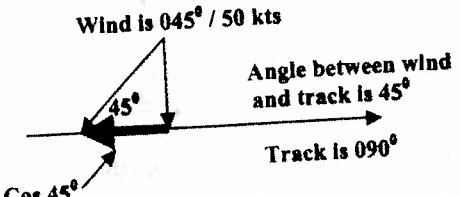
PSR & PET 6 b.
This type of problem can be solved using the standard equation:

PSR = (EH / (O + H) where:

PSR is the time to the point of safe return or maximum distance out from start,
E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Outward groundspeed = (TAS – headwind) and the homebound groundspeed = (TAS + tailwind). So to solve this problem it is necessary to calculate the head or tailwind component. This can be done using the CRP5 or as indicated below.

The track is 090° and the wind direction is 045° so the angle between the track and the wind is 45° as indicated in the diagram at the right.



The along track wind is 50 kts x Cos 45°
So outbound wind is 50 kts x Cos 45° = 35.36 kts headwind
And homebound wind is 35.36 kts tailwind

Groundspeed out = TAS (180 kts) – headwind (35.36 kts) = 144.64 kts
Groundspeed home = TAS (180 kts) + tailwind (35.36 kts) = 215.36 kts

Inserting these figures into the equation gives:

PSR = (EH / (O + H) = (1 hour x 215.36) / (144.64 kts + 215.36 kts)

PSR = 0.598 hours

Multiplying this time by the groundspeed out (144.64 kts) gives a distance of 86.53 nm or approximately 85 nm (option b).

PSR & PET 7 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting the data given in the question gives:

PSR = (8 hours x 465 nm/h) / (385 nm/h + 465 nm/h) = 4.38 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 385 nm/h x 4.38 h = 1684 nm or approximately 1685 nm (option a).

PSR & PET 8 d.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1000 nm

Outward groundspeed = (TAS – headwind) = (490 kts – 20 kts) = 470 kts.

Homebound groundspeed = (TAS + tailwind) = (490 kts + 40 kts) = 530 kts

Inserting these figures into the equation gives:

PET = (1000 nm x 530 nm/h) / (470 nm/h + 530 nm/h) = 530 nm (option d).

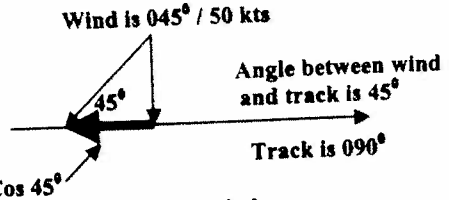
PSR & PET 9 a.
This type of problem can be solved using the standard equation:

PSR = (EH / (O + H) where:

PSR is the time to the point of safe return or maximum distance out from start, E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Outward groundspeed = (TAS – headwind) and the homebound groundspeed = (TAS + tailwind). So to solve this problem it is necessary to calculate the head or tailwind component. This can be done using the CRP5 or as indicated below.

The track is 090° and the wind direction is 045° so the angle between the track and the wind is 45° as indicated in the diagram at the right.



The along track wind is 50 kts x Cos 45°
So outbound wind is 50 kts x Cos 45° = 35.36 kts headwind
And homebound wind is 35.36 kts tailwind

Groundspeed out = TAS (180 kts) – headwind (35.36 kts) = 144.64 kts
Groundspeed home = TAS (180 kts) + tailwind (35.36 kts) = 215.36 kts

Inserting these figures into the equation gives:

PSR = (EH / (O + H) = (1 hour x 215.36) / (144.64 kts + 215.36 kts)

PSR = 0.598 hours

Multiplying this time by the groundspeed out (144.64 kts) gives a distance of 86.53 nm or approximately 85 nm (option a).

PSR & PET 10 b.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PET = (2346 nm x 480 nm/h) / (365 nm/h + 480 nm/h) = 1333 nm.

The time taken to reach this point can be found using the equation:

Time = distance / groundspeed = 1333 nm / 365 nm/h = 3.65 hours or 219 minutes (option b).

PSR & PET 11 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 480 nm/h) / (365 nm/h + 480 nm/h) = 4.83 hours.

Multiplying this by 60 gives a time of 289.7 or approximately 290 minutes (option a).

PSR & PET 12 d.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2900 nm

Outward groundspeed = (TAS + tailwind) = (470 kts +55 kts) = 525 kts.

Homebound groundspeed = (TAS - headwind) = (470 kts -75 kts) = 395 kts

Inserting these figures into the equation gives:

PET = (2900 nm x 395 nm/h) / (525 nm/h + 395 nm/h) = 1245 nm.

The time taken to fly this distance can be found using the equation:

Time taken = distance = groundspeed = 1245 nm / 525 kts = 2.37 hours which is 2 h 22 minutes.

Adding this figure to the time at point A = 1435 + 2 h 22 min = 1657 (option d)

PSR & PET 13 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (470 kts + 55 kts tailwind) = 525 kts.

The homebound groundspeed is (470 kts -75 kts headwind) = 395 kts.

The stated endurance is 9.5 hours.

Inserting these figures into the equation gives:

PSR = (9.5 hours x 395 nm/h) / (525 nm/h + 395 nm/h) = 4.08 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 525 nm/h x 4.08 h = 2141 nm (option b).

PSR & PET 14 a.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2484 nm

Inserting these figures into the equation gives:

PET = (2484 nm x 500 nm/h) / (420 nm/h + 500 nm/h) = 1350 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1350 nm / 420 kts = 3.21 hours or 193 minutes (option a).

PSR & PET 15 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 500 nm/h) / (420 nm/h + 500 nm/h) = 4.62 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 420 nm/h x 4.62 h = 1940 nm (option b).

PSR & PET 16 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (480 kts – 90 kts headwind) = 390 kts.

The homebound groundspeed is (480 kts + 75 kts tailwind) = 555 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:
PSR = (10 hours x 555 nm/h) / (390 nm/h + 555 nm/h) = 5.87 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 390 nm/h x 5.87 h = 2290 nm (option b).

PSR & PET 17 a.
This type of problem can be solved using the standard equation below to find the distance to PSR then subtracting this from the distance to point B:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1973 nm

Inserting these figures into the equation gives:

PET = (1973 nm x 385 nm/h) / (430 nm/h + 385 nm/h) = 932 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 932 nm / 430 kts = 2.17 hours or 130 min (option a).

PSR & PET 18 d.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

7 hours 20 minutes is 7.33 hours

Inserting these figures into the equation gives:

PSR = (7.33 hours x 430 nm/h) / (385 nm/h + 430 nm/h) = 3.87 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 385 nm/h x 3.87 h = 1489 nm or approximately 1490 nm (option d).

PSR & PET 19 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9 hours x 385 nm/h) / (435 nm/h + 385 nm/h) = 4.23 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 435 nm/h x 4.23 h = 1838 nm (option c).

PSR & PET 20 d.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1760 nm

Inserting these figures into the equation gives:

PET = (1760 nm x 385 nm/h) / (435 nm/h + 385 nm/h) = 826 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 826 nm / 435 kts = 1.9 hour or 114 mins (option d).

PSR & PET 21 b.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 3623 nm

Inserting these figures into the equation gives:

PET = (3623 nm x 300 nm/h) / (370 nm/h + 300 nm/h) = 1622 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1622 nm / 370 kts = 4.38 hours or 263 mins (option b).

PSR & PET 22 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (7 hours x 370 nm/h) / (400 nm/h + 370 nm/h) = 3.37 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 400 nm/h x 3.37 h = 1345 nm (option a).

PSR & PET 23 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9 hours x 485 nm/h) / (475 nm/h + 485 nm/h) = 4.55 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 475 nm/h x 4.55 h = 2160 nm (option c).

PSR & PET 24 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (6 hours x 585 nm/h) / (535 nm/h + 585 nm/h) = 3.14 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 535 nm/h x 3.14 h = 1677 nm (option b).

PSR & PET 25 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9.5 hours x 400 nm/h) / (500 nm/h + 400 nm/h) = 4.22 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 500 nm/h x 4.22 h = 2111 nm (option a).

PSR & PET 26 a.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (350 kts – 50 kts headwind) = 300 kts.

The homebound groundspeed is (350 kts + 50 kts tailwind) = 400 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 400 nm/h) / (300 nm/h + 400 nm/h) = 5.71 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 300 nm/h x 5.71 h = 1714 nm (option a).

PSR & PET 27 d.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The endurance of 8 hours and 30 minutes is equal to 510 minutes

Inserting these figures into the equation gives:

PSR = (510 min x 460 nm/h) / (350 nm/h + 460 nm/h) = 289.6 or approximately 290 minutes (option d).

PSR & PET 28 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (480 kts – 90 kts headwind) = 390 kts.

The homebound groundspeed is (480 kts + 75 kts tailwind) = 555 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 555 nm/h) / (390 nm/h + 555 nm/h) = 5.87 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 390 nm/h x 5.87 h = 2290 nm (option a).

PSR & PET 29 a.
This type of problem can be solved using the standard equation below to find the distance to PSR then subtracting this from the distance to point B:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 560 nm

Outward groundspeed = (TAS – headwind) = (280 kts – 15 kts) = 265 kts.

Homebound groundspeed = (TAS + tailwind) = (280 kts + 15 kts) = 295 kts

Inserting these figures into the equation gives:

PET = (560 nm x 295 nm/h) / (265 nm/h + 295 nm/h) = 295 nm.

The distance from PET to point B is distance from A to B (560 nm) - PET (295 nm) = 265 nm, (option a).

PSR & PET 30 d.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 700 nm

Outward groundspeed = (TAS – headwind) = (500 kts – 60 kts) = 440 kts.

Homebound groundspeed = (TAS + tailwind) = (500 kts + 60 kts) = 560 kts

Inserting these figures into the equation gives:

PET = (700 nm x 560 nm/h) / (440 nm/h + 560 nm/h) = 392 nm (option d).

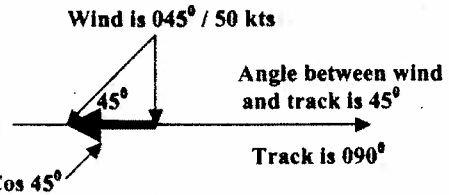
PSR & PET 31 b.
This type of problem can be solved using the standard equation:

PSR = (EH / (O + H) where:

PSR is the time to the point of safe return or maximum distance out from start, E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Outward groundspeed = (TAS – headwind) and the homebound groundspeed = (TAS + tailwind). So to solve this problem it is necessary to calculate the head or tailwind component. This can be done using the CRP5 or as indicated below.

The track is 090° and the wind direction is 045° so the angle between the track and the wind is 45° as indicated in the diagram at the right.



The along track wind is 50 kts x Cos 45°
So outbound wind is 50 kts x Cos 45° = 35.36 kts headwind
And homebound wind is 35.36 kts tailwind

Groundspeed out = TAS (260 kts) – headwind (35.36 kts) = 224.64 kts
Groundspeed home = TAS (260 kts) + tailwind (35.36 kts) = 295.36 kts

Inserting these figures into the equation gives:

PSR = (EH / (O + H) = (1 hour x 295.36) / (224.64 kts + 295.36 kts)

PSR = 0.568 hours

Multiplying this time by the groundspeed out (224.64 kts) gives a distance of 127.59 nm or approximately 128 nm (option b).

PSR & PET 32 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting the data given in the question gives:

PSR = (8 hours x 450 nm/h) / (390 nm/h + 450 nm/h) = 4.29 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 390 nm/h x 4.29 h = 1671 nm (option a).

PSR & PET 33 d.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1200 nm

Outward groundspeed = (TAS – headwind) = (480 kts – 20 kts) = 460 kts.

Homebound groundspeed = (TAS + tailwind) = (480 kts + 40 kts) = 520 kts

Inserting these figures into the equation gives:

PET = (1200 nm x 520 nm/h) / (480 nm/h + 520 nm/h) = 624 nm (option d).

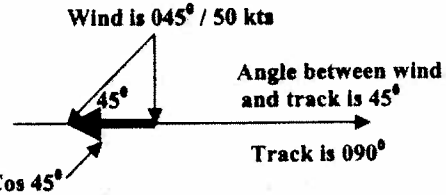
PSR & PET 34 a.
This type of problem can be solved using the standard equation:

PSR = (EH / (O + H) where:

PSR is the time to the point of safe return or maximum distance out from start, E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Outward groundspeed = (TAS – headwind) and the homebound groundspeed = (TAS + tailwind). So to solve this problem it is necessary to calculate the head or tailwind component. This can be done using the CRP5 or as indicated below.

The track is 090° and the wind direction is 045° so the angle between the track and the wind is 45° as indicated in the diagram at the right.



The along track wind is 50 kts x Cos 45°
So outbound wind is 50 kts x Cos 45° = 35.36 kts headwind
And homebound wind is 35.36 kts tailwind

Groundspeed out = TAS (380 kts) – headwind (35.36 kts) = 344.64 kts
Groundspeed home = TAS (380 kts) + tailwind (35.36 kts) = 415.36 kts

Inserting these figures into the equation gives:

PSR = (EH / (O + H) = (1 hour x 415.36) / (344.64 kts + 415.36 kts)

PSR = 0.546 hours

Multiplying this time by the groundspeed out (344.64 kts) gives a distance of 188.4 nm (option a).

PSR & PET 35 b.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PET = (2400 nm x 480 nm/h) / (365 nm/h + 480 nm/h) = 1363 nm.

The time taken to reach this point can be found using the equation:

Time = distance / groundspeed = 1363 nm / 365 nm/h = 3.74 hours or 224 minutes (option b).

PSR & PET 36 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 480 nm/h) / (400 nm/h + 480 nm/h) = 4.64 hours.

Multiplying this by 60 gives a time of 278 (option a).

PSR & PET 37 d.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2900 nm

Outward groundspeed = (TAS + tailwind) = (480 kts +55 kts) = 535 kts.

Homebound groundspeed = (TAS - headwind) = (480 kts -75 kts) = 405 kts

Inserting these figures into the equation gives:

PET = (2900 nm x 405 nm/h) / (535 nm/h + 405 nm/h) = 1249 nm.

The time taken to fly this distance can be found using the equation:

Time taken = distance / groundspeed = 1249 nm / 535 kts = 2.34 hours which is 2 h 20 minutes.

Adding this figure to the time at point A = 1700 + 2 h 20 min = 1920 (option d)

PSR & PET 38 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (490 kts + 55 kts tailwind) = 545 kts.

The homebound groundspeed is (490 kts -75 kts headwind) = 415 kts.

The stated endurance is 9.5 hours.

Inserting these figures into the equation gives:

PSR = (9.5 hours x 415 nm/h) / (545 nm/h + 415 nm/h) = 4.11 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 545 nm/h x 4.11 h = 2238 nm (option b).

PSR & PET 39 a.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2700 nm

Inserting these figures into the equation gives:

PET = (2700 nm x 500 nm/h) / (450 nm/h + 500 nm/h) = 1421 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1421 nm / 450 kts = 3.16 hours or 189 minutes (option a).

PSR & PET 40 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 500 nm/h) / (480 nm/h + 500 nm/h) = 4.34 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 480 nm/h x 4.34 h = 2081 nm (option b).

PSR & PET 41 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (550 kts – 90 kts headwind) = 460 kts.

The homebound groundspeed is (550 kts + 75 kts tailwind) = 625 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:
PSR = (10 hours x 625 nm/h) / (460 nm/h + 625 nm/h) = 5.76 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 460 nm/h x 5.76 h = 2650 nm (option b).

PSR & PET 42 a.
This type of problem can be solved using the standard equation below to find the distance to PSR then subtracting this from the distance to point B:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2450 nm

Inserting these figures into the equation gives:

PET = (2450 nm x 385 nm/h) / (450 nm/h + 385 nm/h) = 1130 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1130 nm / 450 kts = 2.51 hours or 151 min (option a).

PSR & PET 43 d.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

7 hours 20 minutes is 7.33 hours

Inserting these figures into the equation gives:

PSR = (7.33 hours x 365 nm/h) / (430 nm/h + 365 nm/h) = 3.37 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 365 nm/h x 3.37 h = 1228 nm (option d).

PSR & PET 44 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9 hours x 385 nm/h) / (450 nm/h + 385 nm/h) = 4.15 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 450 nm/h x 4.15 h = 1867 nm (option c).

PSR & PET 45 d.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1760 nm

Inserting these figures into the equation gives:

PET = (1760 nm x 370 nm/h) / (450 nm/h + 370 nm/h) = 794 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 794 nm / 450 kts = 1.76 hour or 106 mins (option d).

PSR & PET 46 b.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 3600 nm

Inserting these figures into the equation gives:

PET = (3600 nm x 300 nm/h) / (395 nm/h + 300 nm/h) = 1554 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1554 nm / 395 kts = 3.93 hours or 236 mins (option b).

PSR & PET 47 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (7 hours x 470 nm/h) / (400 nm/h + 470 nm/h) = 3.78 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 400 nm/h x 3.78 h = 1513 nm (option a).

PSR & PET 48 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9 hours x 485 nm/h) / (400 nm/h + 485 nm/h) = 4.93 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 400 nm/h x 4.93 h = 1973 nm (option c).

PSR & PET 49 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (6 hours x 585 nm/h) / (500 nm/h + 585 nm/h) = 3.24 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 500 nm/h x 3.24 h = 1618 nm (option b).

PSR & PET 50 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9.5 hours x 450 nm/h) / (500 nm/h + 450 nm/h) = 4.5 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 500 nm/h x 4.5 h = 2250 nm (option a).

PSR & PET 51 a.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (350 kts – 50 kts headwind) = 300 kts.

The homebound groundspeed is (350 kts + 50 kts tailwind) = 400 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 400 nm/h) / (300 nm/h + 400 nm/h) = 5.71 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 300 nm/h x 5.71 h = 1713 nm (option a).

PSR & PET 52 d.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The endurance of 9 hours and 30 minutes is equal to 570 minutes

Inserting these figures into the equation gives:

PSR = (570 min x 480 nm/h) / (375 nm/h + 480 nm/h) = 320 minutes (option d).

It should be noted that the distance between A and B is not relevant to the solution of this problem.

PSR & PET 53 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (450 kts – 80 kts headwind) = 370 kts.

The homebound groundspeed is (450 kts + 75 kts tailwind) = 525 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 525 nm/h) / (370 nm/h + 525 nm/h) = 5.87 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 370 nm/h x 5.87 h = 2170 nm (option c).

PSR & PET 54 a.
This type of problem can be solved using the standard equation below to find the distance to PSR then subtracting this from the distance to point B:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 560 nm

Outward groundspeed = (TAS – headwind) = (200 kts – 15 kts) = 185 kts.

Homebound groundspeed = (TAS + tailwind) = (200 kts + 15 kts) = 215 kts

Inserting these figures into the equation gives:

PET = (560 nm x 215 nm/h) / (185 nm/h + 215 nm/h) = 301 nm.

The distance from PET to point B is distance from A to B (560 nm) - PET (301 nm) = 259 nm, (option a).

PSR & PET 55 d.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 500 nm

Outward groundspeed = (TAS – headwind) = (375 kts – 60 kts) = 315 kts.

Homebound groundspeed = (TAS + tailwind) = (375 kts + 60 kts) = 435 kts

Inserting these figures into the equation gives:

PET = (500 nm x 435 nm/h) / (315 nm/h + 435 nm/h) = 290 nm (option d).

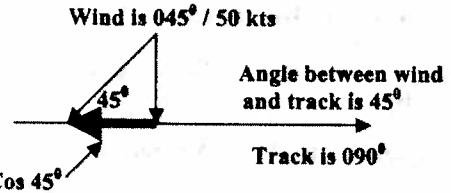
PSR & PET 56 b.
This type of problem can be solved using the standard equation:

PSR = (EH / (O + H) where:

PSR is the time to the point of safe return or maximum distance out from start, E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Outward groundspeed = (TAS – headwind) and the homebound groundspeed = (TAS + tailwind). So to solve this problem it is necessary to calculate the head or tailwind component. This can be done using the CRP5 or as indicated below.

The track is 090° and the wind direction is 045° so the angle between the track and the wind is 45° as indicated in the diagram at the right.



The along track wind is 50 kts x Cos 45°
So outbound wind is 50 kts x Cos 45° = 35.36 kts headwind
And homebound wind is 35.36 kts tailwind

Groundspeed out = TAS (280 kts) – headwind (35.36 kts) = 244.64 kts
Groundspeed home = TAS (280 kts) + tailwind (35.36 kts) = 315.36 kts

Inserting these figures into the equation gives:

PSR = (EH / (O + H) = (1 hour x 315.36) / (244.64 kts + 315.36 kts)

PSR = 0.563 hours

Multiplying this time by the groundspeed out (244.64 kts) gives a distance of 137.77 nm or approximately 138 nm (option b).

PSR & PET 57 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting the data given in the question gives:

PSR = (8 hours x 475 nm/h) / (375 nm/h + 475 nm/h) = 4.47 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 375 nm/h x 4.47 h = 1676 nm (option a).

PSR & PET 58 d.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1500 nm

Outward groundspeed = (TAS – headwind) = (490 kts – 20 kts) = 470 kts.

Homebound groundspeed = (TAS + tailwind) = (490 kts + 40 kts) = 530 kts

Inserting these figures into the equation gives:

PET = (1500 nm x 530 nm/h) / (470 nm/h + 530 nm/h) = 795 nm (option d).

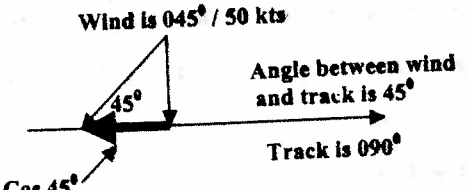
PSR & PET 59 a.
This type of problem can be solved using the standard equation:

PSR = (EH / (O + H) where:

PSR is the time to the point of safe return or maximum distance out from start, E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Outward groundspeed = (TAS – headwind) and the homebound groundspeed = (TAS + tailwind). So to solve this problem it is necessary to calculate the head or tailwind component. This can be done using the CRP5 or as indicated below.

The track is 090° and the wind direction is 045° so the angle between the track and the wind is 45° as indicated in the diagram at the right.



The along track wind is 50 kts x Cos 45°
So outbound wind is 50 kts x Cos 45° = 35.36 kts headwind
And homebound wind is 35.36 kts tailwind

Groundspeed out = TAS (250 kts) – headwind (35.36 kts) = 214.64 kts
Groundspeed home = TAS (250 kts) + tailwind (35.36 kts) = 285.36 kts

Inserting these figures into the equation gives:

PSR = (EH / (O + H) = (1 hour x 285.36) / (214.64 kts + 285.36 kts)

PSR = 0.571 hours

Multiplying this time by the groundspeed out (214.64 kts) gives a distance of 122.5 nm or approximately 123 nm (option a).

PSR & PET 60 b.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PET = (2500 nm x 485 nm/h) / (375 nm/h + 485 nm/h) = 1410 nm.

The time taken to reach this point can be found using the equation:

Time = distance / groundspeed = 1410 nm / 375 nm/h = 3.76 hours or 226 minutes (option b).

PSR & PET 61 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 480 nm/h) / (365 nm/h + 480 nm/h) = 4.82 hours.

Multiplying this by 60 gives a time of 289 or approximately 290 minutes (option a).

PSR & PET 62 d.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2750 nm

Outward groundspeed = (TAS + tailwind) = (470 kts +55 kts) = 525 kts.

Homebound groundspeed = (TAS - headwind) = (470 kts -75 kts) = 395 kts

Inserting these figures into the equation gives:

PET = (2750 nm x 395 nm/h) / (525 nm/h + 395 nm/h) = 1181 nm.

The time taken to fly this distance can be found using the equation:

Time taken = distance = groundspeed = 1181 nm / 525 kts = 2.25 hours which is 2 h 15 minutes.

Adding this figure to the time at point A = 1735 + 2 h 15 min = 1950 (option d)

PSR & PET 63 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (470 kts + 55 kts tailwind) = 525 kts.

The homebound groundspeed is (470 kts -75 kts headwind) = 395 kts.

The stated endurance is 9.5 hours.

Inserting these figures into the equation gives:

PSR = (9.5 hours x 395 nm/h) / (525 nm/h + 395 nm/h) = 4.08 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 525 nm/h x 4.08 h = 2141 nm (option b).

PSR & PET 64 a.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2750 nm

Inserting these figures into the equation gives:

PET = (2750 nm x 500 nm/h) / (420 nm/h + 500 nm/h) = 1495 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1495 nm / 420 kts = 3.56 hours or 213.5 minutes (option a).

PSR & PET 65 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 500 nm/h) / (450 nm/h + 500 nm/h) = 4.47 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 450 nm/h x 4.47 h = 2012 nm (option b).

PSR & PET 66 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (480 kts – 90 kts headwind) = 390 kts.

The homebound groundspeed is (480 kts + 75 kts tailwind) = 555 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:
PSR = (10 hours x 555 nm/h) / (390 nm/h + 555 nm/h) = 5.87 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 390 nm/h x 5.87 h = 2290 nm (option b).

PSR & PET 67 a.
This type of problem can be solved using the standard equation below to find the distance to PSR then subtracting this from the distance to point B:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1950 nm

Inserting these figures into the equation gives:

PET = (1950 nm x 385 nm/h) / (450 nm/h + 385 nm/h) = 899 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 899 nm / 450 kts = 1.998 hours or 120 min (option a).

PSR & PET 68 d.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

7 hours 20 minutes is 7.33 hours

Inserting these figures into the equation gives:

PSR = (7.33 hours x 385 nm/h) / (400 nm/h + 385 nm/h) = 3.59 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 385 nm/h x 3.74 h = 1438 nm (option d).

PSR & 6ET 69 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9 hours x 385 nm/h) / (455 nm/h + 385 nm/h) = 4.125 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 455 nm/h x 4.125 h = 1877 nm (option c).

PSR & PET 70 d.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1760 nm

Inserting these figures into the equation gives:

PET = (1760 nm x 365 nm/h) / (475 nm/h + 365 nm/h) = 765 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 765 nm / 475 kts = 1.61hour or 97 mins (option d).

PSR & PET 71 b.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 3623 nm

Inserting these figures into the equation gives:

PET = (3623 nm x 330 nm/h) / (390 nm/h + 330 nm/h) = 1660 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1660 nm / 390 kts = 4.26 hours or 255 mins (option b).

PSR & PET 72 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (7 hours x 350 nm/h) / (420 nm/h + 350 nm/h) = 3.18 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 420 nm/h x 3.18 h = 1336 nm (option a).

PSR & PET 73 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9 hours x 465 nm/h) / (495 nm/h + 465 nm/h) = 4.36 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 495 nm/h x 4.36 h = 2157 nm (option c).

PSR & PET 74 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (6 hours x 595 nm/h) / (535 nm/h + 595 nm/h) = 3.16 hours.

Distance to PSR = time to PSR x outbound groundspeed.
Inserting the data above gives distance to PSR = 535 nm/h x 3.16 h = 1690 nm (option b).

PSR & PET 75 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9.5 hours x 450 nm/h) / (500 nm/h + 450 nm/h) = 4.5 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 500 nm/h x 4.5 h = 2250 nm (option a).

PSR & PET 76 a.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (375 kts – 50 kts headwind) = 325 kts.

The homebound groundspeed is (375 kts + 50 kts tailwind) = 425 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 425 nm/h) / (325 nm/h + 425 nm/h) = 5.67 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 325 nm/h x 5.67 h = 1842 nm (option a).

PSR & PET 77 d.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The endurance of 8 hours and 30 minutes is equal to 510 minutes

Inserting these figures into the equation gives:

PSR = (510 min x 430 nm/h) / (380 nm/h + 430 nm/h) = 270.74 or approximately 271 minutes (option d).

PSR & PET 78 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (435 kts – 90 kts headwind) = 345 kts.

The homebound groundspeed is (435 kts + 75 kts tailwind) = 510 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 510 nm/h) / (345 nm/h + 510 nm/h) = 5.96 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 345 nm/h x 5.96 h = 2057.9 nm or approximately 2058 nm (option a).

PSR & PET 79 a.
This type of problem can be solved using the standard equation below to find the distance to PSR then subtracting this from the distance to point B:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 650 nm

Outward groundspeed = (TAS – headwind) = (320 kts – 15 kts) = 305 kts.

Homebound groundspeed = (TAS + tailwind) = (320 kts + 15 kts) = 335 kts

Inserting these figures into the equation gives:

PET = (650 nm x 335 nm/h) / (305 nm/h + 335 nm/h) = 340 nm.

The distance from PET to point B is distance from A to B (650 nm) - PET (341 nm) = 309 nm, (option a).

PSR & PET 80 d.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 800 nm

Outward groundspeed = (TAS – headwind) = (475 kts – 60 kts) = 415 kts.

Homebound groundspeed = (TAS + tailwind) = (475 kts + 60 kts) = 535 kts

Inserting these figures into the equation gives:

PET = (800 nm x 535 nm/h) / (415 nm/h + 535 nm/h) = 451 nm (option d).

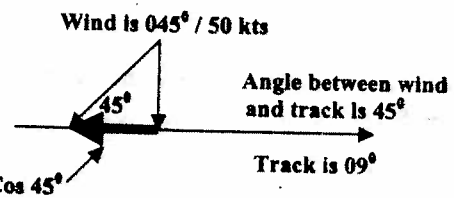
PSR & PET 81 c.
This type of problem can be solved using the standard equation:

PSR = (EH / (O + H) where:

PSR is the time to the point of safe return or maximum distance out from start, E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Outward groundspeed = (TAS – headwind) and the homebound groundspeed = (TAS + tailwind). So to solve this problem it is necessary to calculate the head or tailwind component. This can be done using the CRP5 or as indicated below.

The track is 09° and the wind direction is 045° so the angle between the track and the wind is 45° as indicated in the diagram at the right.



The along track wind is 50 kts x Cos 45°
So outbound wind is 50 kts x Cos 450 = 35.36 kts headwind
And homebound wind is 35.36 kts tailwind

Groundspeed out = TAS (350 kts) – head wind (35.36 kts) = 314.64 kts
Groundspeed home = TAS (350 kts) + tailwind (35.36 kts) = 385.36 kts

Inserting these figures into the equation gives:

PSR = (EH / (O + H) = (1 hour x 385.36) / (314.64 kts + 385.36 kts)

PSR = 0.55 hours

Multiplying this time by the groundspeed out (314.64 kts) gives a distance of 173.21 nm or approximately 173 nm (option b).

PSR & PET 82 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting the data given in the question gives:

PSR = (8 hours x 435 nm/h) / (365 nm/h + 435 nm/h) = 4.35 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 365 nm/h x 4.35 h = 1588 nm (option a).

PSR & PET 83 d.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1300 nm

Outward groundspeed = (TAS – headwind) = (485 kts – 20 kts) = 465 kts.

Homebound groundspeed = (TAS + tailwind) = (485 kts + 40 kts) = 525 kts

Inserting these figures into the equation gives:

PET = (1300 nm x 525 nm/h) / (485 nm/h + 525 nm/h) = 676 nm (option d).

PSR & PET 84 a.
This type of problem can be solved using the standard equation:

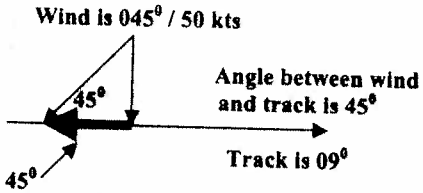
PSR = (EH / (O + H) where:

PSR is the time to the point of safe return or maximum distance out from start,

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Outward groundspeed = (TAS – headwind) and the homebound groundspeed = (TAS + tailwind). So to solve this problem it is necessary to calculate the head or tailwind component. This can be done using the CRP5 or as indicated below.

The track is 09^0 and the wind direction is 045^0 so the angle between the track and the wind is 45^0 as indicated in the diagram at the right.



The along track wind is 50 kts x Cos 45^0
So outbound wind is 50 kts x Cos 450 = 35.36 kts headwind
And homebound wind is 35.36 kts tailwind

Groundspeed out = TAS (345 kts) – headwind (35.36 kts) = 309.64 kts
Groundspeed home = TAS (345 kts) + tailwind (35.36 kts) = 380.36 kts

Inserting these figures into the equation gives:

PSR = (EH / (O + H) = (1 hour x 380.36) / (309.64 kts + 380.36 kts)

PSR = 0.551 hours

Multiplying this time by the groundspeed out (170.68 kts) gives a distance of 171 nm (option a).

PSR & PET 85 b.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PET = (2600 nm x 480 nm/h) / (395 nm/h + 480 nm/h) = 1426 nm.

The time taken to reach this point can be found using the equation:

Time = distance / groundspeed = 1426 nm / 395 nm/h = 3.61 hours or 217 minutes (option b).

PSR & PET 86 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 480 nm/h) / (420 nm/h + 480 nm/h) = 4.53 hours.

Multiplying this by 60 gives a time of 272 (option a).

PSR & PET 87 d.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2900 nm

Outward groundspeed = (TAS + tailwind) = (450 kts +55 kts) = 505 kts.

Homebound groundspeed = (TAS - headwind) = (450 kts -75 kts) = 375 kts

Inserting these figures into the equation gives:

PET = (2900 nm x 375 nm/h) / (505 nm/h + 375 nm/h) = 1236 nm.

The time taken to fly this distance can be found using the equation:

Time taken = distance / groundspeed = 1236 nm / 505 kts = 2.45 hours which is 2 h 27 minutes.

Adding this figure to the time at point A = 1600 + 2 h 27 min = 1827 (option d)

PSR & PET 88 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (390 kts + 55 kts tailwind) = 445 kts.

The homebound groundspeed is (390 kts -75 kts headwind) = 315 kts.

The stated endurance is 9.5 hours.

Inserting these figures into the equation gives:

PSR = (9.5 hours x 315 nm/h) / (445 nm/h + 315 nm/h) = 3.94 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 3.94 h x 445 nm/h = 1752 nm (option b).

PSR & PET 89 a,
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2700 nm

Inserting these figures into the equation gives:

PET = (2700 nm x 515 nm/h) / (465 nm/h + 515 nm/h) = 1419 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1419 nm / 465 kts = 3.05 hours or 183 minutes (option a).

PSR & PET 90 b,
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 475 nm/h) / (380 nm/h + 475 nm/h) = 4.72 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 380 nm/h x 4.72 h = 1794 nm (option b).

PSR & PET 91 b,
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (525 kts – 90 kts headwind) = 435 kts.

The homebound groundspeed is (525 kts + 75 kts tailwind) = 600 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:
PSR = (10 hours x 600 nm/h) / (435 nm/h + 600 nm/h) = 5.797 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 435 nm/h x 5.797 h = 2522 nm (option b).

PSR & PET 92 a,
This type of problem can be solved using the standard equation below to find the distance to PSR then subtracting this from the distance to point B:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 2450 nm

Inserting these figures into the equation gives:

PET = (2450 nm x 385 nm/h) / (350 nm/h + 385 nm/h) = 1283 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1283 nm / 350 kts = 3.67 hours or 220 min (option a).

PSR & PET 93 d,
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

7 hours 20 minutes is 7.33 hours

Inserting these figures into the equation gives:

PSR = (7.33 hours x 375 nm/h) / (440 nm/h + 375 nm/h) = 3.38 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 440 nm/h x 3.38 h = 1484 nm (option d).

PSR & PET 94 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9 hours x 385 nm/h) / (465 nm/h + 385 nm/h) = 4.08 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 465 nm/h x 4.08 h = 1896 nm (option c).

PSR & PET 45 d.
This type of problem can be solved using the standard equation below:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 1760 nm

Inserting these figures into the equation gives:

PET = (1760 nm x 360 nm/h) / (450 nm/h + 360 nm/h) = 782 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 782 nm / 450 kts = 1.74 hour or 104 mins (option d).

PSR & PET 96 b.
This type of problem can be solved using the standard equation:

PET = DH / (O + H) where:

D = distance of total leg, H = homebound groundspeed, O = outbound groundspeed.

The distance of total leg is 3600 nm

Inserting these figures into the equation gives:

PET = (3600 nm x 400 nm/h) / (378 nm/h + 400 nm/h) = 1851 nm.

The time taken to reach this point can be calculated using the equation:

Time taken = distance / groundspeed out = 1851 nm / 378 kts = 3.897 hours or 294 mins (option b).

PSR & PET 97 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (7 hours x 470 nm/h) / (380 nm/h + 470 nm/h) = 3.87 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 380 nm/h x 3.87 h = 1471 nm (option a).

PSR & PET 98 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (9 hours x 485 nm/h) / (436 nm/h + 485 nm/h) = 4.74 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 436 nm/h x 4.74 h = 2066 nm (option c).

PSR & PET 99 a.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (300 kts – 20 kts headwind) = 280 kts.

The homebound groundspeed is (300 kts + 20 kts tailwind) = 320 kts.

The stated endurance is 4 hours.

Inserting these figures into the equation gives:

PSR = (4 hours x 320 nm/h) / (280 nm/h + 320 nm/h) = 2.13 hours (option a).

PSR & PET 100 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (6 hours x 585 nm/h) / (535 nm/h + 585 nm/h) = 3.13 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 535 nm/h x 3.13 h = 1677 nm (option b).

PSR & PET 101 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (6.5 hours x 480 nm/h) / (370 nm/h + 480 nm/h) = 3.67 hours.

Multiplying this by 60 gives a time of 220 (option a).

PSR & PET 102 b.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (300 kts – 50 kts headwind) = 250 kts.

The homebound groundspeed is (300 kts + 50 kts tailwind) = 350 kts.

The stated endurance is 4 hours.

Inserting these figures into the equation gives:

PSR = (4 hours x 350 nm/h) / (250 nm/h + 350 nm/h) = 52333 hours (option b).

PSR & PET 103 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 400 nm/h) / (420 nm/h + 400 nm/h) = 4.15 hours.

Multiplying this by 60 gives a time of 249 (option b).

PSR & PET 104 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:
PSR = (9.5 hours x 400 nm/h) / (550 nm/h + 400 nm/h) = 4.0 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 550 nm/h x 4.0 h = 2200 nm (option a).

PSR & PET 105 c.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 380 nm/h) / (400 nm/h + 380 nm/h) = 4.14 hours.

Multiplying this by 60 gives a time of 249 (option c).

PSR & PET 106 d.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (300 kts – 30 kts headwind) = 270 kts.

The homebound groundspeed is (300 kts + 30 kts tailwind) = 330 kts.

The stated endurance is 5 hours.

Inserting these figures into the equation gives:

PSR = (5 hours x 330 nm/h) / (270 nm/h + 330 nm/h) = 2.75 hours (option d).

PSR & PET 107 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (3.5 hours x 480 nm/h) / (420 nm/h + 480 nm/h) = 1.87 hours.

Multiplying this by 60 gives a time of 112 (option a).

PSR & PET 108 a.
The wording of this question is curious in that "point of safe endurance" is not a

standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (300 kts – 30 kts headwind) = 270 kts.

The homebound groundspeed is (300 kts + 30 kts tailwind) = 330 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 330 nm/h) / (330 nm/h + 270 nm/h) = 5.5 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 270 nm/h x 5.5 h = 1485 nm (option a).

PSR & PET 109 d.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (3.5 hours x 280 nm/h) / (220 nm/h + 280 nm/h) = 1.96 hours.

Multiplying this by 60 gives a time of 118 (option d).

PSR & PET 110 a.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (200 kts – 45 kts headwind) = 155 kts.

The homebound groundspeed is (200 kts + 45 kts tailwind) = 245 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 245 nm/h) / (155 nm/h + 245 nm/h) = 6.125 hours (option a).

PSR & PET 111 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (10.5 hours x 180 nm/h) / (120 nm/h + 180 nm/h) = 6.3 hours.

Multiplying this by 60 gives a time of 378 (option a).

PSR & PET 112 b.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (350 kts – 50 kts headwind) = 300 kts.

The homebound groundspeed is (350 kts + 50 kts tailwind) = 400 kts.
The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 400 nm/h) / (300 nm/h + 400 nm/h) = 5.71 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 300 nm/h x 5.71 h = 1714 nm (option b).

PSR & PET 113 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 180 nm/h) / (190 nm/h + 180 nm/h) = 4.14 hours.

Multiplying this by 60 gives a time of 248 (option a).

PSR & PET 114 a.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (300 kts – 65 kts headwind) = 235 kts.

The homebound groundspeed is (300 kts + 65 kts tailwind) = 365 kts.

The stated endurance is 7 hours.

Inserting these figures into the equation gives:

PSR = (7 hours x 365 nm/h) / (235 nm/h + 365 nm/h) = 4.26 hours (option b).

PSR & PET 115 a.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (6.5 hours x 130 nm/h) / (120 nm/h + 130 nm/h) = 3.38 hours.

Multiplying this by 60 gives a time of 203 (option a).

PSR & PET 116 c.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (300 kts + 50 kts headwind) = 350 kts.

The homebound groundspeed is (300 kts - 50 kts tailwind) = 250 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 250 nm/h) / (350 nm/h + 250 nm/h) = 4.17 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 350 nm/h x 4.17 h = 1458 nm (option c).

PSR & PET 117 c,

This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (8.5 hours x 250 nm/h) / (220 nm/h + 250 nm/h) = 4.52 hours.

Multiplying this by 60 gives a time of 271 (option c).

PSR & PET 118 a,

The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (100 kts – 20 kts headwind) = 80 kts.

The homebound groundspeed is (100 kts + 20 kts tailwind) = 120 kts.

The stated endurance is 5 hours.

Inserting these figures into the equation gives:

PSR = (5 hours x 120 nm/h) / (80 nm/h + 120 nm/h) = 3 hours (option a).

PSR & PET 119 a,

This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (5.5 hours x 110 nm/h) / (95 nm/h + 110 nm/h) = 2.95 hours.

Multiplying this by 60 gives a time of 177 (option a).

PSR & PET 120 a,

The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (200 kts – 15 kts headwind) = 185 kts.

The homebound groundspeed is (200 kts + 15 kts tailwind) = 215 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:
PSR = (10 hours x 215 nm/h) / (185 nm/h + 215 nm/h) = 5.375 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 185 nm/h x 5.375 h = 994 nm (option a).

PSR & PET 121 a,

The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (300 kts – 20 kts headwind) = 280 kts.

The homebound groundspeed is (300 kts + 20 kts tailwind) = 320 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 320 nm/h) / (280 nm/h + 320 nm/h) = 5.333 hours (option a).

PSR & PET 122 d.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (300 kts – 20 kts headwind) = 280 kts.

The homebound groundspeed is (300 kts + 20 kts tailwind) = 320 kts.

The stated endurance is 6 hours.

Inserting these figures into the equation gives:

PSR = (6 hours x 320 nm/h) / (280 nm/h + 320 nm/h) = 3.2 hours (option d).

PSR & PET 123 b.
This type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

Inserting these figures into the equation gives:

PSR = (3.5 hours x 80 nm/h) / (82 nm/h + 80 nm/h) = 1.88 hours.

Multiplying this by 60 gives a time of 113 (option b).

PSR & PET 124 a.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (200 kts – 85 kts headwind) = 115 kts.

The homebound groundspeed is (200 kts + 85 kts tailwind) = 285 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 285 nm/h) / (115 nm/h + 285 nm/h) = 7.125 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 115 nm/h x 7.125 h = 819 nm (option a).

PSR & PET 125 d.
The wording of this question is curious in that "point of safe endurance" is not a standard term If however it is taken to mean the "point of safe return" or PSR then this type of problem can be solved using the standard equation:

PSR = EH / (O + H) where:

E = endurance, H = homebound groundspeed, O = outbound groundspeed.

The outbound groundspeed (400 kts – 75 kts headwind) = 325 kts.

The homebound groundspeed is (400 kts + 75 kts tailwind) = 475 kts.

The stated endurance is 10 hours.

Inserting these figures into the equation gives:

PSR = (10 hours x 475 nm/h) / (325 nm/h + 475 nm/h) = 5.94 hours.

Distance to PSR = time to PSR x outbound groundspeed.

Inserting the data above gives distance to PSR = 325 nm/h x 5.94 h = 1930 nm (option a).

SCALE 1 a.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that two meridians 5^0 apart at 60^0N are represented by 8 cm on the chart .

This means that the chart distance is 8 cm and the earth distance is the departure between these two meridians at 60°N. The departure equation states that:

Departure (in nm) = change in longitude (in min) x cos of latitude

So in this case departure = (5° x 60) x cos 60 = 150 nm

So the chart distance is 8 cm and the earth distance is 150 nm

Inserting these values into the scale equation gives:

Scale = 8 cm / 150 nm

Dividing by 8 gives scale = 1 cm / 18.75 nm

But both distances in the equation must be stated in the same units, so the 18.75 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 18.75 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

18.75 nm = 18.75 x 1852 x 100 = 3 472 500

This means that scale = 1 : 3 472 500 or approximately 1 : 3 500 000 (option a).

SCALE 2 b.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that two meridians 5° apart at 37°N are represented by 9 cm on the chart.

This means that the chart distance is 9 cm and the earth distance is the departure between these two meridians at 37°N. The departure equation states that:

Departure (in nm) = change in longitude (in min) x cos of latitude

So in this case departure = (5° x 60) x cos 37 = 239.6 nm

So the chart distance is 9 cm and the earth distance is 239.6 nm

Inserting these values into the scale equation gives:

Scale = 9 cm / 239.6 nm

Dividing by 9 gives scale = 1 cm / 26.62 nm

But both distances in the equation must be stated in the same units, so the 26.62 nm must now be converted in cm. This can be done by noting that 1 nm = 1852

m and 1 m = 100 cm. So 26.62 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

26.62 nm = 26.62 x 1852 x 100 = 4 930 243

This means that scale = 1 : 4 930 024 or approximately 1 : 5 000 000 (option b).

SCALE 3 c.
This type of problem can be solved using the standard scale conversion equation:

D_A / D_B = Cos A / Cos B

Where: A is the initial latitude (00°) at the Equator.
B is the new latitude (60° S)
D_A is the denominator of scale at A
D_B is the denominator of scale at B

This equation can be rearranged to give $D_B = (D_A \times \text{Cos B}) / \text{Cos A}$

Inserting the data provided in the question gives:

D_B (at 60° S) = (3 704 000 x Cos 60°) / Cos 00° S

Which is D_B (at 60° S) = (3 704 000 x 0.5) / 1 = 1 852 000

Which is Scale at 60° S = 1 : 1 852 000 (option c).

SCALE 4 a.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that 4.63 cm on the chart represents 150 nm on the earth. So the chart distance is 4.63cm and the earth distance is 150 nm.

Scale = 4.63 cm / 150 nm

Dividing by 4.63 gives scale = 1 cm / 32.39 nm
But both distances in the equation must be stated in the same units, so the 32.39 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 32.39 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

32.39 nm = 32.39 x 1852 x 100 = 5 998 628

This means that scale = 1 : 5 998 628 or approximately 1 : 6 000 000 (option a).

SCALE 5 d.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that 7 cm on the chart represents 49 nm on the earth. So the chart distance is 7 cm and the earth distance is 49 nm.

Scale = 7 cm / 49 nm

Dividing by 7 gives scale = 1 cm / 7 nm

But both distances in the equation must be stated in the same units, so the 7 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 7 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

7 nm = 7 x 1852 x 100 = 1 296 400

This means that scale = 1 : 1 296 400 or approximately 1 : 1 300 000 (option d).

SCALE 6. a.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 45° N, and Distance at A = 70 nm
And B = 30° N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (70 nm x Cos 30°) / Cos 45° = 85.73 nm or approximately 86 nm (option a).

SCALE 7 d.
This type of problem can be solved using the standard scale conversion equation:

D_A / D_B = Cos A / Cos B

Where: A is the initial latitude (60°)
B is the new latitude (00° S)
D_A is the denominator of scale at A

D_B is the denominator of scale at B

This equation can be rearranged to give $D_B = (D_A \times \text{Cos B}) / \text{Cos A}$

Inserting the data provided in the question gives:

D_B (at 00° S) = (3 000 000 x Cos 00°) / Cos 60° S

Which is D_B (at 00° S) = (3 000 000 x 1) / 0.5 = 6 000 000

Which is Scale at 60° S = 1 : 6 000 000 (option d).

SCALE 8 a.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / earth distance.

This can be rearranged to give: Chart distance = Scale factor x Earth distance

At the equator each 1 min of longitude is equal to a distance of 1 nm. The angle between 179°E and 175°W is 6° which is 360 minutes. So the Earth distance between 179°E and 175°w is 360 nm.

Inserting this and the scale factor into the above equation gives:

Chart distance = 1/5 000 000 x 360 nm = 0.000072 nm

This can be converted into mm by multiplying by 1852000 mm/nm to give:

Chart distance = 0.000072 nm x 1852000 mm/nm = 133.3 mm or approximately 133 mm (option a).

SCALE 9 b.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

The earth distance can be calculated using the departure equation:

Departure in nm = Change in longitude (in min) x Cos latitude

The change in longitude between the two meridians in this question 10° or 600 min.

Inserting this and the given latitude into the equation gives:

Departure at 47°N = 600 x Cos 47° = 409.2 nm

This can be converted into inches by multiplying by 72960 in/nm to give 29 855 232 inches

Inserting this into the scale equation gives:

Scale factor = 5 inches / 29 855 232 = 1 : 5 971 046 or approximately 1 : 6 000 000 (option b).

SCALE 10 a.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 12 cm / (1/2000000) = 24 000 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 129.6 nm or approximately 130 nm (option a).

SCALE 11 a.
This type of problem can be solved using the equation:

Scale factor = Chart distance / Earth distance

The problem can be simplified by noting that on a Mercator chart, the lines of longitude are parallel, so the chart distance is the same at all latitudes.

The Earth distance at 30^0 can be calculated using the departure equation:

Departure in nm = change of longitude in min x cos latitude

A full circle of the earth is 360^0 which is 360^0 x 60 = 21600 min

So at 30^0N this would be a departure of 21600 x cos 30^0 = 18706.15nm

This can be converted into cm by multiplying by the factors 185200 cm/nm to give earth distance at 30^0N 18706.15 x 185200 = 3 464 378 743 cm

Inserting this and the chart distance of 133 cm into the scale equation gives:

Scale factor at 30^0 N = 133 cm / 3 464 378 743 cm which = 1 / 26 047 961 or approximately 1 : 26 000 000 (option a)

SCALE 12 d.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that 4.89 cm on the chart represents 185 nm on the earth. So the chart distance is 4.89cm and the earth distance is 185 nm.

Scale = 4.89 cm / 185 nm

Dividing by 4.89 gives scale = 1 cm / 37.83 nm

But both distances in the equation must be stated in the same units, so the 37.83 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 37.83 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

37.83 nm = 37.83 x 1852 x 100 = 7 006 116

This means that scale = 1 : 7 006 116 or approximately 1 : 7 000 000 (option d).

SCALE 13 a.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 15^0 N, and Distance at A = 120 nm
And B = 10^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (120 nm x Cos 10^0) / Cos 15^0 = 122.35 nm or approximately 122.3 nm (option a).

SCALE 14 b.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 45^{0} N, and Distance at A = 90 nm
And B = 30^{0} N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (90 nm x Cos 30^{0}) / Cos 45^{0} = 110.2 nm or approximately 110 nm (option b).

SCALE 15 a.
This type of problem can be solved using the standard scale equation:

Scale factor = Chart length / Earth length

The second position is due north of the first so they are on the same meridian. The distance in nm between two points on the same meridian is equal to the number of minutes between the two. In this question the positions are 1^{0} or 60 min apart so they are 60 nm apart. So the earth distance is 60 nm

Inserting these figures into the equation gives:

Scale factor = 6 cm / 60 nm

But the figures in the equation must be in the same units so 60 nm can be converted into nm by multiplying by 185200 cm/nm to give an earth distance of 11 112 000 cm

So scale factor = 6 cm / 11 112 000 cm = 1 852 000.

This means that the scale of the chart is 1 : 1 852 000 or approximately 1 : 1 850 000 (option a).

SCALE 16 a.
This type of problem can be solved using the standard scale equation:

Scale factor = Chart length / Earth length

This can be rearranged to give: Earth length = chart length / Scale factor

The questions specifies a scale of 1 : 1 850 000 which is 1/ 1 850 000

Inserting the data provided in the question gives:

Earth length = 4 cm / (1/ 1 850 000) = 7 400 000 cm

This can be converted into nm by dividing by the conversion factor of 185200 cm/nm to give 39.96 or approximately 40 nm (option a).

SCALE 17 a.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

The earth distance must first be calculated using the departure equation:

Departure = change in longitude (in min) x cos latitude

The change in longitude between W002° and E008° is 10^{0} or 600 min. Inserting this and the given latitude into the equation gives:

Departure = 600 x Cos 60^{0} = 300 nm

This can be converted into cm by multiplying by the conversion factor 185200 cm/nm to give an earth distance of 55 560 000 cm

Inserting this into the scale equation gives:

Scale factor = 20 cm / 55 560 000 cm = 1/2778000

So the scale factor is 1 : 2 778 000 or approximately 1 : 2 780 000 (option a).

SCALE 18 b.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / scale factor

Inserting the data provided in the question gives:

Earth distance = 6 cm / (1/9260000)

This can be converted in nm by dividing by 185200 cm/nm to give:

Earth distance = (6 cm / (1/9260000) / 185200 = 300 nm

The latitude can now be calculated using the departure equation:

Departure = Change in longitude (in min) x Cos latitude

This can be rearranged to give:

Cos latitude = Departure / change in longitude (in min)

The change in longitude specified in the question sis 10^{0} which is 600 min.

Inserting this and the earth distance into the above equation gives:

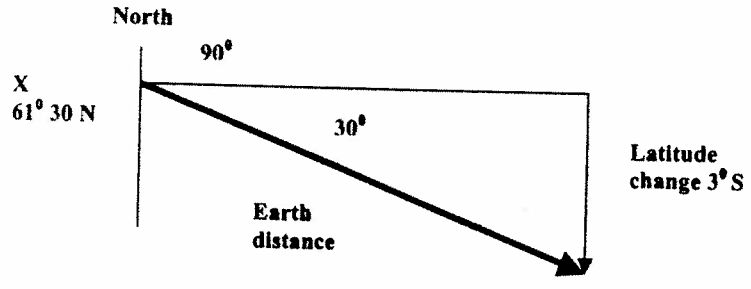
Cos latitude = 300 nm / 600 min = 0.5

This can be converted into an angle of 60^0 so the latitude is 60^0 N or S (option b).

SCALE 19 C.

A straight line on any two points on a Lambert conformal chart may be considered to represent a great circle. This means that the track from X to Y can be considered to be part of a great circle.

Change in latitude between X and Y is X – Y = 61°30'N - 58°30'N = 3^0 S and the course is 1200, so the situation is as illustrated below.



The change of latitude of 3^0 S can be considered to be part of so the distance in nm is equal to the change of latitude in minutes,

So distance south = 3^0 x 60min/deg = 180 nm

So in the triangle above, Sin 30^0 = 180 nm / Earth distance

Rearranging this gives: Earth distance = 180 nm / Sin 30^0 = 360 nm

This earth distance and the chart scale can now be used to calculate the chart distance from the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Chart distance = scale factor x Earth distance
Inserting the figures above gives:

Chart distance = 1/1 000 000 x 360 nm = 360/1 000 000 nm

This can be converted into cm by multiplying by 185200 cm/nm to give 66.7 cm (option c).

SCALE 20 a.

This type of problem can be solved using the standard scale equation:

Scale factor = Chart length / Earth length

This can be rearranged to give: Earth length = chart length / Scale factor

The questions specifies a sacle of 1 : 200 000 which is 1/200 000

Inserting the data provided in the question gives:

Earth length = 11 cm / (1/ 200 000) = 2 200 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 11.88 or approximately 12 nm (option a).

SCALE 21 b.

This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 15 cm / (1/3 000 000) = 45 000 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 242.98 nm or approximately 243 nm (option b).

SCALE 22 a.

This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 20 cm / (1/2 000 000) = 40 000 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 215.98 nm or approximately 216 nm (option a).

SCALE 23 b.

This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 10 cm / (1/5 000 000) = 50 000 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 269.98 nm or approximately 270 nm (option b).

SCALE 24 d.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 35 cm / (1/500 000) = 17 500 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 94.5 nm (option d).

SCALE 25 a.
This type of problem can be solved using the equation:

Scale factor = Chart distance / Earth distance

The problem can be simplified by noting that on a Mercator chart, the lines of longitude are parallel, so the chart distance is the same at all latitudes.

The Earth distance at 30° can be calculated using the departure equation:

Departure in nm = change of longitude in min x cos latitude

A full circle of the earth is 360° which is $360^{\circ} \times 60 = 21600$ min

So at 30°N this would be a departure of 21600 x cos 30° = 18706.15nm

This can be converted into cm by multiplying by the factors 185200 cm/nm to give earth distance at 30°N 18706.15 x 185200 = 3 464 378 743 cm

Inserting this and the chart distance of 140 cm into the scale equation gives:

Scale factor at 30° N = 140 cm / 3 464 378 743 cm = 1 / 24745563 or approximately 1 : 25 000 000 (option a)

SCALE 26 a.
This type of problem can be solved using the equation:

Scale factor = Chart distance / Earth distance

The problem can be simplified by noting that on a Mercator chart, the lines of longitude are parallel, so the chart distance is the same at all latitudes.

The Earth distance at 40° can be calculated using the departure equation:

Departure in nm = change of longitude in min x cos latitude

A full circle of the earth is 360° which is $360^{\circ} \times 60 = 21600$ min

So at 40°N this would be a departure of 21600 x cos 40° = 16546.6 nm

This can be converted into cm by multiplying by the factors 185200 cm/nm to give earth distance at 40°N = 16546.6 x 185200 = 3064422907 cm

Inserting this and the chart distance of 120 cm into the scale equation gives:

Scale factor at 40° N = 120 cm / 3064422907 cm = 1 / 25 536 857 or approximately 1 : 25 500 000 (option d)

SCALE 27 b.
This type of problem can be solved using the equation:

Scale factor = Chart distance / Earth distance

The problem can be simplified by noting that on a Mercator chart, the lines of longitude are parallel, so the chart distance is the same at all latitudes.

The Earth distance at 60° can be calculated using the departure equation:

Departure in nm = change of longitude in min x cos latitude

A full circle of the earth is 360° which is $360^{\circ} \times 60 = 21600$ min

So at 60°N this would be a departure of 21600 x cos 60° = 10800 nm

This can be converted into cm by multiplying by the factors 185200 cm/nm to give earth distance at 60° S 10800 x 185200 = 2 000 160 000 cm

Inserting this and the chart distance of 200 cm into the scale equation gives:

Scale factor at 60° S = 200 cm / 2 000 160 000 cm = 1 / 10 000 800 or approximately 1 : 10 000 000 (option b)

SCALE 28 a.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / earth distance.

This can be rearranged to give: Chart distance = Scale factor x Earth distance

At the equator each 1 min of longitude is equal to a distance of 1 nm. The angle between 179^{0}E and 175^{0}W is 6^{0} which is 360 minutes. So the Earth distance between 179^{0}E and 175^{0}w is 360 nm.

Inserting this and the scale factor into the above equation gives:

Chart distance = 1/15 000 000 x 360 nm = 0.000024 nm

This can be converted into mm by multiplying by 1852000 mm/nm to give:

Chart distance = 0.000024 nm x 1852000 mm/nm = 44.45 mm or approximately 44 mm (option a).

SCALE 29 d.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / earth distance.

This can be rearranged to give: Chart distance = Scale factor x Earth distance

At the equator each 1 min of longitude is equal to a distance of 1 nm. The angle between 165^{0}E and 175^{0}W is 20^{0} which is 1200 minutes. So the Earth distance between 165^{0}E and 175^{0}w is 1200 nm.

Inserting this and the scale factor into the above equation gives:

Chart distance = 1/25 000 000 x 1200 nm = 0.000048 nm.

This can be converted into mm by multiplying by 1852000 mm/nm to give:

Chart distance = 0.000048 nm x 1852000 mm/nm = 88.9 mm or approximately 89 mm (option d).

SCALE 30 b.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / earth distance.

This can be rearranged to give: Chart distance = Scale factor x Earth distance

At the equator each 1 min of longitude is equal to a distance of 1 nm. The angle between 170^{0}E and 170^{0}W is 20^{0} which is 1200 minutes. So the Earth distance between 170^{0}E and 170^{0}w is 1200 nm.

Inserting this and the scale factor into the above equation gives:

Chart distance = 1/20 000 000 x 1200 nm = 0.00006 nm

This can be converted into mm by multiplying by 1852000 mm/nm to give:

Chart distance = 0.00006 nm x 1852000 mm/nm = 111.12 mm or approximately 111 mm (option b).

SCALE 31 a.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / earth distance.

This can be rearranged to give: Chart distance = Scale factor x Earth distance

At the equator each 1 min of longitude is equal to a distance of 1 nm. The angle between 175^{0}E and 175^{0}W is 10^{0} which is 600 minutes. So the Earth distance between 175^{0}E and 175^{0}w is 600 nm.

Inserting this and the scale factor into the above equation gives:

Chart distance = 1/7 000 000 x 600 nm = 0.000086 nm

This can be converted into mm by multiplying by 1852000 mm/nm to give:

Chart distance = 0.000086 nm x 1852000 mm/nm = 158.7 mm or approximately 159 mm (option a).

SCALE 32 c.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / earth distance.

This can be rearranged to give: Chart distance = Scale factor x Earth distance

At the equator each 1 min of longitude is equal to a distance of 1 nm. The angle between 179^{0}E and 179^{0}W is 2^{0} which is 120^{0} minutes. So the Earth distance between 179^{0}E and 179^{0}w is 120 nm.

Inserting this and the scale factor into the above equation gives:

Chart distance = 1/500 000 x 120 nm = 0.00024 nm

This can be converted into mm by multiplying by 1852000 mm/nm to give:

Chart distance = 0.00024 nm x 1852000 mm/nm = 444.5 mm or approximately 444 mm (option c).

SCALE 33 a.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / earth distance.

This can be rearranged to give: Chart distance = Scale factor x Earth distance

At the equator each 1 min of longitude is equal to a distance of 1 nm. The angle between 176^0E and 176^0W is 8^0 which is 480 minutes. So the Earth distance between 176^0E and 176^0w is 480 nm.

Inserting this and the scale factor into the above equation gives:

Chart distance = 1/4 000 000 x 480 nm = 0.00012 nm

This can be converted into mm by multiplying by 1852000 mm/nm to give:

Chart distance = 0.00012 nm x 1852000 mm/nm = 222.24 mm or approximately 222 mm (option a).

SCALE 34 b.
This type of problem can be solved using the standard scale equation:

Scale factor = Chart length / Earth length

This can be rearranged to give: Earth length = chart length / Scale factor

The questions specifies a scale of 1 : 2 000 000 which is 1/ 2 000 000

Inserting the data provided in the question gives:

Earth length = 4 cm / (1/ 2 000 000) = 8 000 000 cm

This can be converted into nm by dividing by the conversion factor of 185200 cm/nm to give 43.19 or approximately 43 nm (option b).

SCALE 35 b.
This type of problem can be solved using the standard scale equation:

Scale factor = Chart length / Earth length

This can be rearranged to give: Earth length = chart length / Scale factor

The questions specifies a scale of 1 : 3 000 000 which is 1/ 3 000 000

Inserting the data provided in the question gives:

Earth length = 24 cm / (1/ 3 000 000) = 72 000 000 cm

This can be converted into nm by dividing by the conversion factor of 185200 cm/nm to give 388.77 or approximately 389 nm (option b).

SCALE 36 d.
This type of problem can be solved using the standard scale equation:

Scale factor = Chart length / Earth length

This can be rearranged to give: Earth length = chart length / Scale factor

The questions specifies a scale of 1 : 5 000 000 which is 1/ 5 000 000

Inserting the data provided in the question gives:

Earth length = 10 cm / (1/ 5 000 000) = 50 000 000 cm

This can be converted into nm by dividing by the conversion factor of 185200 cm/nm to give 269.98 or approximately 270 nm (option d).

SCALE 37 b.
This type of problem can be solved using the standard scale equation:

Scale factor = Chart length / Earth length

This can be rearranged to give: Earth length = chart length / Scale factor

The questions specifies a scale of 1 : 250 000 which is 1/ 250 000

Inserting the data provided in the question gives:

Earth length = 4 cm / (1/ 250 000) = 1 000 000 cm

This can be converted into nm by dividing by the conversion factor of 185200 cm/nm to give 5.4 nm (option b).

SCALE 38 b.
This type of problem can be solved using the standard scale equation:

Scale factor = Chart length / Earth length

This can be rearranged to give: Earth length = chart length / Scale factor

The questions specifies a scale of 1 : 200 000 which is 1/ 200 000

Inserting the data provided in the question gives:

Earth length = 12 cm / (1/ 200 000) = 2 400 000 cm

This can be converted into nm by dividing by the conversion factor of 185200 cm/nm to give 12.96 or approximately 13 nm (option b).

SCALE 39 b.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 40^0 N, and Distance at A = 90 nm
And B = 20^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (90 nm x Cos 20^0) / Cos 40^0 = 110.4 nm or approximately 110 nm (option b).

SCALE 40 a.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 70^0 N, and Distance at A = 90 nm
And B = 10^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (90 nm x Cos 10^0) / Cos 70^0 = 259.14 nm or approximately 259 nm (option a).

SCALE 41 b.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 85^0 N, and Distance at A = 60 nm
And B = 30^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (60 nm x Cos 30^0) / Cos 85^0 = 596.2 nm or approximately 596 nm (option d).

SCALE 42 b.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give: Distance at B = (Distance at A x Cos B) / Cos A
Where A and B are latitudes.

For this question use A = 45^0 N, and Distance at A = 90 nm
And B = 60^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (90 nm x Cos 60^0) / Cos 45^0 = 63.64 nm or approximately 65 nm (option b).

SCALE 43 b.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give: Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 45^0 N, and Distance at A = 25 nm
And B = 30^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (25 nm x Cos 30^0) / Cos 45^0 = 30.62 nm or approximately 31 nm (option b).

SCALE 44 d.

This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

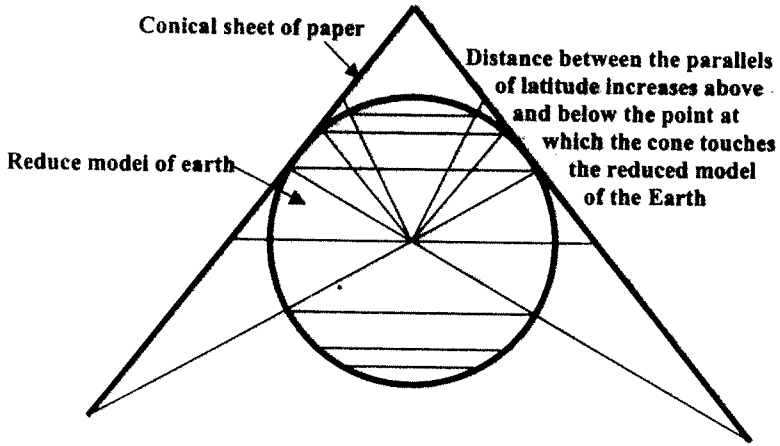
For this question use A = 75^0 N, and Distance at A = 75 nm
And B = 30^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (75 nm x Cos 30^0) / Cos 75^0 = 250.96 nm or approximately 251 nm (option d).

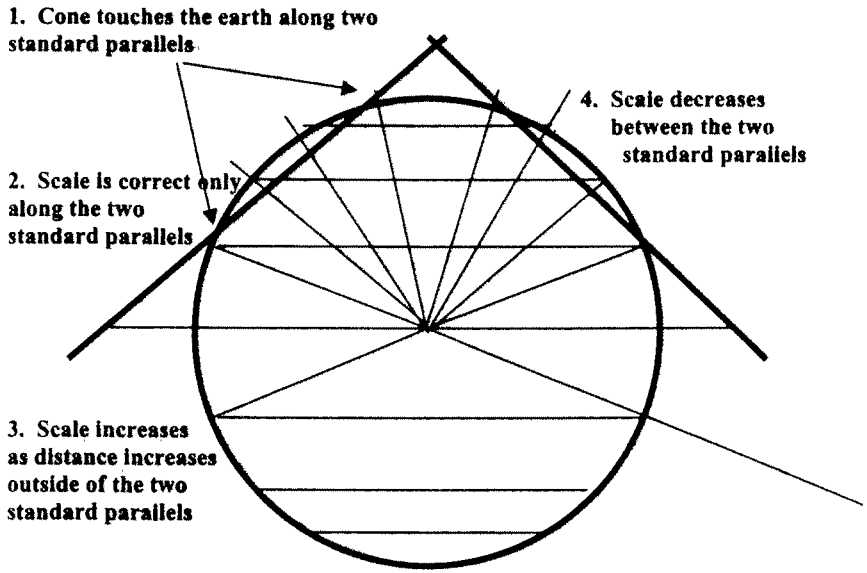
SCALE 45 b.

A Lambert's chart is based upon a conical projection. This means that the graticule of the earth is projected onto the inside of a cone as illustrated below.



This method of projection causes the scale to increase as distance increases away from the line at which the cone is in contact with the model of the Earth. The scale can therefore be correct only along this line of contact. In order to make such a projection conformal the scale is reduced mathematically at all points. This is the equivalent of having the cone pass below the surface of the model of

the earth as illustrated below. This produces two lines of parallel at which the scale is correct. These are termed the "Standard Parallels". Scale between these parallels reduces while scale outside of the standard parallels increases as distance away from the parallels increases. The nominal scale of a Lambert's Conformal chart is therefore constant along any parallel of latitude (option b).

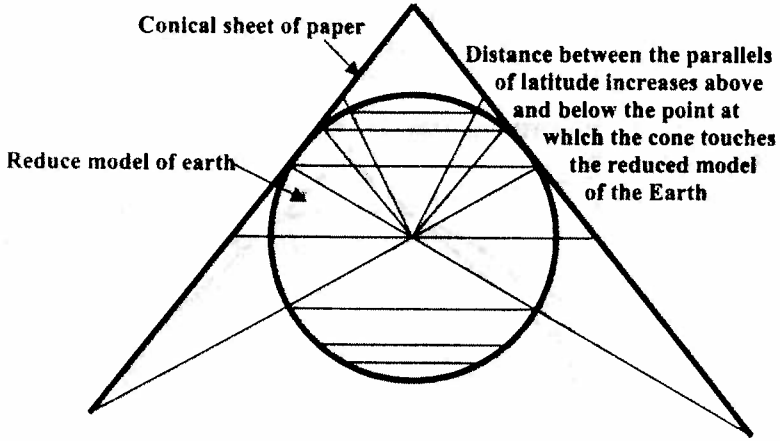


SCALE 46 c.

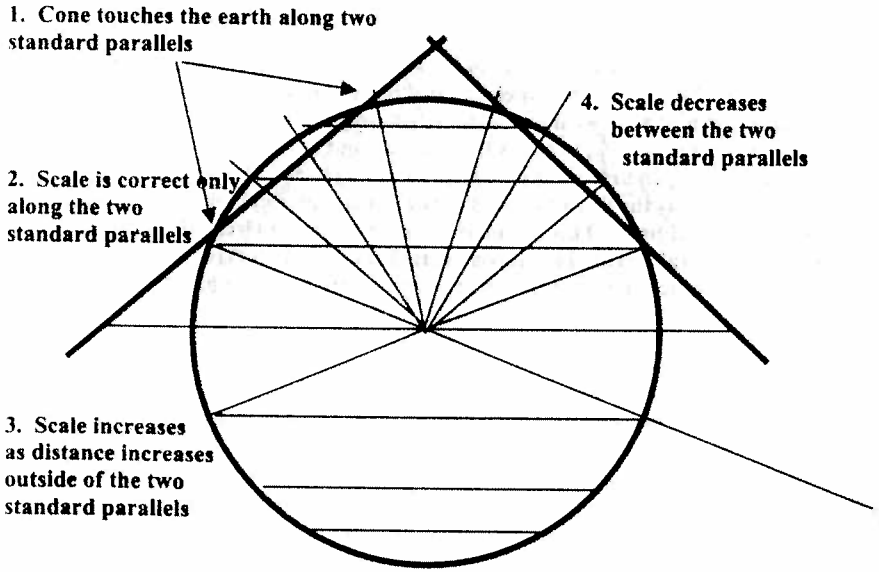
A Great Circle is a circle drawn on the surface of the earth such that its centre is the centre of the earth. Great circles include all meridians plus the equator. Mercator charts are based on a cylindrical projection where a light at the centre of a model of the earth, projects the graticule out onto a sheet of paper, which has been wrapped around the earth to form a cylinder. In the case of Transverse Mercator charts the line of contact between the paper cylinder and the earth is one of the meridians. This meridian is called the great circle of tangency. One of the effects of this form of projection is that the scale is correct only along this great circle of tangency (option c) expanding with increasing distance either side.

SCALE 47 a.

A Lambert's chart is based upon a conical projection. This means that the graticule of the earth is projected onto the inside of a cone as illustrated below.



This method of projection causes the scale to increase as distance increases away from the line at which the cone is in contact with the model of the Earth. The scale can therefore be correct only along this line of contact. In order to make such a projection conformal the scale is reduced mathematically at all points. This is the equivalent of having the cone pass below the surface of the model of the earth as illustrated below. This produces two lines of parallel at which the scale is correct. These are termed the "Standard Parallels". Scale between these parallels reduces while scale outside of the standard parallels increases as distance away from the parallels increases. The nominal scale of a Lambert's Conformal chart is therefore correct only along the standard parallels (option a).



SCALE 48 b.

This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 45^0 N, and Distance at A = 70 nm
And B = 40^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (70 nm x Cos 40^0) / Cos 45^0 = 75.83 nm or approximately 76 nm (option b).

SCALE 49 d.

This type of problem can be solved using the standard scale conversion equation:

D_A / D_B = Cos A / Cos B

Where: A is the initial latitude (60^0)
B is the new latitude (00^0 S)
D_A is the denominator of scale at A
D_B is the denominator of scale at B

This equation can be rearranged to give D_B = (D_A x Cos B) / Cos A

Inserting the data provided in the question gives:

D_B (at 00^0 S) = (4 000 000 x Cos 00^0) / Cos 60^0 S

Which is D_B (at 00^0 S) = (4 000 000 x 1) / 0.5 = 8 000 000

Which is Scale at 60^0 S = 1 : 8 000 000 (option d).

SCALE 50 a.

This type of problem can be solved using the scale equation:

Scale factor = Chart distance / earth distance.

This can be rearranged to give: Chart distance = Scale factor x Earth distance

At the equator each 1 min of longitude is equal to a distance of 1 nm. The angle between 179°E and 175°W is 6° which is 360 minutes. So the Earth distance between 179°E and 175°w is 360 nm.

Inserting this and the scale factor into the above equation gives:

Chart distance = 1/2 000 000 x 360 nm = 0.00018 nm

This can be converted into mm by multiplying by 1852000 mm/nm to give:

Chart distance = 0.00018 nm x 1852000 mm/nm = 333.4 mm or approximately 333 mm (option a).

SCALE 51 d.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

The earth distance can be calculated using the departure equation:

Departure in nm = Change in longitude (in min) x Cos latitude

The change in longitude between the two meridians in this questions 10° or 600 min.

Inserting this and the given latitude into the equation gives:

Departure at 47°N = 600 x Cos 47° = 409.2 nm

This can be converted into inches by multiplying by 72960 in/nm to give 29 855 232 inches

Inserting this into the scale equation gives:

Scale factor = 6 inches / 29 855 232 = 1 : 4 975 872 or approximately 1 : 5 000 000 (option d).

SCALE 52 a.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 15 cm / (1/2000000) = 30 000 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 161.98 nm or approximately 162 nm (option a).

SCALE 53 a.
This type of problem can be solved using the equation:

Scale factor = Chart distance / Earth distance

The problem can be simplified by noting that on a Mercator chart, the lines of longitude are parallel, so the chart distance is the same at all latitudes.

The Earth distance at 30° can be calculated using the departure equation:

Departure in nm = change of longitude in min x cos latitude

A full circle of the earth is 360° which is 360° x 60 = 21600 min

So at 30°N this would be a departure of 21600 x cos 30° = 18706.15nm

This can be converted into cm by multiplying by the factors 185200 cm/nm to give earth distance at 30°N 18706.15 x 185200 = 3 464 378 743 cm

Inserting this and the chart distance of 127 cm into the scale equation gives:

Scale factor at 30° N = 127 cm / 3 464 378 743 cm = 1 / 27 278 573 or approximately 1 : 27 300 000 (option a)

SCALE 54 d.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that 4.89 cm on the chart represents 100 nm on the earth. So the chart distance is 4.89cm and the earth distance is 100 nm.

Scale = 4.89 cm / 100 nm

Dividing by 4.89 gives scale = 1 cm / 20.45 nm

But both distances in the equation must be stated in the same units, so the 20.45 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 20.45 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

20.45 nm = 20.45 x 1852 x 100 = 3 787 340 cm

This means that scale = 1 : 3 787 340 or approximately 1 : 4 000 000 (option d).

SCALE 55 a.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 15^0 S, and Distance at A = 130 nm
And B = 10^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (130 nm x Cos 10^0) / Cos 15^0 = 132.54 nm or approximately 132.5 nm (option a).

SCALE 56 a.
This type of problem can be solved using the standard scale equation:

Scale factor = Chart length / Earth length

This can be rearranged to give: Earth length = chart length / Scale factor

The questions specifies a sacle of 1 : 200 000 which is 1/200 000

Inserting the data provided in the question gives:

Earth length = 27 cm / (1/ 200 000) = 5 400 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 29.16 or approximately 29 nm (option a).

SCALE 57 b.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 25 cm / (1/3 000 000) = 75 000 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 404.97 nm or approximately 405 nm (option b).

SCALE 58 a.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 13 cm / (1/2 000 000) = 26 000 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 140.39 nm or approximately 140 nm (option a).

SCALE 59 b.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 9 cm / (1/5 000 000) = 45 000 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 242.98 nm or approximately 243 nm (option b).

SCALE 60 a.
This type of problem can be solved using the scale equation:

Scale factor = Chart distance / Earth distance

This can be rearranged to give: Earth distance = Chart distance / Scale factor

Inserting the data provided in the question gives:

Earth distance = 7 cm / (1/500 000) = 3 500 000 cm

This can be converted into nm by dividing by 185200 cm/nm to give 18.89 nm or approximately 19 nm (option a).

SCALE 61 a.
This type of problem can be solved using the equation:

Scale factor = Chart distance / Earth distance

The problem can be simplified by noting that on a Mercator chart, the lines of longitude are parallel, so the chart distance is the same at all latitudes.

The Earth distance at 30^0 can be calculated using the departure equation:

Departure in nm = change of longitude in min x cos latitude

A full circle of the earth is 360^0 which is 360^0 x 60 = 21600 min

So at 30^0N this would be a departure of 21600 x cos 30^0 = 18706.15nm

This can be converted into cm by multiplying by the factors 185200 cm/nm to give earth distance at 30^0N = 18706.15 x 185200 = 3 464 378 743 cm

Inserting this and the chart distance of 115 cm into the scale equation gives:

Scale factor at 30^0 N = 115 cm / 3 464 378 743 cm = 1 / 30 125 033 or approximately 1 : 30 000 000 (option a)

SCALE 62 a.
This type of problem can be solved using the equation:

Scale factor = Chart distance / Earth distance

The problem can be simplified by noting that on a Mercator chart, the lines of longitude are parallel, so the chart distance is the same at all latitudes.

The Earth distance at 40^0 can be calculated using the departure equation:

Departure in nm = change of longitude in min x cos latitude

A full circle of the earth is 360^0 which is 360^0 x 60 = 21600 min

So at 40^0N this would be a departure of 21600 x cos 40^0 = 16546.6 nm

This can be converted into cm by multiplying by the factors 185200 cm/nm to give earth distance at 40^0N = 16546.6 x 185200 = 3064422907 cm

Inserting this and the chart distance of 95 cm into the scale equation gives:

Scale factor at 40^0 N = 95 cm / 3064422907 cm = 1 / 32 257 083 or approximately 1 : 32 250 000 (option a)

SCALE 63 b.
This type of problem can be solved using the equation:

Scale factor = Chart distance / Earth distance

The problem can be simplified by noting that on a Mercator chart, the lines of longitude are parallel, so the chart distance is the same at all latitudes.

The Earth distance at 60^0 can be calculated using the departure equation:

Departure in nm = change of longitude in min x cos latitude

A full circle of the earth is 360^0 which is 360^0 x 60 = 21600 min

So at 60^0N this would be a departure of 21600 x cos 60^0 = 10800 nm

This can be converted into cm by multiplying by the factors 185200 cm/nm to give earth distance at 60^0S 10800 x 185200 = 2 000 160 000 cm

Inserting this and the chart distance of 85 cm into the scale equation gives:

Scale factor at 60^0 S = 85 cm / 2 000 160 000 cm = 1 / 23 531 294 or approximately 1 : 23 500 000 (option b)

SCALE 64 a.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that two meridians 5^0 apart at 60^0N are represented by 12 cm on the chart .

This means that the chart distance is 12 cm and the earth distance is the departure between these two meridians at 60^0N. The departure equation states that:

Departure (in nm) = change in longitude (in min) x cos of latitude

So in this case departure = (5^0 x 60) x cos 60 = 150 nm

So the chart distance is 12 cm and the earth distance is 150 nm

Inserting these values into the scale equation gives:

Scale = 12 cm / 150 nm

Dividing by 12 gives scale = 1 cm / 12.5 nm

But both distances in the equation must be stated in the same units, so the 12.5 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 12.5 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

12.5 nm = 12.5 x 1852 x 100 = 2 315 000

This means that the scale = 1 : 2 315 000 or approximately 1 : 2 300 000 (option a).

SCALE 65 b.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that two meridians 5^0 apart at 37^0N are represented by 11cm on the chart.

This means that the chart distance is 11 cm and the earth distance is the departure between these two meridians at 37^0N. The departure equation states that:

Departure (in nm) = change in longitude (in min) x cos of latitude

So in this case departure = (5^0 x 60) x cos 37 = 239.6 nm

So the chart distance is 11 cm and the earth distance is 239.6 nm

Inserting these values into the scale equation gives:

Scale = 11 cm / 239.6 nm

Dividing by 11 gives scale = 1 cm / 21.78 nm

But both distances in the equation must be stated in the same units, so the 21.78 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 21.78 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

21.78 nm = 21.78 x 1852 x 100 = 4 033 835

This means that scale = 1 : 4 033 835 or approximately 1 : 4 000 000 (option b).

SCALE 66 c.
This type of problem can be solved using the standard scale conversion equation:

D_A / D_B = Cos A / Cos B

Where: A is the initial latitude (00^0)
B is the new latitude (60^0 S)
D_A is the denominator of scale at A
D_B is the denominator of scale at B

This equation can be rearranged to give $D_B = (D_A \times \text{Cos B}) / \text{Cos A}$

Inserting the data provided in the question gives:

D_B (at 60^0 S) = (3 000 000 x Cos 60^0) / Cos 00^0 S

Which is D_B (at 60^0 S) = (3 000 000 x 0.5) / 1 = 1 500 000

Which is Scale at 60^0 S = 1 : 1 500 000 (option c).

SCALE 67 a.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that 4.63 cm on the chart represents 150 nm on the earth. So the chart distance is 4.63cm and the earth distance is 150 nm.

Scale = 4.63 cm / 125 nm

Dividing by 4.63 gives scale = 1 cm / 27 nm

But both distances in the equation must be stated in the same units, so the 27 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 27 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

27 nm = 27 x 1852 x 100 = 5 000 000

This means that the scale = 1 : 5 000 000 (option a).

SCALE 68 d.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that 7 cm on the chart represents 55 nm on the earth. So the chart distance is 7 cm and the earth distance is 55 nm.

Scale = 7 cm / 55 nm

Dividing by 7 gives scale = 1 cm / 7.86 nm

But both distances in the equation must be stated in the same units, so the 7.86 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 7.86 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

7.86 nm = 7.86 x 1852 x 100 = 1 455 672

This means that scale = 1 : 1 455 672 or approximately 1 : 1 500 000 (option d).

SCALE 69 a.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 45^0 N, and Distance at A = 79 nm
And B = 30^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (79 nm x Cos 30^0) / Cos 45^0 = 96.75 nm or approximately 97 nm (option a).

SCALE 70 d.
This type of problem can be solved using the standard scale conversion equation:

D_A / D_B = Cos A / Cos B

Where: A is the initial latitude (60^0)
B is the new latitude (00^0 S)
D_A is the denominator of scale at A
D_B is the denominator of scale at B

This equation can be rearranged to give D_B = (D_A x Cos B) / Cos A

Inserting the data provided in the question gives:

D_B (at 00^0 S) = (3 500 000 x Cos 00^0) / Cos 60^0 S

Which is D_B (at 00^0 S) = (3 500 000 x 1) / 0.5 = 7 000 000

Which is Scale at the Equator = 1 : 7 000 000 (option d).

SCALE 71 c.
This type of problem can be solved using the standard scale conversion equation:

D_A / D_B = Cos A / Cos B

Where: A is the initial latitude (00^0)
B is the new latitude (60^0 S)

D_A is the denominator of scale at A
D_B is the denominator of scale at B

This equation can be rearranged to give D_B = (D_A x Cos B) / Cos A

Inserting the data provided in the question gives:

D_B (at 60^0 S) = (2 400 000 x Cos 60^0) / Cos 00^0 S

Which is D_B (at 60^0 S) = (2 400 000 x 0.5) / 1 = 1 200 000

Which is Scale at 60^0 S = 1 : 1 200 000 (option c).

SCALE 72 a.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that 4.5 cm on the chart represents 125 nm on the earth. So the chart distance is 4.5cm and the earth distance is 125 nm.

Scale = 4.5 cm / 125 nm

Dividing by 4.5 gives scale = 1 cm / 27.78 nm

But both distances in the equation must be stated in the same units, so the 27.78 nm must now be converted in cm. This can be done by noting that 1 nm = 1852 m and 1 m = 100 cm. So 27.78 nm can be converted into cm by multiplying by 1852 m/nm and 100 cm/m to give:

27.78 nm = 27.78 x 1852 x 100 = 5 144 444

This means that scale = 1 : 5 144 444 or approximately 1 : 5 100 000 (option a).

SCALE 73 d.
This type of problem can be solved using the standard equation:

Scale = Chart distance / Earth distance

The question states that 14 cm on the chart represents 55 nm on the earth. So chart distance is 14 cm and earth distance is 55 nm.
Scale = 14 cm / 55 nm

Dividing by 14 gives scale = 1 cm / 3.93 nm

But both distances in the equation must be stated in the same units, so the 3.93nm must now be converted in cm. This can be done by noting that 1 nm =

1852 m and 1 m = 100 cm. So 7 nm can be converted into cm by muitiplying by 1852 m/nm and 100 cm/m to give:

3.93 nm = 3.93 x 1852 x 100 = 727 836

This means that scale = 1 : 727 836 or approximately 1 : 725 000 (option d).

SCALE 74 a.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 45^0 N, and Distance at A = 98 nm
And B = 30^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (98 nm x Cos 30^0) / Cos 45^0 = 120.02 nm or approximately 120 nm (option a).

SCALE 75 d.
This type of problem can be solved using the standard scale conversion equation:

D_A / D_B = Cos A / Cos B

Where: A is the initial latitude (60^0)
B is the new latitude (00^0 S)
D_A is the denominator of scale at A
D_B is the denominator of scale at B

This equation can be rearranged to give D_B = (D_A x Cos B) / Cos A

Inserting the data provided in the question gives:

D_B (at 00^0 S) = (2 750 000 x Cos 00^0) / Cos 60^0 S

Which is D_B (at 00^0 S) = (2 750 000 x 1) / 0.5 = 5 500 000

Which is Scale at the Equator = 1 : 5 500 000 (option d).

SCALE 76 b.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 70^0 N, and Distance at A = 120 nm
And B = 10^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (120 nm x Cos 10^0) / Cos 70^0 = 345.53 nm or approximately 346 nm (option b).

SCALE 77 d.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 85^0 N, and Distance at A = 98 nm
And B = 30^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (98 nm x Cos 30^0) / Cos 85^0 = 973.78 nm or approximately 974 nm (option d).

SCALE 78 b.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 45^0 N, and Distance at A = 96 nm
And B = 60^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (96 nm x Cos 60^0) / Cos 45^0 = 67.88 nm or approximately 68 nm (option b).

SCALE 79 b.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 45^0 N, and Distance at A = 39 nm
And B = 30^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

Distance at B = (39 nm x Cos 30^0) / Cos 45^0 = 47.77 nm or approximately 48 nm (option b).

SCALE 80 d.
This type of problem can be solved using the standard equation:

Distance at A / Distance at B = Cos A / Cos B

This can be rearranged to give:

Distance at B = (Distance at A x Cos B) / Cos A

Where A and B are latitudes.

For this question use A = 75^0 N, and Distance at A = 55 nm
And B = 30^0 N, and distance at B is to be calculated

Inserting these values into the equation gives:

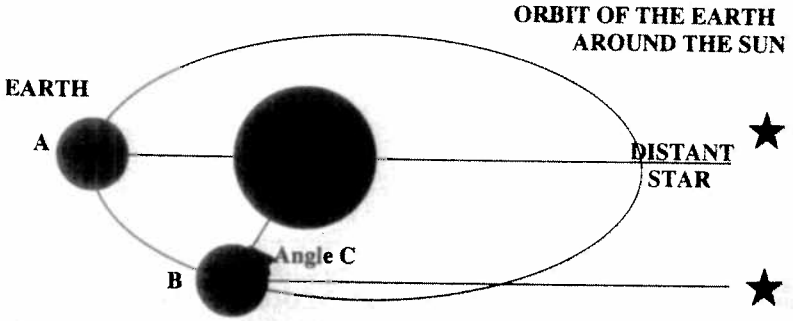
Distance at B = (55 nm x Cos 30^0) / Cos 75^0 = 184.03 nm or approximately 184 nm (option d).

SOLAR SYSTEM &TIME 1 c.
The mean solar day is the average length of time that it takes for the earth to complete one 360^0 rotation about its axis as measured by reference to a distance star. The mean noon is the time in a mean day at which the earth has completed 180^0 of rotation about its axis. At any point on the earth, the mean noon is the time at which the star being used as a reference is directly above the meridian on which the point lies. If the earth were not rotating about the sun, the mean noon at any point on the Earth, would also be the time at which the sun and the star being used as a reference would be directly above the meridian on which the point lies. In this situation the sun and the star would be in a straight line above the meridian as illustrated where the earth is at point A in the diagram below.

The apparent noon is the time at which the sun appears to be directly overhead of a point on a meridian. Because the earth rotates around the sun, the mean noon and the apparent noon are not always the same point in time.

The diagram shows the Earth as viewed from above the North Pole. When the Earth is at point A in the diagram, the sun and the star are in a straight line above the same meridian, so it is both mean noon and apparent noon.

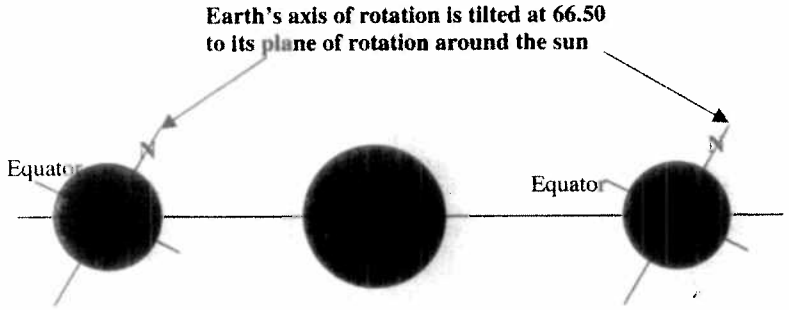
But when the earth has moved point B in its orbit around the sun, the star and the sun are no longer in a straight line. So although it is mean noon, the earth must rotate through a further angle before it will be apparent noon. This means that the apparent noon will be later than the mean noon. The difference between mean noon and apparent noon varies as the earth moves in its orbit around the sun. The difference is greatest during the months of November and February (option c).



The earth is at the same point In its rotation about its axis at points A and B, but is at different points In its orbit around the Sun.

SOLAR SYSTEM &TIME 2 a.
The main reason for the seasonal changes is because the earth's spin axis is inclined to the plane of its orbit around the sun (option a). As illustrated below this causes the sun to appear to move north of the equator for half of the year and south of the equator fro the other half. This means that the duration of

daylight and the apparent intensity of the suns heating effect changes over a 12 month cycle.



The Sun appears to be North of Equator when the Earth is at this point in its orbit

The Sun appears to be South of the equator when the earth is at this point in its orbit

SOLAR SYSTEM &TIME 3 b.

Coordinated Universal Time (UTC) is derived from atomic clocks and changes at a constant rate. It is regularly corrected to match Greenwich Mean Time (GMT). For all practical navigation purposes it can be assumed that UTC = GMT. UTC is used as the datum for world time. The difference between Local Mean Time (LMT) at any point (in hours) and UTC is equal to 1/15 of the longitude of the point measured to the West of the prime (Greenwich) meridian. But in countries that span a large range of longitude, this would cause the time to be different in different parts of the country. To overcome this problem some countries use Standard Time across the entire country, which is the Local Mean Time, adjusted to the whole hour or half hour difference from UTC (option b).

SOLAR SYSTEM &TIME 4 d.

The length of a day is the time taken for the Earth to turn through one complete revolution about its spin axis. To an observer on the Earth this rotation gives the impression of the sun rotating about the Earth in a East to West direction. The time taken for one complete revolution is approximately 24 hours or one solar day. Noon in a solar day at a point on any given meridian is the time at which the sun is directly above that meridian. This means that noon occurs slightly later as longitude increases in a westerly direction. This in turn means that the local time at any given point on the earth depends upon its longitude. Longitude as are measured relative to the prime (000^0 Greenwich) meridian.

The time difference between any two longitudes can be found by dividing the 24 hour day by 360^0, to give a difference 0.0667 hours/^{0}. This can also be expressed as 1 hour/15^0.

A time difference of 5 hours 20 minutes and 20 seconds is equal to 5.33889 hours.

Multiplying this by 15^0/hour gives a longitude difference of 80^0 05' (option d).

SOLAR SYSTEM &TIME 5 b.

Night and day are caused by the rotation of the Earth about its spin axis. Daytime is that part of the rotation during which the sun is visible, and night is that part of the rotation during which it is not. In addition to spinning about its own axis, the earth also orbits the Sun in a plane called the Ecliptic. The Earth spins about its axis at a constant rate of approximately 360^0 every 24 hours. So if the spin axis of the Earth were at 90^0 to the Ecliptic, the duration of the day and the night would be equal. Under these circumstances the change from day to night would be almost entirely due to the rotation of the earth about its axis.

But if spin axis were in line with or at 0^0 to the Ecliptic, then during each 24 hour period, the sun would be permanently visible in the hemisphere closest to it and permanently invisible in the other. It would therefore be permanently day in one hemisphere and permanently night in the other. If the spin axis were set at any angle between 90^0 and 0^0 each 24 hour period would be part day and part night, but the day would be longer than the night in the hemisphere closest to the Sun.

The spin axis of the Earth is set at 66.5^0 to the Ecliptic. This means that as the earth orbits the Sun, the poles alternate between being the closer and the further from the sun. So the lengths of day and night gradually change as the Earth orbits the Sun. So the main reason that day and night, throughout the year have different lengths is the inclination of the Ecliptic to the Equator (option b).

SOLAR SYSTEM &TIME 6 c.

This type of problem can be solved using the standard equation:

Time difference (in hours) UTC = Change in longitude West (in degrees) /15

The change in longitude in this question = 40^0 W + 25^0 E = 65^0 W

Inserting this into the above equation gives:

Time difference = 65 / 15 = 4.33 hours which is 4 h 20 mins.

Adding this to the sunrise time at 25^0E gives:

Sunrise time at 40^0 W 0254 UTC + 4 h 20 min = 0714 UTC (option c).

SOLAR SYSTEM &TIME 7 c.

This type of problem can be solved using the standard equation:

Time difference (in hours) UTC = Change in longitude West (in degrees) /15

The change in longitude in this question = 35^0 W + 40^0 E = 75^0 W

Inserting this into the above equation gives:

Time difference = 75 / 15 = 5 hours.

Adding this to the sunrise time at 40^0E gives:

Sunrise time at 35^0 W 0243 UTC + 5 h = 0743 UTC (option c).

SOLAR SYSTEM &TIME 8 a.

This type of problem can be solved using the standard equation:

Time difference (in hours) UTC = Change in longitude West (in degrees) /15

The change in longitude in this question = 75^0 W - 20^0 W = 55^0 W

Inserting this into the above equation gives:

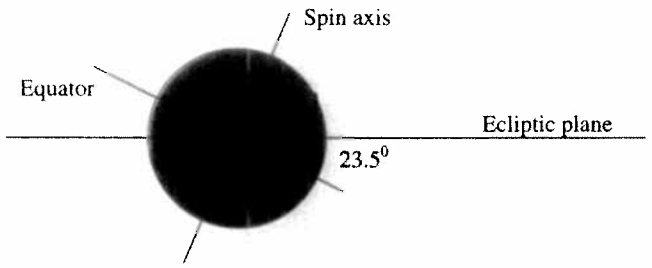
Time difference = 55 / 15 = 3.667 hours which is 3 hours 40 mins.

Adding this to the sunrise time at 20^0W gives:

Sunrise time at 75^0 W 0250 UTC + 3 h 40 min = 0630 UTC (option a).

SOLAR SYSTEM &TIME 9 c.

The Ecliptic is the plane in which the earth orbits the Sun. The spin axis of the Earth is set at 66.5^0 to the Ecliptic. The plane of the Equator is set at 90^0 to the spin axis. So the angle between the plane of the Ecliptic and the plane of the Equator is 23.5^0 (option c). This situation is illustrated below.



SOLAR SYSTEM &TIME 10 a.

The Earth orbits the Sun in an elliptical orbit the plane of which is called the Ecliptic. Each orbit takes approximately 1 year to complete. The point in the orbit at which the Earth is at its greatest distance from the Sun is called the

Aphelion. It occurs at the beginning (approximately 4^{th}) of July each year (option a).

SOLAR SYSTEM &TIME 11 b.

The Earth spins about its own axis whilst orbiting the Sun in an elliptical orbit. The plane of this orbit is called the Ecliptic. Because the spin axis of the Earth is not at right angles to the Ecliptic, the length of day and night vary as the position of the earth changes throughout the year. The rate of change of the lengths of day and night is greatest at the points in the year when day and night are of equal length. These times are the Spring (or Vernal) Equinox and the Autumn Equinox (option b). The points in the year when the difference between day and night is greatest are called the summer and winter Solstices.

SOLAR SYSTEM &TIME 12 b.

The term sensible horizon refers to the points at which the sun would become visible when rising, and cease to be visible when setting, if its light traveled in straight lines. Although light in a vacuum travels in straight lines, sunlight passing through the atmosphere is refracted downwards by the atmosphere. This means that the Sun will become visible shortly before it rises above and remain visible shortly after it sets below the sensible horizon. The term Twilight refers to these periods before sunrise and after sunset, during which the Sun is visible. The term Civil Twilight refers between sunset and when the centre of the Sun is 6^0 or less below the sensible horizon (option b).

SOLAR SYSTEM &TIME 13 a.

The earth orbits the Sun once per year, in an elliptical orbit, the plane of which is called the Ecliptic. Because the spin axis of the Earth is not at 90^0 to the Ecliptic, the Sun appears to move to the North and then to the South of the Equator as each year progresses. This means that the latitude at which the sun appears to pass directly overhead also changes throughout the year. The highest latitudes at which this occurs is 23.5^0 North and South. Option a, is therefore the most accurate in this question.

SOLAR SYSTEM &TIME 14 c.

For this type of question it is necessary to refer to an extract from the Aeronautical Almanac. This will usually be provided in JAR ATPL Course Notes and as an Annex to the examination paper. Solving this type of problem involves finding the time in LMT of the event at that latitude, then adjusting this to UTC by taking account of the longitude by adding or subtracting the arc of time between 000^0 and the actual latitude. The extract from the Almanac includes tables of the LMT of events at various latitudes and also an Arc of Time table.

An examination of such an extract at page 27 of this book reveals that the end of Evening Civil Twilight at 51^0N on 15^{th} August is 1959 LMT

This can be converted into UTC using the Arc of Time table on page 29. which indicates that the time difference 008^0 W will be 32 minutes later.

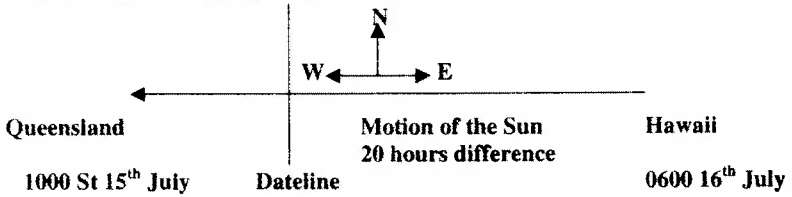
To decide whether to add or subtract this difference it must be noted that the Sun moves from East to West, so end of Civil Twilight at 008^0 W will be later than at 000^0. This effect can be remembered by using the rule "If longitude is West then UTC is best". This means that UTC is greater than LMT. So the difference must be added to give the end of Civil Twilight at 51^0N 008^0 W the end of Civil Twilight will be at 1959 + 32 minutes = 2031 UTC (option c).

SOLAR SYSTEM &TIME 15 a.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the time difference between UTC and Standard Time at the two locations and using these differences to convert the time at one location into the time at the second. The extract from the Almanac includes tables of the differences between UTC and the Standard Times at various locations.

The extract on page 25 of this book shows that the standard time in Hawaii is 10 hour earlier than UTC. Page 24 of the extract also shows that standard time in Queensland Australia is 10 hours later than UTC. This means that the time difference between Hawaii and Queensland is either 20 hours or 4 hours. But the International Dateline runs between the two, to the East of Australia and to the West of Hawaii. The sun moves from East to West so the time/date in Hawaii is ahead of that in Australia. So when it is 0600 ST on the 16th in Hawaii it is 20 hours earlier, which is 1000 St on the 15th in Queensland Australia (option a).

This situation is illustrated below.



SOLAR SYSTEM &TIME 16 b.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the time difference between UTC and Standard Time at the two locations and using these differences to convert the time at one location into the time at the second. The extract from the Almanac includes tables of the differences between UTC and the Standard Times at various locations.

The extract on page 24 of this book shows that the standard time in Kuwait is 3 hour later than UTC. The extract on page 24 also shows that standard time in Algeria 1 hour later than UTC. This means that the time in Kuwait is 2 hours later than that in Algeria. So when it is 0700 ST in Kuwait it is 0500 ST in Algeria (option b).

SOLAR SYSTEM &TIME 17 a.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the time difference between UTC and Standard Time at the two locations and using these differences to convert the time at one location into the time at the second. The extract from the Almanac includes tables of the differences between UTC and the Standard Times at various locations.

The extract on page 24 of this book shows that standard time in Queensland Australia is 10 hours later than UTC. The extract on page 24 also shows that the standard time in Hawaii is 10 hour earlier than UTC. This means that the time difference between Hawaii and Queensland is 20 hours. This could mean that the time in Hawaii is 20 hours earlier but on the same day ad Queensland, or the Queensland is 20 hours earlier but on an earlier day.

The International Dateline runs between the two, to the East of Australia and to the West of Hawaii. The sun moves from East to West, and Queensland is West of Hawaii, so if there is a date difference between the two, Hawaii will be 1 day ahead of Queensland. So when it is 1200 ST on the 10th July in Queensland it is 20 hours earlier, or 1600 ST on the 9th July in Hawaii (option a).

SOLAR SYSTEM &TIME 18 c.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the LMT time of the event at the stated latitude, then adjusting this to UTC by taking account of the longitude quoted in the question. The extract from the Almanac includes tables showing the times of events at various latitudes, and figures for the Arc of Time between the Prime meridian and various other longitudes.

The extract provided on page 26 of this book shows that at 49N on the 6th of January the sunrises is at 0754 LMT.

Vancouver is at longitude 123^0 30'W so UTC at sunrise at Vancouver can be calculated using the arc of time as follows:

Arc of time in hours = Change of longitude in degrees/ 15

123^0 30' is equal to 123.50 so inserting this into the above equation gives:

Arc of time = 123.5 / 15 = 8.23 hours which is 8 hours and 14 mins.

Sunrise at Vancouver is 0754 + 8 hours and 14 mins = 1608 LMT (option c).

SOLAR SYSTEM &TIME 19 c.

The earth orbits the Sun once per year, in an elliptical orbit, the plane of which is called the Ecliptic. Because the spin axis of the Earth is not at 900 to the Ecliptic, the Sun appears to move to the North and then to the South of the Equator as each year progresses. This means that the latitude at which the sun appears to pass directly overhead also changes throughout the year. The highest latitude at which this occurs is 23.5^0 North and South. Option c is therefore the most accurate in this question.

SOLAR SYSTEM &TIME 20 a.

The term sensible horizon refers to the points at which the sun would become visible when rising, and cease to be visible when setting, if its light traveled in straight lines. Although light in a vacuum travels in straight lines, sunlight passing through the atmosphere is refracted downwards by the atmosphere. This means that the Sun will become visible shortly before it rises above and remain visible shortly after it sets below the sensible horizon. The term Twilight refers to these periods before sunrise and after sunset, during which the Sun is visible. The term Civil Twilight refers between sunset and when the centre of the Sun is 6^0 or less below the sensible horizon (option a).

SOLAR SYSTEM &TIME 21 a.

This type of problem can be solved using the standard equation:

Time difference (in hours) = Change in longitude West (in degrees) /15

The change in longitude in this question = 34^0 W + 40^0 E = 74^0 W

Inserting this into the above equation gives:

Time difference = 74 / 15 = 4.93 hours which is 4 hours 56 minutes.

The above figure could also have been obtained from the Arc of Time table on page **** of this book.

The sun moves from east to west so sunrise at 40^0E will be earlier than at 34^0W.

So subtracting 4 hours 56 min from the sunrise time at 34^0W gives:

Sunrise time at 40^0 E 0743 UTC - 4 h 56 m = approximately 0243 UTC (option a).

SOLAR SYSTEM &TIME 22 a.

Because the spin axis of the Earth is inclined at an angle of 66.5^0 to the Ecliptic plane about which it orbits the Sun, the Sun appears to move to the north then to the south of the equator as the year progresses. When the sun is south of the equator, the extreme north of the earth is permanently shielded from its rays, so the Sun does not rise over that area. Similarly, when the Sun is over the northern hemisphere the extreme south of the earth does not experience sunrise. The latitudes 66^0N and 66^0S are the extremes beyond which the sun does not rise and set every day (option a).

SOLAR SYSTEM &TIME 23 c.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the time in LMT of the event at the stated latitude, then adjusting this to UTC to take account of the longitude quoted in the question. The required correction from LMT to UTC is found from the Arc of Time table in the Almanac extract.

The extract on page 28 of this book shows that sunrise at latitude 49^0 50'N, on 6 December is at approximately 0741 UTC.

This can be converted into UTC using the arc of time table on page 29. For longitude 097° 30'W this shows an arc of 6 hours 30 mins. Using the rule "longitude West so UTC is best" we add correction this to the sunrise LMT at to give 0741 + 0630 = 1411 UTC (option c).

SOLAR SYSTEM &TIME 24 b.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the Arc of Time between the two locations. The extract from the Almanac includes tables showing the difference between UTC and the Standard Time at various locations. By comparing figures for two locations it is possible to calculate the difference between the two.

The extract on page 24 of this book shows that the standard time in Kuwait is 3 hour later than UTC. The extract on page 24 shows that standard time in Angola 1 hour later than UTC. This means that the time in Kuwait is 2 hours later than that in Angola. So when it is 1000 ST in Kuwait it is 0800 ST in Angola (option b).

SOLAR SYSTEM &TIME 25 a.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the Arc of Time between the two locations. The

extract from the Almanac includes tables showing the difference between UTC and the Standard Time at various locations. By comparing figures for two locations it is possible to calculate the difference between the two.

The extract on page 24 of this book shows that standard time in Guam is 10 hours ahead of UTC, so at 2300 standard time in Guam it is 1300 UTC. After an 11 hour 15 min flight the time of landing in Los Angeles will be 1300 + 11 hour 15 min = 2415 UTC. But page 25 shows that standard time in Los Angeles (in California) is 8 hours behind UTC. So the landing will occur at 2415 – 8 = 1615.

But the question states that summer time rules apply, and the notes at the base of the Almanac extract indicate that this means that Los Angeles time is a further 1 hour behind UTC. So the landing will occur at 1715 Los Angeles standard time on the 30th (option a).

SOLAR SYSTEM &TIME 26 c.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the time difference between UTC and Standard Time at the two locations and using these differences to convert the time at one location into the time at the second. The extract from the Almanac includes tables of the differences between UTC and the Standard Times at various locations.

The extract on page 24 of this book shows that standard time in Queensland Australia is 10 hours later than UTC. The extract on page 25 also shows that the standard time in Hawaii is 10 hour earlier than UTC. This means that the time difference between Hawaii and Queensland is 20 hours. This could mean that the time in Hawaii is 20 hours earlier but on the same day as Queensland, or the Queensland is 20 hours earlier but on an earlier day.

The International Dateline runs between the two, to the East of Australia and to the West of Hawaii. The sun moves from East to West, and Queensland is West of Hawaii, so if there is a date difference between the two, Hawaii will be 1 day ahead of Queensland. So when it is 1300 ST on one day in Queensland it is 20 hours earlier, or 1700 ST on the previous day in Hawaii (option c).

SOLAR SYSTEM &TIME 27 a.

The Sun moves over the Earth from east to West and time is measured in relation to the position of the Sun. Noon at any given point on the Earth for example, is the time at which the sun is directly overhead the meridian on which the point lies. So noon at all points on longitude 000^0 for example is when the sun is directly overhead meridian 000^0. This means that the time at any point on the Earth is later that that at any other point lying to the East and earlier than any point lying to the West.

Universal Standard Time is time related to the Prime Meridian 000^0, which passes through Greenwich, England. Standard Time at any location is UTC adjusted to take account of the time difference between the two. This difference is called the arc of time and is related to the time it takes the Sun complete one full revolution of the Earth. The arc of time between any two longitudes is 1 hour for each degree of longitude change between them. But if all countries used UTC, the time of noon would differ with longitude. At 180^0 W for example, noon would be at 2400 UTC. To overcome this anomaly, countries usually use what is called Standard Time. The Standard time at any location is the time set by the legal authorities for a country or part of a country (option a).

SOLAR SYSTEM &TIME 28 c.

UTC is a time system based upon the Prime Meridian, which passes through Greenwich, England. Local Mean Time (LMT) at any location is UTC adjusted to take account of the difference in longitude between the prime meridian (000^0 W) and the actual longitude of the location in question.

The difference between UTC and LMT can be calculated using the Arc of Time equation:

Time difference = Arc of Time in hours = Longitude change in degrees / 15

123°45' is equal to 123.75 degrees, so at 123°45'W the time difference between LMT and UTC I = 123.75 / 15 = 8.25 hours which is 8 hours 15 mins

But because the Sun moves from East to West, the time at all locations West of the Prime meridian is earlier than UTC. The difference above must therefore be subtracted from UTC.

So when it is 2200 UTC it is 2200 – 0815 = 1345 LMT at position 65°25'N 123°45'W (option c).

It should be noted that the Arc of Time could also have been obtained from an extract of the Air Almanac provided in the JAR ATPL examination paper.

SOLAR SYSTEM &TIME 29 d.

Night and day are caused by the rotation of the Earth about its spin axis. Daytime is that part of the rotation during which the sun is visible, and night is that part of the rotation during which it is not. In addition to spinning about its own axis, the earth also orbits the Sun in a plane called the Ecliptic. The Earth spins about its axis at a constant rate of approximately 360^0 every 24 hours. So if the spin axis of the Earth were at 90^0 to the Ecliptic, the duration of the day and the night would be equal. Under these circumstances the change from day to night would be almost entirely due to the rotation of the earth about its axis.

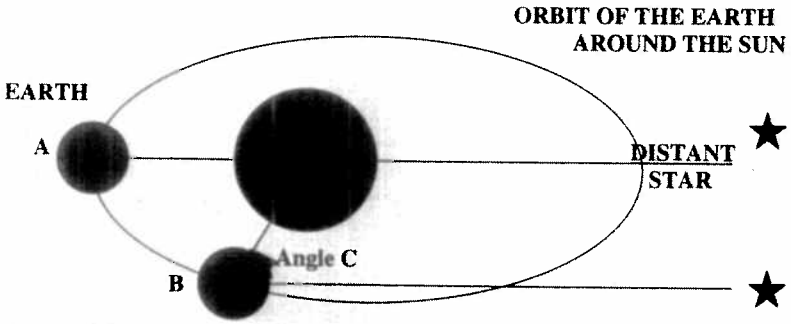
But if spin axis were in line with or at 0^0 to the Ecliptic, then during each 24 hour period, the sun would be permanently visible in the hemisphere closest to it and permanently invisible in the other. It would therefore be permanently day in one

hemisphere and permanently night in the other. If the spin axis were set at any angle between 90^0 and 0^0 each 24 hour period would be part day and part night, but the day would be longer than the night in the hemisphere closest to the Sun.

The spin axis of the Earth is set at 66.5^0 to the Ecliptic. This means that as the earth orbits the Sun, the poles alternate between being the closer and the further from the sun. So the lengths of day and night gradually change as the Earth orbits the Sun. So the main reason that day and night, throughout the year have different lengths is the inclination of the Ecliptic to the Equator (option d).

SOLAR SYSTEM &TIME 30 a.

The mean solar day is the average length of time that it takes for the earth to complete one 360^0 rotation about its axis as measured by reference to a distance star. The mean noon is the time in a mean day at which the earth has completed 1800 of rotation about its axis. At any point on the earth, the mean noon is the time at which the star being used as a reference is directly above the meridian on which the point lies. If the earth were not rotating about the sun, the mean noon at any point on the Earth, would also be the time at which the sun and the star being used as a reference would be directly above the meridian on which the point lies. In this situation the sun and the star would be in a straight line above the meridian as illustrated where the earth is at point A in the diagram below.



The earth is at the same point in its rotation about its axis at points A and B, but is at different points in its orbit around the Sun.

The apparent noon is the time at which the sun appears to be directly overhead of a point on a meridian. Because the earth rotates around the sun, the mean noon and the apparent noon are not always the same point in time.

The diagram show the Earth as viewed from above the North Pole. When the Earth is at point A in the diagram, the sun and the star are in a straight line above the same meridian, so it is both mean noon and apparent noon.

But when the earth has moved point B in its orbit around the sun, the star and the sun are no longer in a straight line. So although it is mean noon, the earth must rotate through a further angle before it will be apparent noon. This means

that the apparent noon will be later than the mean noon. The difference between mean noon and apparent noon varies as the earth moves in its orbit around the sun. The difference is greatest during the months of February and November (option a).

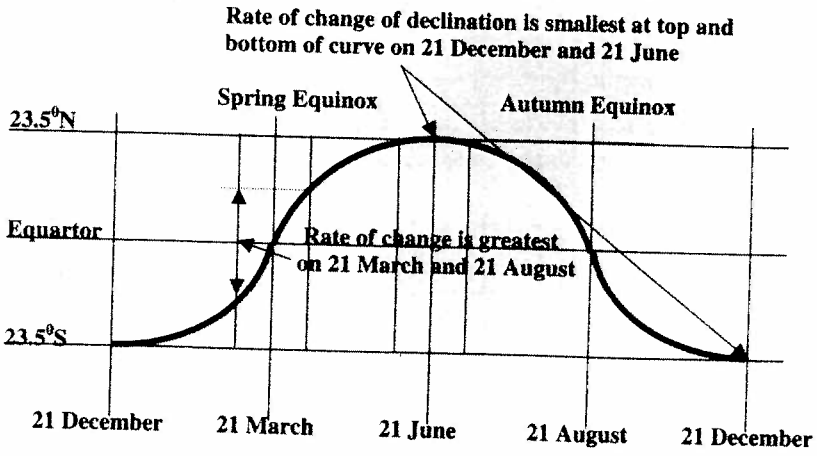
SOLAR SYSTEM &TIME 31 a.

The earth orbits the Sun once per year, in an elliptical orbit, the plane of which is called the Ecliptic. Because the spin axis of the Earth is not at 90^0 to the Ecliptic, the Sun appears to move to the North and then to the South of the Equator as each year progresses. This means that the latitude at which the sun appears to pass directly overhead also changes throughout the year. The highest latitudes at which this occurs is 23.5^0 North and South. Option a, is therefore the most accurate in this question.

SOLAR SYSTEM &TIME 32 b.

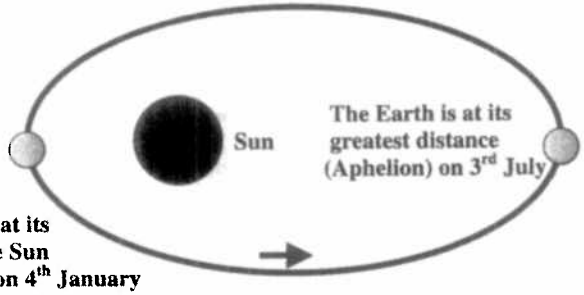
The spin axis of the Earth is tilted at an angle of 66.5^0 to the Ecliptic plane in which it orbits the Sun. Because of this tilt, the North Pole is tilted towards the Sun at one point in the year, then gradually becomes tilted away from it during the subsequent 6 months. Having reached its maximum tilt away, the pole then gradually returns to tilting towards the Sun over the following 6 months. This cyclic variation causes the Sun to move first in a northerly direction then in a southerly direction relative to the Equator as the year progresses. The apparent angle of the Sun north or south of the Equator is termed its declination.

The path of the Sun takes the form of a cosine wave as illustrated below. The maximum northerly position occurs on 21 June and the maximum southerly position on 21 December each year. On 21 March and 21 September the Sun is directly above the equator and the lengths of day and night are equal. These dates are termed the Spring Equinox and the Autumn Equinox respectively. The illustration also shows that the rate of change of the lengths of day and night and the rate of change of declination are greatest on the Spring and Autumn Equinox (option b).



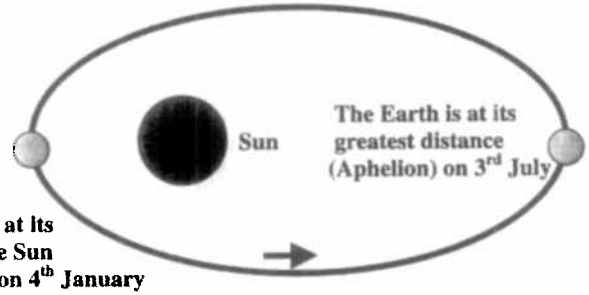
SOLAR SYSTEM &TIME 33 d.

The Earth orbits the Sun in an elliptical orbit approximately once per year. As illustrated below it reaches its closest point at the perihelion at the beginning of January (option d).



SOLAR SYSTEM &TIME 34 a.

The Earth orbits the Sun in an elliptical orbit approximately once per year. As illustrated below it reaches its furthest point from the Sun at the Aphelion at the beginning of July (option a).



SOLAR SYSTEM &TIME 35 b.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the time in LMT of the event at the stated latitude, then adjusting this to UTC to take account of the longitude quoted in the question. The required correction from LMT to UTC is found from the Arc of Time table in the Almanac extract.

The question does not state whether the morning or evening civil twilight are to be considered, but the options all suggest that it is the evening. The table at page 27 indicates that Evening Civil twilight at 051N 008W on 15th August ends at 1959 LMT. The Arc of Time table at page 29 indicates that at 008^0 longitude, the correction from LMT to UTC is 32 minutes. Using the rule "If longitude is west then UTC is best" this correction is added to the LMT to give UTC = 1959 + 0032 = 2031, or approximately 2030 UTC (option b).

SOLAR SYSTEM &TIME 36 c.

For this type of question it is necessary to refer to an extract from the Air Almanac, an example of which is in the Key Facts section of this book. A suitable extract be provided as an Annex to the examination paper. Solving this type of problem involves finding the time in LMT of the event at the stated latitude, then adjusting this to UTC to take account of the longitude quoted in the question. The required correction from LMT to UTC is found from the Arc of Time table in the Almanac extract.

The table on page 28 indicates that sunset at latitude 49N on 6th December is at approximately 0736 LMT. The Arc of time table on page 29 indicates that at 123^0 30' W the correction from LMT to UTC is 8 hours 14 minutes. Using the rule "If longitude is west then UTC is best" this correction is added to LMT to give UTC = 0736 LMT + 0814 = 1550 UTC (option c).

SOLAR SYSTEM &TIME 37 c.

The ratio of elipticity = (Major axis – Minor axis) / Major axis

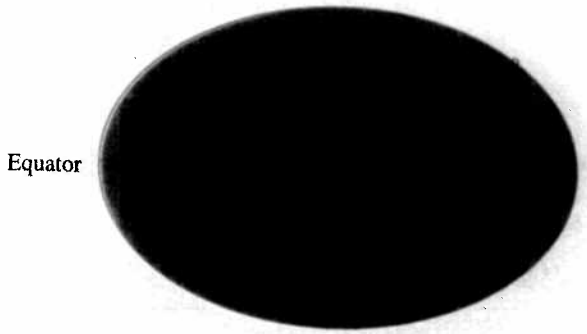
So 1/297 = (6956 – Minor axis) / 6956

This can be rearranged to give:

Minor axis = 6956 – 6956/297 = 6932 (option c)

SOLAR SYSTEM &TIME 38 c.

The Earth is not a perfect sphere, but is an oblate spheroid. This means that its East-West diameter parallel to the equator is slightly greater than it North-South diameter. This situation is illustrated below.



The Ellipicity in this diagram is greatly exaggerated

The term "geocentric latitude" means the latitude measured from the centre of the Earth. The term "geodetic latitude" means the latitude measured from a point were a line at 90^0 to the meridian crosses the Equator. because this line does not necessarily pass through the center of the Earth, the geocentric and geodetic latitudes are not necessarily the same. The maximum difference between the two is 11.6 minutes of arc and occurs at 45^0 North and South (option c).

SOLAR SYSTEM &TIME 39 a.
The south Pole is the most Southerly point on the Earth. This means that all directions on the surface of the earth from the South Pole must be in a Northerly direction. So when standing at the South Pole you must be facing North (option a).

SOLAR SYSTEM &TIME 40 c.
The Earth is not a perfect sphere but is an oblate spheroid. This means that its diameter parallel to the equator is slightly greater than its diameter in a North-South direction. But the average diameter of the Earth is taken to be 3875 nm. Multiplying this by π gives a circumference of 21600 nm (option c).

SOLAR SYSTEM &TIME 41 c.
This type of problem can be solved by using the departure equation:

Distance between two meridians = change in longitude (in min) x cos latitude

This can be rearranged to give:

Change in longitude = Distance between meridians / Cos latitude

For a complete circumnavigation of the earth at any latitude the change of longitude is 360^0. So the change in longitude at the equator will be the same ads that at 60N.

This means that:

Distance at 60^0N / Cos 60^0 = Distance at equator / Cos 00^0

But the groundspeed is equal to the distance divided by the time and both aircraft complete their journeys in the same time. So the distances in each side of the above equation can be replaced by the groundspeeds to give:

Groundspeed at 60^0N / Cos 60^0 = Groundspeed at Equator / Cos 00^0

This can be rearranged to give:

(Groundspeed at 60^0N / Cos 60^0) x Cos 00^0 = Groundspeed at the Equator

Inserting the data provided in the question gives:

(240 Kts / 0.5) x 1 = Groundspeed at Equator = 480 Kts (option c).

SOLAR SYSTEM &TIME 42 d.
The Earth is not a perfect sphere but is an oblate spheroid. This means that its diameter parallel to the equator is slightly greater than its diameter in a North-South direction. But the average diameter of the Earth is taken to be 12732.4 km. Multiplying this by π gives a circumference of 40000 km (option d).

SOLAR SYSTEM &TIME 43 a.
This type of problem can be solved using the standard equation:

Time difference (in hours) UTC = Change in longitude West (in degrees) /15

The change in longitude in this question = 40^0 W + 50^0 E = 90^0 W

Inserting this into the above equation gives:

Time difference = 90 / 15 = 6hours.

Adding this to the sunrise time at 50^0E gives:

Sunrise time at 40^0 W 0254 UTC + 6hours = 0854 (option a).

SOLAR SYSTEM &TIME 44 d.
This type of problem can be solved using the standard equation:

Time difference (in hours) UTC = Change in longitude West (in degrees) /15

The change in longitude in this question = 60^0 W + 25^0 E = 85^0 W

Inserting this into the above equation gives:

Time difference = 85 / 15 = 5.67 hours, which is 5 h 40 mins.

Adding this to the sunrise time at 25^0E gives:

Sunset at 60^0 W 1633 UTC + 5 h 40 min = 2213 UTC (option d).

SOLAR SYSTEM &TIME 45 c.
This type of problem can be solved using the standard equation:

Time difference (in hours) UTC = Change in longitude West (in degrees) /15

The change in longitude in this question = 40^0 E from 25^0 W = 65^0 E

Inserting this into the above equation gives:

Time difference = 65 / 15 = 4.33 hours which is 4 h 20 mins.

Subtracting this from the sunrise time at 25^0 W gives:

Sunrise time at 40^0 E 0654 UTC - 4 h 20 min = 0234 UTC (option c).

SOLAR SYSTEM &TIME 46 a.

This type of problem can be solved by using the departure equation:

Distance between two meridians = change in longitude (in min) x cos latitude

This can be rearranged to give:

Change in longitude = Distance between meridians / Cos latitude

For a complete circumnavigation of the earth at any latitude the change of longitude is 360^0. So the change in longitude at the equator will be the same as that at 50N.

This means that:

Distance at 50^0N / Cos 50^0 = Distance at equator / Cos 00^0

But the groundspeed is equal to the distance divided by the time and both aircraft complete their journeys in the same time. So the distances in each side of the above equation can be replaced by the groundspeeds to give:

Groundspeed at 50^0N / Cos 50^0 = Groundspeed at Equator / Cos 00^0

This can be rearranged to give:

(Groundspeed at 50^0N / Cos 50^0) x Cos 00^0 = Groundspeed at the Equator

Inserting the data provided in the question gives:

(340 Kts / 0.643) x 1 = Groundspeed at Equator = 529 Kts (option a).

SOLAR SYSTEM &TIME 47 b.

This type of problem can be solved by using the departure equation:

Distance between two meridians = change in longitude (in min) x cos latitude

This can be rearranged to give:

Change in longitude = Distance between meridians / Cos latitude

For a complete circumnavigation of the earth at any latitude the change of longitude is 360^0. So the change in longitude at the equator will be the same as that at 45N.

This means that:

Distance at 45^0N / Cos 45^0 = Distance at equator / Cos 00^0

But the groundspeed is equal to the distance divided by the time and both aircraft complete their journeys in the same time. So the distances in each side of the above equation can be replaced by the groundspeeds to give:

Groundspeed at 45^0N / Cos 45^0 = Groundspeed at Equator / Cos 00^0

This can be rearranged to give:

(Groundspeed at 45^0N / Cos 45^0) x Cos 00^0 = Groundspeed at the Equator

Inserting the data provided in the question gives:

(300 Kts / 0707) x 1 = Groundspeed at Equator = 424.3 Kts (option b).

SOLAR SYSTEM &TIME 48 c.

This type of problem can be solved by using the departure equation:

Distance between two meridians = change in longitude (in min) x cos latitude

This can be rearranged to give:

Change in longitude = Distance between meridians / Cos latitude

For a complete circumnavigation of the earth at any latitude the change of longitude is 360^0. So the change in longitude at 60N will be the same as that at 20N.

This means that:

Distance at 60^0N / Cos 60^0 = Distance at 20^0N / Cos 20^0

But the groundspeed is equal to the distance divided by the time and both aircraft complete their journeys in the same time. So the distances in each side of the above equation can be replaced by the groundspeeds to give:

Groundspeed at 60^0N / Cos 60^0 = Groundspeed at 20^0N / Cos 20^0

This can be rearranged to give:

(Groundspeed at 60^0N / Cos 60^0) x Cos 20^0 = Groundspeed at 20^0N

Inserting the data provided in the question gives:

(240 Kts / 0.5) x 0.94 = Groundspeed at 20^0N = 451 Kts (option c).

SOLAR SYSTEM &TIME 49 c.

This type of problem can be solved by using the departure equation:

Distance between two meridians = change in longitude (in min) x cos latitude

This can be rearranged to give:

Change in longitude = Distance between meridians / Cos latitude

For a complete circumnavigation of the earth at any latitude the change of longitude is 360^0. So the change in longitude at 45S will be the same as that at 75N.

This means that:

Distance at 75^0N / Cos 75^0 = Distance at 45^0S / Cos 45^0

But the groundspeed is equal to the distance divided by the time and both aircraft complete their journeys in the same time. So the distances in each side of the above equation can be replaced by the groundspeeds to give:

Groundspeed at 75^0N / Cos 75^0 = Groundspeed at 45^0S / Cos 45^0

This can be rearranged to give:

(Groundspeed at 75^0N / Cos 75^0) x Cos 45^0 = Groundspeed at 45^0S

Inserting the data provided in the question gives:

(300 Kts / 0.259) x 0.707 = Groundspeed at 45^0S = 820 Kts (option c).

SOLAR SYSTEM &TIME 50 b.

This type of problem can be solved by using the departure equation:

Distance between two meridians = change in longitude (in min) x cos latitude

This can be rearranged to give:

Change in longitude = Distance between meridians / Cos latitude

For a complete circumnavigation of the earth at any latitude the change of longitude is 360^0. So the change in longitude at the equator will be the same as that at 30N.

This means that:

Distance at 30^0N / Cos 30^0 = Distance at equator / Cos 00^0

But the groundspeed is equal to the distance divided by the time and both aircraft complete their journeys in the same time. So the distances in each side of the above equation can be replaced by the groundspeeds to give:

Groundspeed at 30^0N / Cos 30^0 = Groundspeed at Equator / Cos 00^0

This can be rearranged to give:

(Groundspeed at 30^0N / Cos 30^0) x Cos 00^0 = Groundspeed at the Equator

Inserting the data provided in the question gives:

(400 Kts / 0.866) x 1 = Groundspeed at Equator = 462 Kts (option b).