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1000 QUESTIONS

ANSWERS AND EXPLANATIONS FOR

JAR EASA ATPL (A) AND CPL (A) RADIO NAVIGATION

KEITH WILLIAMS

JAR EASA ATPL (A) AND CPL (A) RADIO NAVIGATION

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INTRODUCTION

The purpose of this book is to assist students preparing to undertake the EASA ATPL and CPL Radio Navigation Examinations. The questions are based upon feedback provided by students who have undertaken the JAR/EASA 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. This first edition includes questions drawn from the JAR CQB15.

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

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SECTION 1

KEY FACTS AND COMMONLY USED EQUATIONS

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BASICS

Speed Frequency And Wavelength.

The speed of propagation of radio waves = 300 000 000 metre per second or 162 000 nautical miles per hour.

Wavelength is the distance travelled by the wave in one cycle.

Wavelength in metres = 300 000 000 / frequency in Hz.

Frequency is the number of complete cycles per second.

Frequency is measured in Hertz (Hz) where 1 Hz is one cycle per second.

Wavelength = Speed of Light / Frequency.

FREQUENCY SPECTRUM

Frequency	Band	Wavelength	Uses
3 to 30 Hz	VLF	10 km to 100 km	Very long range navigation.
30 to 300 Khz	LF	1 km to 10 km	LORAN C, DECCA, NDB.
300 to 3000 Khz	MF	100 m to 1 km	NDB, Radio ranging.
3 to 30 MHz	HF	10 m to 100 m	HF R/T.
30 to 300 MHz	VHF	1 m to 10 m	VHF R/T, VOR, VDF, ILS.
300 to 3000 MHz	UHF	10 cm to km	DME, ILS Glidepath, Surveillance radars
3 to 30 GHz	SHF	1 cm to 10 cm	PAR, Doppler, Weather radar, RADALT.
30 to 300 GHz	EHF	1 mm to 1 cm	Airfield surface movement radar

PROPAGATION METHODS

Direct wave:

Follows a straight-line path from the transmitter so can be use for line of sight paths only.

Surface wave:
Waves, which are diffracted by the atmosphere such that they follow the curvature of the earth.

Most effective at low frequencies.

Effectiveness depends on surface type, and is better of dry land than over water.

Not usable over long ranges at frequencies above 30 MHz so used only for HF and below.

Ground wave:
Combined effects of direct wave and waves reflected by the ground.

Sky waves:
Radio waves that have been reflected back from the ionosphere.

Used for over the horizon communications.

Most effective in HF band and lower frequencies.

Not usable in VHF frequency and above due to attenuation in the ionosphere.

The D layer attenuates all but VLF frequencies and below at daytime.

The skip distance is the distance between the transmitter and the point at which the first returning skywave strikes the ground.

The dead zone is the area between the transmitter and the skip distance, within which returning sky waves cannot be received.

SIGNAL MODULATION METHODS

AM
Information is transmitted by varying the amplitude of the signal.

Susceptible to static interference.

FM
Information is transmitted by modulating the frequency of the signal.

Less susceptible to static interference.

VHF DIRECTION FINDING (VDF)

Frequencies and emission type.
VDF employs frequencies between 118 MHz and 137 MHz in the VHF frequency band.

The signals used are A3E, which means that they are voice modulated carrier waves.

Equipment used.
VDF employs the following equipment:

1. A VHF transmitter/receiver in the aircraft.
2. A VHF transmitter/receiver in the ATC station.
3. A directional aerial and CRT display in the ATC station.

Method of operation.
The pilot uses a VHF radio to request the required service (QDM, QDR, QTE or QUJ) from the ATC station.

The VDF equipment at the ATC station uses the directional aerial to determine the direction from which the request is coming. This is displayed on the CRT display.

The ATC station then uses a VHF radio to give the pilot of the requested information.

Services provided.
QDM The magnetic heading to steer in zero wind to the station. This is used mainly for station homing and letdowns.
QDR The magnetic bearing from the station. This is used for en-route navigation.
QTE The true bearing of the aircraft from the station. This is used for en-route navigation.
QUJ The aircraft's true track to the station. This is not generally used.

Classification and accuracy of bearings.
Class A. Within +/- 2 degrees.
Class B. Within +/- 5 degrees.
Class C. Within +/- 10 degrees.
Class D. Worse than +/- 10 degrees.

Signal propagation and maximum possible range.
Signals are propagated as direct waves, which follow straight-line line-of-sight paths.

Maximum range is limited by the transmitter power, the height of aircraft and the height of ATC station.

In cases where the height of the aircraft and the station are not limiting factors, unusually atmospheric conditions including inversions may produce longer ranges due to ducting or super-refraction of the signals.

Maximum Range (in nm) = 1.25 x ($\sqrt{H1} + \sqrt{H2}$)

Where H1 is the height of the station in feet and H2 is the height of the aircraft, in feet.

Factors affecting accuracy.
Propagation errors / site errors may be caused by the aircraft signals being terrain or building close to the station.

The simultaneous reception of direct waves and ground reflected waves cause fading. Multi-path signals reduce accuracy.

VDF signals are vertically polarised, so best reception requires straight and level flight during transmission and reception of signals.

Accuracy is poor when the aircraft is directly over the station.

Emergencies.
In UK airspace auto-triangulation position fixing is used when transmissions are made on the VHF emergency frequency 112.5 MHz (VHF) and 243.0 MHz (UHF).

VHF let down services.
In a QDM let down the pilot requests a series of QDM, then uses them to follow the published approach pattern, making his/her own adjustments to height and heading.

In a QGH let down the controller obtains bearings from the aircraft's transmissions then tells the pilot which headings and heights are to be flown.

AUTOMATIC DIRECTION FINDING (ADF)

Frequencies and emission type.
ADF employs Non Directional Beacons (NDBs) transmitting on frequencies between 190 KHz and 1,750 KHz in the LF and MF frequency bands.

Two types of he NDB are used. These transmit the following signals (depending on type of NDB). The signals from each NDB include a unique morse-code identifier to enable the pilot to confirm that the signal that is being received is coming from the beacon that has been selected.

NONA1A With this type of NDB the Beat Frequency

Oscillator (BFO) must be switched on for tuning identification and monitoring. The purpose of the BFO is to convert the non-audible NDB signal into an audible signal to enable the pilot to hear the identifier and to use it to identify the beacon.

NONA2A With this type of NDB the BFO must be switched on for tuning and identification, then switched off for monitoring.

Ground Based Equipment.
ADF employs the following two types of ground based Non Directional Beacons (NDBs), which transmit signals in all directions.

Locator (L) These are low powered NDBs that are used for airfield runway approach procedures. They are usually co-located with the Outer and Middle Markers in ILS systems. Their maximum range is typically between 10 nm and 25 nm.

En-Route NDBs These are used for en-route and airways navigation, ~~homing~~ and holding. Their maximum range is typically 50 nm or more.

Airborne Equipment.
To use ADF, the aircraft must be fitted with the following:

A Sense Aerial.
A Loop Aerial.
A Control Unit.
A Receiver.
A Cockpit Display (RMI or RBI).

Method of operation.
The pilot selects the frequency of the required NDB. The loop and sense aerials then detect the NDB signals and feed them to the receiver. Using the BFO, the pilot listens to the morse-identifier within the NDB signal and confirms that the signals are coming from the selected NDB. The loop and sense aerials then determine the direction from which the signals are approaching the aircraft. This information is then displayed to the pilot on the RMI or RBI. The pilot uses this display to flying the aircraft in the required direction.

Relative Bearing Indicator (RBI).
The RBI consists of a standard compass rose and a moving needle. The compass rose is either fixed with 000 degrees aligned with the aircraft nose, or can be rotated by the pilot using heading knob, to align the intended heading with the aircraft nose.

When ADF is in use the needle always points towards the beacon (QDM). In this way the needle always indicates the relative bearing of the beacon. The tail of the needle always points in the direction of QDR.

Radio Magnetic Indicator (RMI).
The compass rose is driven by the magnetic compass, such that it is always aligned with local magnetic field of the Earth. As with the RBI, the point of the needle points towards the beacon (QDM) and the tail points in the direction of QDR.

Services provided.
Locators provide azimuth guidance during runway approaches

En-Route NDBs provide azimuth guidance for homing, holding, en-route navigation and airways navigation.

Accuracy of bearings.
ADF bearings are accurate within +/- 5 degrees during daytime only, within the Designated Operational Coverage (DOC).

Bearings are less accurate at night due to "night effect errors" that are caused by changes in the ionosphere.

Signal propagation and maximum possible range.
Signals are propagated as surface waves.

Maximum range is proportional to the square root of the transmitter power and can be calculated as follows:

Range over water in nm = 3 x √ Power output in watts.
Range over land in nm = 2 x √ Power output in watts.

Factors affecting accuracy.

Static Interference Thunderstorms produce extremely strong static electricity discharges. In precipitation the collision of water droplets and ice crystals produce much weaker static electrical discharges. In both cases these discharges interfere with the reception of the NDB signals.

Station Interference Because of severe congestion within the LF and MF bands, each frequency is used by more than one NDB. Under certain conditions the aircraft ADF system can simultaneously receive signals from more than one NDB station. This greatly reduces the accuracy of the system.

Mountain Effect. Reflection and diffraction of NDB signals in mountainous areas changes the direction from which NDB

signals approach the aircraft.

Quadrantal Errors. Strong electrical fields are generated around aircraft in flight. These fields are aligned with the longitudinal axis of the aircraft. NDB signals approaching the aircraft are bent such that they become more aligned in the longitudinal direction. This causes the ADF to produce inaccurate bearings.

Coastal refraction. Radio signals move faster over water than over land. When NDB signals move across coasts at angles other than 90 degrees, this change of velocity causes their paths to be bent due to the process of refraction. This changes the direction from which the NDB signals approach aircraft.

Bank Angle (Dip). The ADF loop aerial is used to determine the direction from which the NDB signals are approaching the aircraft. But the aerial is designed to be most accurate when in the vertical position. Significant bank angles therefore reduce the accuracy of the ADF system.

VHF OMNI-DIRECTIONAL RANGE (VOR)

Frequencies and emission type.
VOR employs Omni-Directional Beacons transmitting on frequencies between 108 MHz and 117.95 MHz in the VHF frequency band.

40 channels between 108 and 112 MHz are used for ILS and Terminal VORs (TVOR). The first decimal digits of frequencies for TVORs are even (108.0 109.25, 110.45 etc). The first decimal digits for ILS VORs are odd (108.1, 109.3, 110.5 etc)

120 channels between 112 and 117.95 MHz are used for en-route VORs.

Emission code is A9W. A = Double side-band amplitude modulated carrier wave
9 = Composite system.
W = Combined telephony / telegraphy.

Ground Based Equipment.
Each VOR beacon transmits two signals simultaneously:

A **Reference Signal** frequency modulated at 30 Hz. This produces a **constant phase** regardless of the bearing of the receiver relative to the VOR.

A **Variable Signal** amplitude modulated at 30 Hz, created by a rotating Limacon. The **phase of this signal varies** with bearing of the receiver relative to the VOR beacon.

The phase difference between the two signals is equal to the bearing of the aircraft relative to the VOR beacon. So, for example, the two signals are in phase when the aircraft is due north of the VOR beacon. And they are 90 degrees out of phase when the aircraft is due east of the VOR beacon.

Airborne Equipment.
To use VOR, the aircraft must be fitted with the following:

An Aerial to receive the signals.
A Receiver to process the signals and to enable the pilot to select the required VOR beacon.
A Cockpit Display (RMI or CDI).

Method of operation.
The pilot selects the frequency of the required VOR beacon, and the required course. The aerial then detects the VOR signals and feeds them to the receiver. Using the BFO, the pilot listens to the morse-identifier within the signal and confirms that the signals are coming from the selected VOR. The receiver then uses the phase difference between the reference signal and the variable signal to determine the bearing of the aircraft relative to the VOR beacon. This information is then displayed to the pilot on the RMI, or CDI. The pilot uses this display to flying the aircraft in the required direction.

Relative Bearing Indicator (RBI).
See ADF key points for details of the RBI.

Magnetic variation is applied at the VOR station.

Course Deviation Indicator (CDI).
The basic CDI consists of a deviation pointer moving over a horizontal scale. The aircraft position is at the centre of the scale and the position of the pointer indicates the position of the select VOR radial. If for example, the pointer moves to the right of centre, this means that the selected radial is to the right of the aircraft, so the aircraft must fly to the right to get onto the selected radial.

On a standard 5 dot CDI the scale is made up of an inner circle, the deg of which represents the first dot, then a further four dots to left and 4 to the right. Each dot represents 2 degrees, so full-scale deflection (5 dots) represents 10 degrees deviation.

A "TO" flag and a "FROM" flag indicate whether the selected radial is TO or FROM the VOR beacon.

More advanced CDIs include an additional pointer moving over a vertical scale. These indicate deviation from the glide slope

when using ILS, while the horizontal scale and pointer indicate deviation from the ILS centreline.

Services provided.
VORs can be used to provide the following services:

1. En-route navigation aids providing navigation lines.
2. Marking the beginning, end and centre-lines of airways and sections of airways.
3. Marking holding points for airborne aircraft in vicinity of airports.
4. Let-down aids at airfields using published procedures.

Accuracy of bearings.
VOR beacons are accurate within +/- 1 degree.

Airborne VOR equipment is accurate within +/- 3 degree.

Overall system accuracy is within +/- 5 degrees.

Signal propagation and maximum possible range.
Signals are propagated as direct waves, which follow straight-line line-of-sight paths.

Maximum range is limited by the transmitter power, the height of aircraft and the height of the VOR beacon.

In cases where the height of the aircraft and the station are not limiting factors, unusually atmospheric conditions including inversions may produce longer ranges due to ducting or super-refraction of the signals.

Maximum Range (in nm) = $1.25 \times (\sqrt{H1} + \sqrt{H2})$

Where H1 is the height of the VOR beacon in feet and H2 is the height of the aircraft, in feet.

Factors affecting accuracy.

Site Errors. These are caused by structures, hills, uneven terrain and long grass, close to the transmitter. These cause reflections bend the paths taken by the signals. Ground VOR site errors are monitored to ensure that they do not exceed +/- 1 degree.

Propagation Errors. These are similar to site errors but are caused by more distant objects.

Scalloping Errors. These are imperfections or deviations in the received VOR signals. They are caused by reflections from buildings or terrain, and cause the VOR radials to deviate from the standard tracks. The course deviation indicator moving slowly or rapidly from side to side indicates scalloping.

Airborne Equipment Errors. These are caused by minor inaccuracies in the processes whereby the aircraft equipment converts the signals into bearings. This type of error should be within +/- 3 degrees.

The cumulative effect of the above errors should be within +/- 5 degrees. Addition inaccuracies will be caused by the pilot interpretation of the system indications.

Types of VOR

Conventional VOR (CVOR). Uses an FM reference signal and AM variable signal. Produces a clockwise rotating limacon polar diagram.

Doppler VOR (DVOR). Uses an AM reference signal and an FM variable signal. Is less sensitive to site errors, so it is more accurate than CVOR.

Terminal VOR (TVOR). Low powered VORs used at major airports.

Test VOR (VOT). Used at certain airfields to transmit a 180 degree test radial. Used to test aircraft VOR systems but not used for navigation purpose.

Aerodrome Flight And Terminal Information Service Broadcast (AFISVOR). Used to transmit AFIS and ATIS information at some airports.

Co-Located VOR and TACAN/DME Beacons (VORTAC). Used to provide simultaneous bearing and distance information.

DISTANCE MEASURING EQUIPMENT (DME)

Frequencies and pulse characteristics.
DME employs frequencies between 962 MHz and 1213 MHz in the UHF frequency band. Channel spacing is 1 MHz, giving 252 channels.

Signals are transmitted in the form of a series of pulse-pairs.

Spacing between pulses is randomly jittered to enable airborne equipment to identify their own signals and the response to them

The frequency of the signals transmitted by the airborne interrogator and the ground station differ by +/- 63 MHz to

prevent the airborne equipment from locking onto reflections of its own signals.

Ground Based Equipment.
DME employs the ground-based stations, which respond to interrogations for airborne equipment.

Stations transmit a 3 letter identifier during the initial identification phase of operation. Range information is not available during this period.

Pulse rate is initially 150 pulses per second (pps), then reduces to 60 pps after 15000 pulse pairs have been transmitted. Pulse rate then decreases to 25 pps after lock-on has been achieved.

Maximum ground station pulse rate is 2700 pps, giving a capacity to service approximately 100 aircraft simultaneously.

When the ground station becomes saturated (more than 10 aircraft requesting service) the gain rate is reduced such that only the strongest interrogation signals are responded to.

DME and VOR ground stations often work in conjunction with each other. The DME provides accurate slant range information and the VOR provides accurate magnetic bearing information.

Associated Stations. These are DME and VOR stations that are within 100 feet in a TMA or within 2000 feet outside a TMA. They share the same call sign and are frequency paired.

Not Associated Stations. Located beyond the distance limits set for associated stations. If they service the same locations the third letter of the DME identifier is Z. They are frequency paired

Separated Stations. These are DME and VOR stations that are more than 6 nm apart. Their call signs are different.

Airborne Equipment.
To use DME, the aircraft must be fitted with the following:

An Aerial.
A Receiver/Interrogator Unit.
A Control and Display Unit.

Method of operation.
The pilot selects the frequency of the required DME ground station. The receiver/interrogator then sends out a series of pulse-pairs on the selected frequency, and simultaneously commence a range search.

Upon receiving the interrogation signal the ground station transponder waits for 50 microseconds then sends back the interrogation pulse-pairs at a frequency that is +/-63 MHZ from the airborne interrogator frequency.

The airborne receiver/interrogator analyses incoming signals and using its own unique stream of pulses, identifies the responses to its interrogation signals. The interrogator then goes into track mode in which it maintains contact with the ground station, but at a reduced pulse rate of approximately 25 pps.

In the track mode the interrogator t calculates the slant range to the ground station by measuring the time delay interval between the transmission of its interrogation signal and the receipt of the ground station response.

Calculation of Ground Speed. DME calculates the ground speed of the aircraft by measuring the rate of change of the slant range. This calculation is most accurate when the aircraft is tracking directly towards or way from the station, is at low altitude and is at long range from the station.

Signal propagation and maximum possible range.
Signals are propagated as direct wåves, which follow straight-line line-of-sight paths.

Maximum range is limited by the transmitter power, the height of aircraft and the height of the DME station.

In cases where the height of the aircraft and the station are not limiting factors, unusually atmospheric conditions including inversions may produce longer ranges due to ducting or super-refraction of the signals.

Maximum Range (in nm) = $1.25 \times (\sqrt{H1} + \sqrt{H2})$

Where H1 is the height of the DME ground station in feet and H2 is the height of the aircraft, in feet.

Accuracy of Range Indications.
Total system error must be not greater than +/- 0.2 nm for aircraft registered on or after 1 January 1989.

Total system error must be not greater than +/- 0.25 nm plus 1.25% for aircraft registered before 1 January 1989.

DME indicates Slant Range. The difference between Slant range and Ground Range increases as the aircraft height increases and as the range decreases. This difference is

significant when range (in nm) is less than 3 times the aircraft height (in thousands of feet).

When the aircraft is directly above the DME station the Ground range will be zero but the indicated range will be the height of the aircraft in nm.

INSTRUMENT LANDING SYSTEMS (ILS)

Frequencies And Ground-Based Components.

Localiser. 40 channels between 108 MHz and 111.975 MHz In the VHF band. The aerial is located at the upwind end of the runway.

Glide Path. 40 channels between 329.15 MHz and 335 MHz in the UHF band. Frequency paired with the Localiser. The aerial is located abeam the touch-down point.

Markers. The INNER MARKER, MIDDLE MARKER and OUTER MARKER all transmit vertical fan shaped beams on 75 MHz in the VHF band. They are distinguished from each other by their colour and their morse-code pattern.

Back Beam. Transmitted by the Localiser on the same frequency., They may be used for non-precision approaches to the reciprocal runway.

Locator. Low powered NDB located at the Outer Marker.

DME. Sometimes used in place of the markers. Transmit on standard DME frequencies. Frequency paired with the ILS. DME is zero-referenced to the threshold.

Ident. 2 or 3 letters transmitted at a rate of 7 groups per second. The Ident is suppressed if the ILS is unserviceable. A continuous tone is transmitted during maintenance. VOR Idents are transmitted 3 times every 30 seconds. DME idents are transmitted 1 time every 30 seconds.

Markers

Outer. Located 6.5 km to 11.1 km from threshold
Blue.
Modulated at 400 Hz. "da da" once per sec.

Middle. Located 1050 metres from threshold
Orange.
Modulated at 1300 Hz. "dit da" 3 times per sec.

Inner. Located 75 to 450 metres from threshold
White.
Modulated at 3000 Hz. "dit" 6 times per sec.

Coverage And Range.

Localiser. 10 degrees each side of centreline out to 25 nm.
35 degrees each side of centreline out to 17 nm.
Outside of 10 degrees each side of centreline out to 10 nm.

Glide Path. 8 degrees either side of centreline out to 10 nm.
0.45 ϕ below to 1.75 ϕ above the published glide path angle where ϕ is the published glide path angle.

Operating Principles.

Localiser. Two horizontally overlapping lobes are transmitted.
The left lobe is modulate at 90 Hz frequency.
The right lobe is modulated at 150 Hz frequency.
The depth of modulation (DoM)increases away from the centreline.
The difference in depth of modulation (DDM) is zero on the centreline.
Aircraft position relative to centreline is determined by measuring DDM.

Back Course. If approved this can be used for non-precision approaches to the reciprocal runway.
CDI readings will be reversed.
HSI readings can be in correct sense if front course QDM is set.

Glide Path. Two vertically overlapping lobes are transmitted.
The upper lobe is modulated at 90 Hz frequency.
The lower lobe is modulated at 150 Hz frequency.
The depth of modulation (DoM) increases away from the published glide path angle (ϕ).
The difference in depth of modulation (DDM) is zero on ϕ.
Aircraft position relative to ϕ is determined by measuring DDM.
False Glide Paths occurs at multiples of ϕ, so for a 3 degree glide path the first false glide path is at an angle of 6 degrees.

Glide path Reference Datum is (usually 50 feet)the height of the glide path above the threshold.

Cockpit Indications.

Course Deviation Indicator (CDI) or Horizontal Situation Indicator (HSI).
On a standard 5 dot CDI/HSI the horizontal (localiser) scale is made up of an inner circle, the deg of which represents the first

dot, then a further four dots to left and 4 to the right. Each dot represents 0.5 degree, so full-scale deflection (5 dots) represents 2.5 degrees or more.

The vertical (glide path) scale is of the same form, but each dot represents 0.14 degrees deviation and full-scale deflection represents a deviation of 0.7 degrees or more.

Factors affecting accuracy.

Beam Bends. These are caused by atmospheric conditions such as heavy precipitation.

Beam Noise. This is generated by the ILS transmitter or interference from other systems.

Scalloping and Reflection Errors. These are caused by reflections from buildings or terrain, and vehicles close to the ILS aerials. When the main ILS signals are reflected from objects, they take different paths to the aircraft. This causes the airborne ILS equipment to receive two or more signals simultaneously. These multi-path signals reduce the accuracy of the system.

The following areas are defined to protect the ILS signals from interference:

ILS CRITICAL AREA.
An area of specified dimensions around the ILS aerials, from which vehicles and aircraft are excluded during all ILS operations.

ILS SENSITIVE AREA.
An area beyond the critical area, within which parking of vehicles and aircraft are controlled to prevent unacceptable interference during low visibility ILS operations.

ILS Categories.

Category 1. An instrument approach and landing with:

1. Decision Height (DH) not lower than 200 feet (60 metres).
2. Runway Visual Range (RVR) not less than 550 metres.

Category 2. An instrument approach and landing with:

1. Decision Height (DH) not lower than 200 feet (60 metres).
2. Runway Visual Range (RVR) not less than 300 metres.

Category 3A. An instrument approach and landing with:

1. Decision Height (DH) not lower than 100 feet (30 metres).
2. Runway Visual Range (RVR) not less than 200 metres.

Category 3B. An instrument approach and landing with:

1. Decision Height (DH) not lower than 50 feet (15 metres).
2. Runway Visual Range (RVR) less than 200 metres, but not less than 50 metres.

Category 3C. An instrument approach and landing with no DH or RVR.

PAPIs. These provide visual guidance of the position of the aircraft relative to the glide path.

MICROWAVE LANDING SYSTEM (MLS)

Frequencies and Channels.
MLS operates on frequencies from 5031 MHz to 5090 MHz is the SHF band, providing 200 channels.

Coverage And Range.
Azimuth. At least degrees each side of the runway Centreline, out to a usable range of 20 to 30 nm.

Glide Path. From 0.9 degrees to 20 degrees above the horizontal can be selected, out to a usable range of 20 to 30 nm.

Overshoot And Departure A secondary system provides overshoot and departure guidance between +/- 20 degrees of the runway direction up to 15 degrees elevation.

Operating principle.
MLS employs a Time Referenced Scanning Beam system. This means that the azimuth part of the system scans 'to and fro" from left to right and back again across the designated area of coverage. The azimuth position of an approaching aircraft is calculated by measuring the time taken for the beam to sweep over it in successive "to and fro" scans. The glide path element of the system operates in the same manner, but with the beam scanning up and down.

This scanning process enables the problem of reflected signals to be eliminated by temporarily switching off the beams as they pass over areas of known obstructions.

Advantages.
MLS is less susceptible to site errors, so it can be used in locations that would be unsuitable for ILS

The increased azimuth and elevation coverage enables pilots to

select their own approaches.

Has a built in DME.

Is compatible with conventional localiser and glide path instruments, EFIS, Area Navigation Systems and Autopilot Systems.

RADAR THEORY

Types Of Radar.
Primary Radar. Detects targets by transmitting radio energy towards the target and detecting any energy that is reflected back from the target.

Secondary Radar. An **interrogator** transmits pulses of radio energy on one frequency. When a **transponder** in the target receives the signal transmitted from the interrogator, it transmits a reply signal on a different frequency.

Radar Frequencies.
Radar system employs frequencies in the VHF band and above.

These frequencies are free from static interference and ionospheric scatter.

Higher frequencies produce shorter wavelengths, which are able to produce shorter pulses.

Reflection of radar energy from objects is determined by the size of the object in relation to the wavelength of the signal. Short wavelengths are reflected better than long wavelengths.

Pulse Technique.
Most radars employ pulse technique in which radar energy is transmitted in short bursts or pulses.

The time periods between the transmissions of each successive pair of pulses is used to receive energy that has been reflected from the targets.

The **Pulse Recurrence Interval (PRI)** is the time interval between two successive pulses. This period is also commonly called the **Pulse Recurrence period (PRP).**

Pulse Recurrence Frequency (PRF) is the number of pulses transmitted per second. It is also known as the **Pulse Recurrence Rate (PRR).** The term **PPS** refers to the **Pulses Per Second** transmitted by the radar.

PRR = 1 / PRF

The range or distance from the radar antenna to the target is calculated by measuring he time interval between the transmission of a pulse and the reception of energy from that **pulse, reflected** back to from the target. That is the time taken for a pulse to go from the antenna to the target and back again.

Radar energy moves at the speed of light, which is 300 000 000 metres per second. So the range to the target can be calculated using the following equation:

Range (in metres) = (Time (in secs) x 300 000 000 m/sec) / 2

Maximum Unambiguous Range.
To provide unambiguous range, each pulse must have sufficient time to fly out to the furthest target and return to the antenna, before the next pulse is transmitted. This means that the PRF determines the maximum unambiguous range.

Max range (in metres) = 300 000 000 m/sec / (PRF x 2)

This can be rearranged to give PRF for a given maximum range:

PRF (in PPS) = 300 000 000 m/sec / (2 x Max Range in metres)

Minimum Unambiguous Range.
To detect targets at close range the reflected energy must not arrive back at the antenna before the transmission of the pulse has been completed. This means that the duration of the pulse (Pulse Width) determines the minimum unambiguous range at which targets can be detected.

Min Range (metres) = Pulse Width (secs) x 300 000 000 m/sec.

Target Direction And Elevation. The direction and elevation of the target relative to the antenna, are determined by measuring the azimuth and vertical angles from which the reflected energy is being received.

<u>Factors Affecting Maximum Theoretical Range.</u>
Transmitter Power. The intensity of the radar energy is attenuated as it moves through the air. This reduces the strength of the signals that are reflected back from targets to the antenna. The relationship between transmitter power and energy is described by the following equation:

Theoretical max range (nm) = 4√ Power in watts.

This means that to double the maximum theoretical range the power must be increased by a factor of 16.

Characteristics Of Reflecting Objects. The size, shape, aspect and material of the target all have marked effects on their reflective properties. Metals for example, are more reflective than wood or composite materials. Large objects with surfaces at 90 degrees to the radar beam reflect better than small objects set at oblique angles. Aircraft side elevations reflect better than forward or rear elevations.

Antenna Height and Target Height. The signals produced by radar systems travel in straight lines, so the maximum range can be limited by intervening terrain or other obstructions.

Max theoretical range (nm) = 1.25 x (√H1 + √H2))

Where H1 is the antenna height in feet and H2 is the target height in feet.

Wavelength And Attenuation by Raindrops.
Attenuation is the process whereby radar energy is absorbed by water droplets in the atmosphere. The attenuation rate is determined by the wavelength and the size of the water droplets. For wavelengths less than 4 cm attenuate rate is significant in temperate latitudes. For wavelengths between 4 cm and 10 cm attenuation is significant only in tropical rain. For wavelengths greater than 10 cm attenuation is negligible.

Atmospheric Conditions.
When there is a temperature inversion and decrease in humidity with height, a process called **Super Refraction** or **Ducting** increases the range that can be achieved. Certain other conditions produce a process called **Sub-refraction** whereby range is reduced.

Radar Resolution.
When targets are detected they are shown as rectangles on the radar display. The term "resolution" refers to the size of the rectangle displayed for a given target size.

Radial resolution is determined by half the pulse length. So for example a 1 microsecond pulse would stretch a target to 150 metres because radar energy moves a distance of 150 metres in 1 microsecond. If two or more targets are located within a radial distance of 150 metres, they will appear as a single target on the radar display.

Azimuth resolution is determined by the width of the beam. So for example a 2 beam width at 60 nm would stretch a target to 2 nm (using the 1 in 60 rule). This means that if two or more targets are located within 2 nm at a range of 60 nm they would be displayed as a single target.

Radar Antenna.

The purposes of the radar antenna are to focus the radar energy into a beam of the required shape and size, to project it in the required directions, and to receive any energy that is reflected from targets.

Increasing the antenna size decreases the beam width. Increasing the rate of rotation or scanning rate of the antenna increases the rate at which radar information is refreshed.

The majority of the energy that is fed to the antenna is focused into a single main lobe, but all types of antenna also produce additional sides. Most radar system include circuits to reduce side lobes in order to reduce improve system performance.

Flat plane antenna produce less side lobes than other antenna types.

GROUND RADAR

Ground Radar system used by ATC have the following characteristics:

Terminal Area Surveillance Radar (TAR).
The terminal area is likely to contain a significant number of aircraft within a relatively small area. For this reason the Terminal Area Surveillance Radar (TAR) requires a high rate of information renewal and good target discrimination. To achieve this a TAR typically employs the following:

1. Frequency in the region of 1200 MHz in the UHF band giving wavelengths of 25 cm.
2. Pulse length 1 to 3 microseconds.
3. PRI of 2800 microseconds.
4. Aerial rotation rate of 8 RPM.
5. Beam width of 2 degrees.
6. Range up to 80 nm.

Aerodrome Surveillance Radar (ASR).
Aerodrome Surveillance Radars (ASR) provide guidance to aircraft during approach and departure. To achieve this they require good target discrimination, accurate range and bearing information, plus rapid target information renewal rate. All of these capabilities must be maintained out to a range of 25 nm. ASR employs the following:

1. Frequency in the region of 3 000 MHz in the UHF band giving wavelengths of approximately 10 cm.
2. Pulse length 0.5 to 1 microseconds.

3. PRI of 1400 microseconds.
4. Aerial rotation rate of 15 RPM.
5. Beam width of 1.5 degrees.
6. Range up to 25 nm.

Airfield Surface Movements Radar (ASMR).
Airfield Surface Movements Radars (ASMR) provide a very accurate radar display of aircraft and vehicles (moving and stationary) on all runways, taxiways and aprons. Some older types of surface movement radar operated in the EHF band up to 35 GHz, but this made then very vulnerable to attenuation caused by precipitation. This decreased range and also degraded the target discrimination capabilities due to the detection of more moisture droplets in the atmosphere.

Modern ASMR systems operate in the SHF band with frequencies of approximately 15 000 GHz and 2 cm wavelengths greatly reducing the weather interference problems. The change has also improved the resolution to such an extent that it is sometimes possible to determine the shape and type of aircraft that is generating the radar returns. ASMRs employ the following:

1. Frequency in the region of 15 000 MHz in the SHF band giving wavelengths of approximately 2 cm.
2. Pulse length 0.5 microseconds.
3. PRI of 65 microseconds.
4. Aerial rotation rate of 60 to 75 RPM.
5. Beam width of 0.25 to 0.5 degrees.
6. Range up to 2.5 to 6 nm.

Precision Approach Radar (PAR).
PAR is used at military airfield to provide a talk-down facility in both elevation and azimuth, down to 0.25 nm from the threshold, for incoming aircraft. This requires accuracy within +/- 30 feet elevation and +/- 20 feet azimuth. To achieve the required level of accuracy PAR employs the following:

1. Two system (one in azimuth and another in elevation) operating at 10 000 MHz in the X Band, to produce 3 cm wavelength signals.
2. One display screen for azimuth and another for elevation.
3. 0.5 degrees beam width.
4. An azimuth scanner scanning out to 10 degrees either side of the extended centreline.
5. An elevation scanner scanning from +6 degrees to –1 degrees relative to the horizon.
6. A controller who passes guidance information to enable the pilot to remain on the glide path.

En-Route Surveillance Radar (RSR).
RSR is used to monitor aircraft on airways and advisory routes to provide navigation information and to ensure that the required separation standards are maintained. To achieve this they must be relatively immune to weather interference and must have an operating range of at least 250 nm. To ensure that the required performance standards are achieved RSR employs the following:

1. Frequency in the region of 600 MHz in the UHF band giving a wavelength of approximately 50 cm.
2. Pulse length 4.2 microseconds.
3. PRI of 3700 microseconds.
4. Aerial rotation rate of 5 RPM.
5. Beam width of 3 degrees.
6. Range 200 nm to 300 nm.

Moving Target Indicators (MTIs)
Moving Target Indicators are fitted to some ground radar systems in order to improve the clarity of the displays by reducing clutter. They do this be eliminating the images of all stationary targets. This makes it easier for the controllers to see moving targets. But the use of MTIs introduces a new risk in that the controllers cannot see stationary targets, so they are unable to detect impending collisions between moving targets and stationary targets.

AIRBORNE WEATHER RADAR (AWR)

Function.
Airborne Weather Radar (AWR) is a primary radar system. It employs the searchlight system to determine relative bearing and the echo principle to detect the range of targets.

The primary function of AWR is to detect areas of intense turbulence associated precipitation and cloud activity. A secondary function of AWR is to aid navigation by providing a ground mapping capability.

Components.
AWR is an entirely airborne system comprising of a radar transmitter/receiver, an antenna, an indicator (display) and a control unit.

Early versions of AWR employed monochrome cathode displays, but on more modern systems the AWR is integrated with the EFIS Navigation Display.

Early AWR systems used parabolic antennae, but modern systems employ the flat plate type. In both cases the antenna produced a pencil beam for weather detection and long-range mapping, and a fan shaped (cosecant) beam for short-range

mapping.

Frequency and Wavelength.
Modern AWR systems employ a frequency of 9375 MHz +/- 30 MHz to produce a wavelength of approximately 3.2 cm. This is approximately equal to the 3 cm diameter of the large droplets of water and ice that are associated with intense turbulence.

Display.
The size and concentration of water droplets in clouds is directly related to the intensity of turbulence. Turbulence is most intense where areas of Very light precipitation are very close to areas of intense precipitation. So AWR is able to indicate the probable areas of most intense turbulence by measuring and displaying the areas of differing precipitation intensity.

Some older systems use a monochrome (black and white) display. On this type of display the intensity of rain activity is indicated by the intensity of the echo displayed on the screen.

In order to improve the visibility of areas of extremely turbulent cloud, such radars employ a CONTOUR facility. When this is selected it inverts the display, causing it be shown in negative form. Areas of extreme turbulence then appear as bright white areas. These are called **ISO ECHOES**. They give the impression of holes in the clouds on the display.

Modern AWR system employ full colour displays on which precipitation intensity is indicated using the following scale:

Colour	Returns	Rain intensity
Black	Very light or no returns	Less than 0.7 mm/hour
Green	Light returns	0.7 to 4 mm/hour
Yellow	Medium returns	4 to 12 mm/hour
Red	Strong returns	Greater than 12 mm/hour
Magenta	Turbulence	Due to rainfall intensity

The areas of greatest potential turbulence are those in which the rate of change of rainfall is greatest. These are shown on the display by return of different colours very close together. So the closer the areas of colour on the screen, the greater the risk of turbulence.

Antenna Stabilisation And Tilt Control.
In order to provide a stable display the AWR antenna is stabilised in Pitch and Roll.

The angle at which the radar beam is projected forward from the aircraft can be adjusted vertically. This function can be used to determine the height of the top or bottom of a cloud formation

	relative to the aircraft. The height of the cloud relative to the aircraft can be calculated using the following equations: Cloud Top Elevation Angle = Tilt angle – ½ beam width. Cloud Base Elevation Angle = Tilt Angle +1/2 Beam Width. Relative Height in feet = (Elevation Angle x Range x 6080) / 60 Where: 1. Relative Height is the height of the cloud relative to the aircraft. 2. Elevation angle is the elevation angle of the cloud top or bottom, in degrees relative to the aircraft. 3. Range is the range of the cloud from the aircraft in nautical miles.
SECONDARY SURVEILLANCE RADAR (SSR)	**Components And Function.** SSR enables aircraft to transmit information such as call sign, pressure altitude or flight level, groundspeed and destination to suitably equipped ATC units. This information is displayed adjacent to the radar echo on the ATC radar screen. SSR requires a ground based Interrogator at each ground station plus airborne Transponders in each aircraft. Both the ground stations and the aircraft require suitable SSR aerials. The ground based interrogators send interrogation signals to the aircraft and the transponders then send reply signals back to the ground stations. **Frequencies.** Ground stations transmit narrow beams at 1060 MHz in the UHF band. Airborne Transponders transmit their replies omni-directionally at 1090 MHz in the UHF band. **Modes And Responses.** **Mode A** 8 microsecond interrogation pulse spacing for identity. 12 reply pulses (with 20.6 microsecond spacing between framing pulses) give 4096 possible combinations One extra pulse (SPI) is used (for 20 seconds) for squawk ident.

	Mode C 21 microsecond interrogation pulse spacing for pressure altitude. Pressure altitude is transmitted and displayed rounded to the nearest 100 feet. **Mode S** Selective Addressing uses 24 bit addresses to provide 17 million codes. Provides datalink air-ground, ground-air and air-air communications to individual aircraft and ground stations. Height read out is provided in increments of 25 feet. Provides unambiguous identification of aircraft. Improves surveillance by eliminating garbling, reflections and over-interrogation. By transmitting more information it gives greater situational awareness and improved short-term alert for ATC controllers. Datalink communications reduce R/T traffic. **Special Codes.** 2000 Used when no instructions have been given. 7000 Conspicuity code used in UK airspace. 7500 Hijacking (remember as 75 taken alive). 7600 Radio failure (remember as 76 in a fix). 7700 Emergency (remember as 77 going to heaven). **Interrogation Codes.** **All Call** Used to elicit replies for the acquisition of Mode S transponders. **Broadcast** Used to transmit information to all Mode s transponders, for which no reply is required. **Selective Calling** Used for surveillance of, and for communication with individual Mode S transponders. For each interrogation, only the selected transponders will reply. **Intermode** Used by modes A, C and S. Used to elicit replies and for surveillance of mode A and C transponders and for the acquisition of mode S transponders. **Disadvantages Of SSR.** Garbling causes overlapping of replies when aircraft are less than 1.7 nm apart.

Fruiting causes interference by replies to other interrogations

There are a limited number of codes (4096) available for modes A and C. This is overcome with mode S which provides 17 million codes.

EFIS EHSI DISPLAY MODES

Colour Codes Used In EFIS Displays.

Under CS 25 regulations EFIS must use the following colour codes:

Item / Information Type.	Colour.
Warnings	Red
Flight envelope and system limits	Red
Cautions, abnormal sources	Amber/Yellow
Earth	Tan/Brown
Engaged modes	Green
Sky	Cyan/Blue
ILS deviation pointer	Magenta
Flight director bar	Magenta/Green

Two sets of colours may be used for certain display values.

Item / Information Type.	Colour set 1	Colour set 2
Fixed reference symbols	White	Yellow
Current data, values	White	Green
Armed modes	White	Cyan
Selected data values	Green	Cyan
Selected heading	Magenta	Cyan
Active route/flight plan	Magenta	White

Precipitation and turbulence should always be coded as follows:

Precipitation	Colour
0-1 mm/hour	Black
1-4 mm/hour	Green
4-12 mm/hour	Amber/Yellow
12-50 mm/hour	Red
Above 50 mm/hour	Magenta

Turbulence White or Magenta

A static map with active route oriented to true north.

No wind speed or direction information is available.

Active route from the FMC is shown in magenta.

Changes to the route may be selected though FMC.

Weather radar information is inhibited in this mode.

PLAN MODE

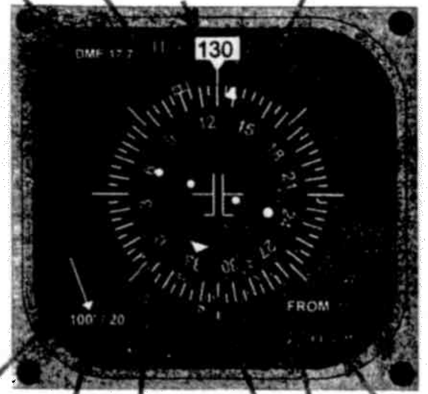
In this mode the EHSI displays flight plan data from the FMC against a moving map.

The display covers 45^0 on either side of instantaneous track.

The display is oriented to magnetic north when between 73^0N and 65^0S.

The display is oriented to true north when above 73^0N and below 65^0S.

MAP MODE



Weather radar data is not available in this mode.

FULL VOR MODE

Weather radar data can also be displayed.

Magenta bug indicates selected heading

DME distance

Current heading

Selected course is indicated by a magenta needle, currently 150^0

Wind direction and speed

VOR source

A white triangle at bottom of display represents the aircraft.

Magenta course deviation bar

Selected VOR frequency

EXPANDED VOR

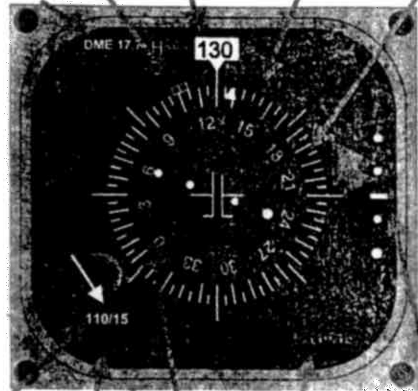
Magenta bug indicates the manually selected heading

Current heading

Selected localiser course is indicated by a magenta needle, currently 150^0

Full compass rose

DME distance



Wind direction and speed

ILS source

Magenta localiser course deviation bar

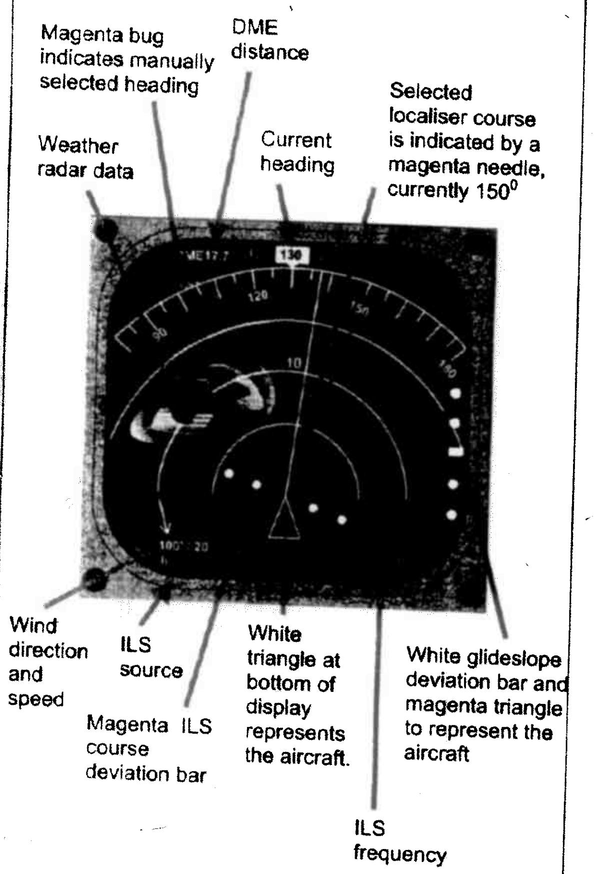
White glideslope deviation bar and magenta triangle to represent the aircraft

ILS frequency

Displayed when an ILS frequency is selected.

- Weather radar data cannot be displayed in this mode.

FULL ILS MODE

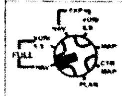
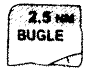
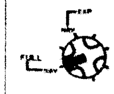
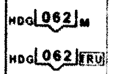
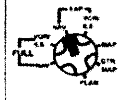


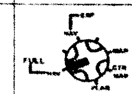
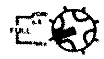
With an ILS frequency selected this mode display about 90^0 of the compass rose.

The range of the display in nm can be selected. The outer range arc of the compass rose is the furthest range selected.

EXPANDED ILS MODE

EFIS DISPLAY SYMBOLS

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
200NM or NM 124	DISTANCE DISPLAY (W)		Distance to next navigation waypoint (NM) or tuned navaid (DME) is displayed. (When displayed distance is less than 100 miles, tenths are displayed.)
 2.5 NM BUGLE	ACTIVE WAYPOINT NAME (M)	HDG (Heading up) 	Displays the name of the active waypoint.
 HDG 062 M HDG 062 TRU	HDG (G) - Displayed data is referenced to APL HEADING TRACK/HDG (W) - index pointer. 062 (W) - Numeric value of HDG or TRK. M (G) - Indicates display is referenced to MAGNETIC NORTH. TRU BOX (W), TRU (G) - Indicates display is referenced to TRUE NORTH.		Indicates number under index pointer is the current heading.

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
 0358.4z VAR/MAP +12	ETA DISPLAY (W)		Indicates FMC computed ETA for the active waypoint
0358.4z VAR/MAP +12	WEATHER RADAR ANNUNCIATION GAIN (G) /MODE (G) TILT (G)		GAIN - VAR indicates gain control on weather radar control panel is not in the CAL (calibrated) detent. MODES: MAP - Weather radar is operating in map mode. WX - Weather radar is operating in weather mode. WX+T - Weather radar is operating in weather mode with turbulence detection enabled. TEST - Weather radar is in test mode and test pattern is displayed. TILT - Indicates antenna tilt.
	EXPANDED COMPASS ARC (W)		The compass arc rotates through 360° as a function of aircraft heading. In the NAV, VOR/ILS, MAP, and PLAN modes, an arc of approximately 70° is displayed. An arc of approximately 120° is displayed when the CTR MAP mode is selected.
	FULL COMPASS ROSE (W) FIXED REFERENCE MARKS (W)		The compass rose rotates through 360° as a function of the aircraft heading. Fixed reference marks are evenly spaced at 45 ° intervals.

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
	SELECTED HEADING BUG (M) and REFERENCE LINE (M)		Indicates the heading selected on the MCP. A dashed line extends from the marker to the aircraft symbol (except for Plan mode) for ease in tracking the marker when it is out of view.
137	WAYPOINT BEARING POINTER (M)		Displays relative bearing to active waypoint
ADF 1 ADF 2 Head Tail	ADF BEARING POINTERS (G)		Indicates relative bearing to tuned NDB as received from the respective ADF receiver
165° / 45	DIRECTION ARROW (W) WIND DIRECTION/SPEED (W)		Indicates wind direction and wind speed in knots with respect to the map display orientation and compass reference (MAG or TRU). Direction arrow rotates through 360°. Displayed if wind magnitude is greater than 8 knots and blanked if wind magnitude becomes less than 4 knots.

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
VOR 1 or VOR 2 ILS 1 or ILS 2 NAV	HSI NAV DATA SOURCE (G)		Indicates the source of the displayed navigation data. In the VOR/ILS mode the displayed data source is a function of the tuned frequency (VOR or LOC). In the NAV mode "NAV" indicates the data source is the FMC
ALERT	COURSE CHANGE ALERT ANNUNCIATION (A)		Displayed 10 seconds prior to course change or 10 seconds prior to sequencing a waypoint if no course change is required. Removed as APL begins roll to new course or when waypoint is sequenced.
110.10	VOR/ILS FREQUENCY DISPLAY (G)		Displays frequency of manually tuned navaid. The word "AUTO" is displayed in place of the frequency if the VHF NAV receiver is in the auto tune mode.
4.5 ▷L 4.5 ▽R	POSITION DIFFERENCE DISPLAY (W)		NUMBERS - Indicate the Position Difference in NM between the FMC's present position and the L IRS and R IRS present positions respectively. ARROWS - Rotate thru 360° to indicate the relative bearing to the associated IRS present position. L or R - Indicates which IRS present position the displayed position corresponds to. Displayed when the Position Difference of the L IRS and/or R IRS exceeds the Position Difference Limits detected by the FMC or EFIS Symbol generator.

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
N	TRUE NORTH POINTER (G)		... the map background is oriented true north.
	VERTICAL POINTER (M) DEVIATION SCALE (W) NUMERIC DISPLAY (W)		Displayed only during descent. Displays vertical deviation from FMC descent profile. Scale range is ± 400 feet deviation. Numeric value is displayed when pointer moves beyond the scale limits. Pointer represents path. Centre of scale represents aircraft position.
	GLIDESLOPE DEVIATION POINTER (M) AND DEVIATION SCALE (W)		Displays glideslope deviation. Scale appears when LOC frequency is tuned. Pointer appears when the signal is usable. The pointer is not displayed when track and the front course on the MCP differ by more than 90° (back course).
	AIRCRAFT SYMBOL (Expanded Rose) (W)		Represents the aircraft. In the MAP modes, present position is indicated by the apex of the triangle.
	AIRCRAFT SYMBOL (FULL Rose) (W)		Represents the aircraft when FULL compass rose is displayed. Present position is indicated by centre of aircraft symbol.
	CURVED TREND VECTOR (W)		Displays prediction of aircraft's ground track. The furthest end point of each vector segment represents the airplane's predicted position after a period of 30, 60, and 90 seconds, respectively. The selected range determines the number of segments displayed. Range > 20 NM ... 3 segments; Range = 20 NM 2 segments; Range = 10 NM ... 1 segment

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
	PRESENT TRACK LINE (W) AND RANGE SCALE (W)		Displays present ground track based on aircraft heading and wind. Range numeric values are one-half the actual selected range. With heading up orientation, the track line will be rotated left or right at an angle equal to the drift angle.
	DRIFT ANGLE POINTER (W)		Indicates aircraft's present track. Replaces track line when a Full Rose mode is selected.
	ALTITUDE RANGE ARC (G)		The intersection of the arc with the track line is the predicted point where MCP altitude will be reached. The prediction is based on present ground speed and aircraft vertical speed.
	LATERAL DEVIATION INDICATOR BAR (M) AND DEVIATION SCALE (W)		Displays ILS, VOR, FMC (NAV) course deviation. ILS 1 dot = 1°; VOR 1 dot = 5°; NAV 1 dot = 2 NM
	SELECTED COURSE POINTER (W) and LINE (M)		Points to selected course as set by the respective MCP course selector (VOR/ILS) or by the FMC (NAV).
	SELECTED COURSE POINTER (W) TO/FROM POINTER (W)		Points to selected course as set by the respective MCP course selector (VOR/ILS) or by the FMC (NAV). TO/FROM symbol is displayed when VOR navigation is being used.
TO FROM 110.90	TO/FROM ANNUNCIATION (W)		Operative in VOR mode only. Indicates whether or not the selected course, if intercepted directly and tracked, would take the aircraft TO or FROM the station.

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
(Standard WPT) AMBOT (Conditional WPT) ( )	FLIGHT PLAN WAYPOINT: ACTIVE (M) DOWNPATH (W)	MAP, CTR MAP, PLAN	Active - Represents the flight plan waypoint the airplane is currently navigating to. Downpath - Represents a downpath waypoint in an Active or Modified flight plan route. Data with parenthesis for conditional waypoints indicates type of conditional waypoint (altitude "VECTORS", "INTC", etc.)
ABCDE	OFF-ROUTE WAYPOINT (C)	MAP, CTR MAP, PLAN	When the WPT switch is ON, FMC data base waypoints not used in the selected flight plan route are displayed. Displayed only for HSI ranges of 10, 20, or 40 NM.
KXYZ	AIRPORT (C)	MAP, CTR MAP, PLAN	ARPT switch - OFF Only origin and destination airports are displayed. ARPT switch -ON ALL FMC data base airports within the MAP area are displayed.
KABC 22L	AIRPORT IDENTIFIER AND RUNWAY (W)	MAP, CTR MAP, PLAN	Available when the EHSI display range is 80, 160, or 320 NM. Displayed if the airport has been selected as the origin or destination airport with a specific runway selected.
22L	AIRPORT AND RUNWAY (W)	MAP, CTR MAP, PLAN	Available when the EHSI display range is 10, 20, or 40 NM. Displayed if the airport has been selected as the origin or destination airport with a specific runway selected. Runway symbol is scaled to represent the length of the selected runway. The dashed centre lines extend outward 14.2 nm from the runway thresholds.

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
ABCDE PGHIJ KLMNO XYZ	INACTIVE ROUTE (C) ACTIVE ROUTE (M) ACTIVE ROUTE MODIFICATION (W)	MAP, CTR MAP, PLAN	An active route is displayed with continuous lines between waypoints. An active route modification is displayed with short dashes between waypoints. When a modification is EXECUTED, the short dashes are replaced with the continuous lines. Inactive routes are displayed with long dashes between waypoints.
ABCDE 12000 0835Z	ROUTE DATA (M, W)	MAP, CTR MAP, PLAN	When the RTE DATA switch is ON, altitude constraints and ETA's for route waypoints will be displayed.
T/C S/C T/D E/D	VERTICAL PROFILE POINTS (G) IDENTIFIERS (G)	MAP, CTR MAP, PLAN	Represents an FMC computed vertical profile point in the active flight plan as T/C (top-of-climb), T/D (top-of-descent), S/C (step climb), and E/D (end of descent). A deceleration segment point has no identifier.
	VOR (C, G) DME/TACAN (C G) VORTAC (C, G)	MAP, CTR MAP, PLAN	NAV AID switch - OFF Tuned navaids(excluding NDB's) are displayed in green. NAV AID switch - ON ALL appropriate navaids contained in the FMC data base and within the MAP area are displayed when the range is 10, 20 or 40 nm. Only high altitude navaids are displayed when selected range is 80, 160, or 320 NM. Nav aids not being used are displayed in cyan (blue).

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
	MANUALLY TUNED VOR RADIALS (G)	MAP, CTR MAP, PLAN	When a VOR navaid is manually tuned the associated MCP selected course and its reciprocal are displayed.
V1 V2	VOR RADIALS (G)	MAP, CTR MAP	The VOR/ADF Switch on the EFIS Control Panel must be ON and a valid VOR signal must be received. Displays relative bearing to the tuned VOR station(s).
A1 A2	ADF BEARINGS (G)	MAP, CTR MAP	The VOR /ADF Switch on the EFIS Control Panel must be ON and a valid ADF signal must be received. Displays relative bearing to the tuned ADF station(s)
ABC	SELECTED FIX CIRCLE (G) FIX SYMBOL AND IDENTIFIER (C or G)	MAP, CTR MAP, PLAN	Depicts the selected reference point as entered on the FMC / CDU FIX INFO page. Can appear with other special map symbols (e.g. VOR, VORTAC airport or waypoint, etc.) if stored in the FMC data base.
FMC RADIO IRS-R IRS-L	POSITION SHIFT SYMBOL ACTIVE POSITION (M) OTHER POSITIONS (G) POSITION SELECTED FOR UPDATE (W)	PLAN	Represents the position of each navigation sensor. Symbols will only appear if the POS SHIFT page is displayed on the FMC / CDU

SYMBOL	NAME (COLOUR)	APPLICABLE MODE(S)	REMARKS
ABC 40	SELECTED FIX RADIAL (G) SELECTED FIX DME CIRCLE (G)	MAP, CTR MAP, PLAN	A fix reference radial is displayed for each downtrack bearing entered on the FMC/CDU FIX INFO page. AOME reference circle is displayed for each distance entered on the FMC/CDU FIX INFO page.
	HOLDING PATTERN ACTIVE (M) MODIFICATION (W) INACTIVE (C)	MAP, CTR MAP, PLAN	Appears as a fixed size holding pattern if selected range is greater than 80 NM. A scaled representation of the holding pattern is displayed when the range is 80 NM or less and the airplane is within 3 min. of the holding fix.
	WEATHER RADAR RETURNS (G, Y, R, M)	EXP NAV, VOR ILS, MAP, CTR MAP	When either WXR switch is selected to the ON position, multicoloured weather radar returns are displayed. The most intense precipitation areas are displayed in red, less intensities, yellow, and lowest intensities green. Areas of turbulence associated with precipitation are displayed in magenta
	RANGE ARCS (W)	EXP NAV, VOR ILS, MAP	Range arcs are displayed in the expanded rose VOR/ILS and NAV modes when the Weather Radar Switch is ON. Range arcs are displayed in the MAP mode with or without the WXR switch ON.

FLIGHT MANAGEMENT SYSTEM (FMS)

FMC Databases.
The flight management computer (FMC) contains two databases. The first of these is the **Performance Database.** This contains all information relating to the performance capability of the aircraft. This information is used for calculating such things as optimum altitude, and landing reference speeds.

The second database within the FMC is the **Navigation Database.** This contains information relating to the navigation of the aircraft including the following:

1. Aerodrome details, elevations, positions, and runway lengths.
2. Navigation facilities, including location, altitude, frequency, identification codes, and DOC.
3. Airways routes, including reporting points.
4. SIDs, STARs, and runway approaches.
5. Company routes.

Multi-Function Control And Display Unit (MCDU)
Pilot inputs to the FMS are made using the MCDU. A typical MCDU is illustrated below.

Database updates.
Monthly updates are input by maintenance staff every 28 days.

Although the pilot is able to input information relating to the

flight being prepared for or undertaken, this does not constitute alteration if the database. From the pilot's point of view the database is read only.

Lateral Navigation
When engaged in lateral navigation mode the FMS steers the aircraft such that it flies great circle routes between pre-programmed waypoints.

Under certain circumstances the aircraft may deviate to the left or right of the planned great circle track. The FMS measures this deviation and displays it as a Cross Track Distance (XTK distance).

At any point during the flight the active waypoints are the waypoint from which the aircraft is currently flying (the most recently passed waypoint) and the waypoint to which it is currently flying the next waypoint at which the aircraft will arrive). XTK is the distance between the actual position and the great circle track between active waypoints.

AREA NAVIGATION SYSTEMS (RNAV)

Function of RNAV.
An Area Navigation System (RNAV) is a system whereby the aircraft can be navigated to the required level of accuracy without having to fly directly over ground- based navigation aids.

RNAV System Benefits.
By eliminating the need to fly directly over navigation aids and waypoints RNAV provides the following benefits:

1. Reduction in required vertical and horizontal separation criteria.
2. Reduction in flight distance, flight time, fuel consumed and cost, through the use of more flexible choices of routes.
3. Increased route capacity through better use being made of available airspace, more direct routes, parallel routes, dual routes and bypass routes, for aircraft overlying high density terminal areas.

Inputs to RNAV.
Typical inputs to an RNAV system include the following:

VOR/DME
ILS/MLS
LORAN
GNSS
ADC
INS/IRS
Time

Types And Levels Of RNAV.
The following two types of RNAV are in current use:

Basic RNAV. Basic RNAV)B-RNAV) is required to give position accuracy within 5 nm on 95% of occasions. This is mandatory for all aircraft carrying 30 or more passengers within Euro-control airspace.

Precision RNAV. Precision RNAV (P-RNAV) must provide position accuracy within 1.0 nm on 95% of occasions.

The following three levels of RNAV are in current use

2D RNAV. Providing navigation functions in the horizontal plane only.
3D RNAV. Providing navigation function in the horizontal and vertical planes.
4D RNAV. Providing navigation functions in the horizontal and vertical planes plus a timing function.

RNAV System Components.
The following components make up the RNAV system in BOEING 737-800 aircraft:

Flight Management Computer (FMC).
Autopilot Flight Director System (AFDS).
Auto-throttle System (A/T).
2 Inertial Reference Systems (IRS).

DOPPLER

Purpose.
Doppler Radar systems employ the Doppler Drift principle to measure aircraft grounds peed and drift.

Advantages and disadvantages of Doppler Systems.
1. They are self-contained systems which require no inputs from ground based navigation aids.
2. They can be used throughout the world.
3. They are most accurate over land.
4. They are less accurate when flying over water because the surface winds, currents and tides, move the water surface in random directions.
5. They sometimes fail to measure ground speed and drift when flying over very smooth seas.
6. Modern Doppler systems are used in conjunction with inputs form other systems such as IRS, GPS, VOR and DME, the overall accuracy of the navigation fixes can be improved.

Doppler Principle.
When there is a relative motion between a transmitter and a receiver, this causes a difference between the transmitted frequency and the received frequency. This frequency shift is proportional to the relative velocity. The change in frequency (fd) is called the Doppler Shift, Doppler Frequency or Doppler Effect.

The change in frequency can be calculated using the following equation:

$$fd / f = V / C$$

Where:
fd = frequency change.
F = transmitted frequency.
V = Relative velocity.
C = Speed of Light.

Airborne Doppler Systems.
Airborne Doppler system typically comprise of the following antenna arrangements:

1. 2, 3, or 4, separate antennae each consisting of separate transmitting and receiving aerials.
2. Each antenna is angle downwards at an angle of 60 to 70 degrees; such that the signals strike the ground beneath and are reflected from it.
3. These antennae are arranged so that they point in opposite directions. This arrangement makes the system more sensitive to frequency shifts caused by the Doppler principle. This arrangement is called the **JANUS** system.
4. The system transmits on a frequency of 8800 MHz or 13300 MHz in the SHF band.

GLOBAL NAVIGATION SYSTEMS & GLOBAL POSITIONING SYSTEMS (GNSS/GPS)

GPS Segments.
The NAVSTAR Global Positioning System (GPS) employs the following three segments.

The Space Segment. This consists of the following:

1. At any moment in time 24 satellites in orbit around the Earth. 21 of these satellites are operational and the other three are in-space spares.
2. The average orbital height of the satellites is 10908 nautical miles (20180 kilometers).
3. The satellite orbits are inclined at an angle of 55 degrees to the Equator.
4. Each satellite orbits the Earth every 12 hours.
5. A satellite is considered to be masked and not usable when at an elevation of less than 5 degrees above the horizon.

6. Each satellite has four atomic clocks. Two of these clocks are caesium based and two are rubidium based
7. The satellites transmit signals containing Pseudo-Random-Noise (PRN) codes of one-millisecond duration, on two frequencies (L1 and L2) in the UHF band. Each satellite has its own unique PRN code.
8. The L1 frequency is 1575.42 MHz contains two codes. The first of these is the Coarse acquisition (C/A) code which is repeated every millisecond., modulated at 1.023 MHz. The second is the Precision (P) code, which is repeated every 7 days, modulated at 10.23 MHz. Navigation and system data messages transmitted at 50 Hz are used by both the C/A code and the P code.
9. The L2 frequency transmits only the P code at 1227.6 MHz. This frequency is also used to determine the ionospheric delay.
10. Only the C/A code is available to civil users, while both the C/A code and the P code are available to US military users.
11. The PRN codes include the following information:
    A. Satellite position.
    B. Satellite clock time.
    C. Satellite clock error.
    D. Ionosperic delay information.
    E. Supplementary information.
12. The GPS provides the following two services:
    A. Standard positioning service (SPS) based on the C/A code.
    B. Precision positioning service (PPS) based on the P code.

The Control Segment. This consists of the following ground-based stations.:

1. A master control station based at Colorado Springs USA.
2. A back-up control station based at Onizuka USA.
3. 5 monitoring stations based at Colorado springs, Ascension Island, Diego Garcia, Wajalein and Hawaii.
4. The monitoring stations check the satellite positions at least once every 12 hours. When an error is detected this information is transmitted to the satellite concerned and included in its transmissions.
5. The monitoring stations also check the satellite clock times. The clocks cannot be adjusted, so if an error is detected, this is sent to the satellite concerned, and included in its transmissions to users.

The User Segment. The user segment is all of the receivers

that use satellite information for navigation purposes.

Principle Of Operation.

The basic principle of operation of GPS is to calculate the position of the receiver by measuring the time taken for a radio signal to travel from a satellite to the receiver. By carrying out this calculation for a signal coming from four satellites simultaneously it is possible to determine the position of the receiver in three dimensions, plus time.

The navigation message sent be each satellite includes the following data:

1. Satellite clock correction data.
2. Satellite ephemeris data.
3. Almanac data for all satellites in orbit.
4. Other data such as UTC.

The receiver keeps a stored copy of the almanac data for all satellites, so provided the position of the receiver is known with reasonable accuracy it will know which satellites should be in view each time it is when it is switched on. This will enable it to contact those satellites very quickly and obtain apposition fix within 30 seconds.

If the almanac stored within the receiver becomes lost or corrupted, or if the receiver position is not known with reasonable accuracy at switch on, the receiver will go into SKYSEARCH mode. In this mode it will carry out a search to find all satellites that are in view. It will then download a new copy of the almanac data and the first position fix will take 15 minutes to complete.

The position initially calculated by GPS always includes inaccuracies cased by receiver clock errors. For this reason this initial fix is called a PSEUDO-RANGE. The receiver then adjusts this pseudo-range mathematically to determine the true range.

GPS ERRORS.

Ephemeris Error. These are errors in the satellite's calculation of its position. The gravitational effects of the sun, moon and other planets in the solar system cause them. The ground monitoring stations check satellite position every 12 hours, so the maximum error is 2.5 metres.

Satellite Clock errors. Caused by the inherent inaccuracy of the atomic clocks used in the satellites. They are checked by the ground monitoring stations every 12 hours, so the maximum position error caused by clock errors is 1.5 metres.

Ionospheric Propagation errors. The effect that the ionosphere has on radio waves is proportional to the frequency of the waves. The satellite broadcasts contains a model of the ionosphere, which is used to make corrections to the time taken fro signals to reach the receivers. But the condition of the ionosphere is constantly changing, so the corrections made are imperfect. The model of the ionosphere is corrected by the ground stations every 12 hours, so the maximum position error is 5 metres.

Tropospheric Propagation Errors. Variations in pressure, temperature and air density cause variations in the speed at which radio waves move through the troposphere. This affects the time taken for satellite signals to reach the receivers. The maximum position error caused by troposheric propagation errors is between 0.3 and 0.5 metres.

Receiver Noise Errors. Internal noise produced within the circuits of the receivers causes position errors of up to 0.3 metres.

Multi-Path Reception Errors. Reflections from the ground and parts of the aircraft can cause the receivers to receive signals from more than one path. The maximum position error caused by these effects is 0.6 metres.

Geometric Dilution Of Precision Errors (GDOP). These occur when the range arcs produced by the satellites cross each other at poor angles. They are greatest when the satellites are relatively close to each other.

Aircraft Manoeuvre Errors. These are caused when manoeuvring of the aircraft temporarily blocks the reception of signals from one or more of the satellites that are being used.

Selective Availability Errors (S/A). This is the facility whereby the GPS operator, the US Department Of Defense deliberately degrades the accuracy of the C/A signals during times of political tension.

SYSTEM ACCURACY.

The Standard positioning System (SPS) that is available to civil users is certified to be accurate within 15 metres. In practice it has been found to be accurate with 5 metres. The Precision Positioning System (PPS) that is available to selected military users is accurate within 3 metres,

RECEIVER AUTONOMOUS INTEGRITY MONITORING (RAIM).

ICAO specifications for aircraft radio navigation systems requires that they provide a 2 second warning of failure for precision systems such as ILS, and an 8 second warning for non-precision systems.

For a system providing a 3D position fix, RAIM requires the simultaneous reception of data from at least 5 satellites.

When 4 satellites are being used to provide a 3D position fix, there is no means of detecting degradation of the information provided by one or more of the satellites, so RAIM is not available.

When 5 satellites are being used to provide a 3D position fix, the data from the satellites is compared to detect errors in any individual satellite. The defective satellite is then deselected, leaving 4 satellites to provide the 3D fix. But with only 4 satellites in use the RAIM facility is no longer available.

When 6 satellites are being used to provide a 3D position fix, the data from the satellites is compared to detect errors in any individual satellite. The satellite is then deselected, leaving 5 satellites to provide the 3D fix. With 4 satellites remaining is use the RAIM facility continues to be available.

DIFFERENTIAL GPS (DGPS).

DGPS is the means by which GPS receivers are able to detect degradation in the data transmitted by satellites. When data is being received from a number of satellites simultaneously, the receiver is able to compare the position fixes provided by different combinations of these individual sets of data to detect if any data set is incompatible with the others. The receiver then deselects the satellite that is transmitting the incompatible data. This enables the system to provide warnings of failures in the satellite data and minimize or prevent the effects of incorrect data.

The following three types of DGPS are in use or under development:

Air Based Augmentation Systems (ABAS).
This system requires no additional satellites or ground stations. When 5 satellites are being used to provide a 3D position fix, the data from the satellites is compared to detect errors in any individual satellite. The defective satellite is then deselected, leaving 4 satellites to provide the 3D fix. But with only 4 satellites in use the RAIM facility is no longer available. To enable a defective satellite to be deselected whilst still

maintaining RAIM capability, at least 6 satellites must be available.

Ground Based Augmentation Systems (GBAS).
GBAS is a form of Local Area Augmentation System (LAAS), which means that it is effective only over a narrow area. It is employed to provide precision runway approaches.

A ground-based GPS receiver receives satellite data and uses this data in the usual way to determine its position. This calculated position is compared with the known position of the receiver to detect any anomalies in the satellite data. The results of this process are then transmitted to approaching aircraft in a format that makes them identical to satellite data. For this reason the transmitter is called a pseudolite (pseudo-satellite)

This system is able to detect all errors with the exception of receiver noise errors and multi-path errors.

Space Based Augmentation Systems (SBAS).
SBAS is a form of Wide Area Augmentation System (WAAS), which means that it covers a large area of the surface of the Earth.

The system employs ground-based reference stations similar to those used for GBAS. But instead of transmitting error information directly to approaching aircraft, SBAS reference stations transmit the data to geo-stationary satellites. The geo-stationary satellites then transmit the data to airborne receivers. This enables the airborne receivers receive error data while simultaneously receiving data from GPS satellites in the usual way. The airborne receivers then apply the error data to the GPS satellite data to produce improved position fixes and to detect defective data sets.

SECTION 2

QUESTIONS

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BASIC PRINCIPLES 1.
Wavelength is the distance from?

A. Wave crest to wave crest.
B. Through to next wave crest. Trough
C. The E and H fields superimposed onto the system reactance background scatter.
D. Wave crest to next trough.

BASIC PRINCIPLES 2.
The emission characteristics A3E describe?

A. ILS.
B. VOR.
C. HF communications.
D. VHF communications.

BASIC PRINCIPLES 3.
Electromagnetic waves travel at?

A. The speed of sound.
B. 300 000 metres per second
C. The speed of light.
D. 162 000 miles per hour.

BASIC PRINCIPLES 4.
In regard to radio what does the term frequency mean? 1

A. The number of waveform in one hour.
B. The number of complete waveform passing a point in one second.
C. The speed of radio waves in metres per second.
D. The length of a complete waveform in metres.

BASIC PRINCIPLES 5.
The Automatic Direction Finder (ADF) uses the following wavelength?

A. Metric.
B. Decimetric.
C. Centimetric.
D. Hectometric or Kilometric.

BASIC PRINCIPLES 6.
According to ICAO Annex 10, in which frequency band(s) does a locator transmit?

A. HF.
B. LF/MF.
C. HF/VHF.
D. MF/HF.

BASIC PRINCIPLES 7.
The VHF Direction Finder uses the following wavelengths?

A. Hectometric.
B. Decimetric.
C. Metric.
D. Centimetric.

BASIC PRINCIPLES 8.
The Instrument Landing System (ILS) uses the following wavelengths?

A. Hectometric.
B. Decimetric.
C. Metric.
D. Centimetric.

BASIC PRINCIPLES 9.
The frequency band for the Automatic Direction Finder (ADF) is?

A. Hectometric.
B. Decimetric.
C. Metric.
D. Centimetric.

BASIC PRINCIPLES 10.
The Microwave Landing System (MLS) uses the following wavelengths?

A. Myriametric.
B. Metric.
C. Hectometric.
D. Centimetric.

2

BASIC PRINCIPLES 11.
Into what range does ILS localiser wavelength fall?

A. Kilometric.
B. Metric.
C. Nanometric.
D. Millimetric.

BASIC PRINCIPLES 12.
A transmission of RF energy at a wavelength of 18 metres is in which frequency band?

A. MF.
B. LF.
C. HF.
D. VHF.

BASIC PRINCIPLES 13.
The Distance Measuring Equipment (DME) uses the following wavelengths?

A. Decimetric.
B. Metric.
C. Hectometric.
D. Centimetric.

LVF 3-30
LF 30-300
MF 300-3000
HF 3-30
VHF

BASIC PRINCIPLES 14.
The VHF Omnirange (VOR) uses the following wavelengths?

A. Decimetric.
B. Metric.
C. Hectometric.
D. Centimetric.

1cm = 1/100 m.
0.0222
13.5135 MHz
1358

BASIC PRINCIPLES 15.
What is the wavelength of the ILS Localiser signal?

A. Myriametric.
B. Metric.
C. Hectometric.
D. Centimetric.

BASIC PRINCIPLES 16.
What is the wavelength of a VOR?

A. Decimetric.
B. Metric.
C. Hectometric.
D. Centimetric.

BASIC PRINCIPLES 17.
Frequency is define as the?

A. Number of complete cycles recurring in one unit of time.
B. Distance between a crest and a crest.
C. Number of complete cycles recurring in ten units of time.
D. Distance from axis to peak value.

BASIC PRINCIPLES 18.
A radio facility transmits on a wavelength of 2.22 cm. The facility could be a ...... operating on a frequency of ....?

A. VDF, 135 MHz.
B. DME, 1350 MHz.
C. Doppler 13500 MHz.
D. Radio Altimeter 13500 kHz.

BASIC PRINCIPLES 19.
The Marker beacons use the following wavelengths?

A. Myriametric.
B. Metric.
C. Hectometric.
D. Centimetric.

BASIC PRINCIPLES 20.
The Secondary Surveillance Radar (SSR) uses the following wavelengths?

A. Myriametric.
B. decimetric.
C. Hectometric.
D. Centimetric.

BASIC PRINCIPLES 21.
The Low Altitude Radio Altimeter (RADALT) uses the following wavelengths?

A. Decimetric.
B. Metric.
C. Myriametric.
D. Centimetric.

BASIC PRINCIPLES 22.
A radio transmitter modulator?

A. Tunes the aerial only.
B. Ensures receiver compatibility.
C. Couples the RF signal to an aerial.
D. Superimposes an audio frequency signal (AF) onto a radio frequency signal (RF).

BASIC PRINCIPLES 23.
SELCAL is an equipment that?

A. Functions as a frequency modulator.
B. Is coupled with TCAS II and is concerned with TA warnings systems.
C. Automatically receives incoming signals.
D. Automatically transmits data signals.

BASIC PRINCIPLES 24.
What is the wavelength corresponding to a frequency of 375 kHz?

A. 8 metres.
B. 80 metres.
C. 800 metres.
D. 8000 metres.

BASIC PRINCIPLES 25.
What is the wavelength corresponding to a frequency of 75 MHz?

A. 4 metres.
B. 40 metres.
C. 7.5 metres.
D. 75 metres.

BASIC PRINCIPLES 26.
A wavelength of 8.5 metres corresponds to a frequency of?

A. 2 833.3 MHz.
B. 3 594.4 MHz.
C. 28 333 MHz.
D. 35,294 MHz.

BASIC PRINCIPLES 27.
The VHF frequency band is in the?

A. 3 to 30 kHz range.
B. 30 to 300 kHz range
C. 3 to 30 MHz range.
D. 30 to 300 MHz range.

BASIC PRINCIPLES 28.
The VHF frequency band is in the?

A. 3 to 30 kHz range.
B. 30 to 300 kHz range
C. 3 to 30 MHz range.
D. 30 to 300 MHz range.

BASIC PRINCIPLES 29.
Assuming a wavelength of 1 centimetre, the frequency will be?

A. 30 MHz.
B. 0.3 GHz.
C. 3.0 GHz.
D. 30 GHz.

BASIC PRINCIPLES 30.
Decimetric waves correspond to a frequency of?

A. 300 to 3 000 kHz.
B. 3 000 to 30 000 kHz.
C. 300 to 3 000 MHz.
D. 3 000 to 30 000 MHz.

BASIC PRINCIPLES 31.
The wavelength of a radio signal transmitted at a frequency of 118.7 MHz?

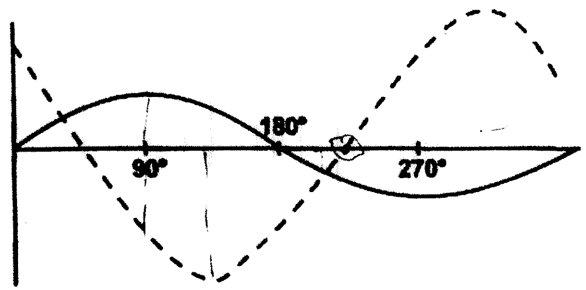
A. 2.53 metres.
B. 25.3 metres.
C. 2.53 centimetres.
D. 25.3 centimetres.

BASIC PRINCIPLES 32.
The wavelength of a radio signal with a frequency of 121.95 MHz?

A. 26.60 metres.
B. 24.60 centimetres.
C. 2.46 centimetres.
D. 2.46 metres.

BASIC PRINCIPLES 33.
In the diagram below what is the phase difference of the higher amplitude signal from the reference signal?

A. 135 degrees.
B. 225 degrees.
C. 315 degrees.
D. 045 degrees.



BASIC PRINCIPLES 34.
What is the frequency corresponding to a wavelength of 12 centimetres is?

A. 2500 kHz.
B. 2500 MHz.
C. 360 MHz.
D. 3600 MHz.

BASIC PRINCIPLES 35.
Assuming a frequency of 20 MHz, the wavelength will be?

A. 1.5 metres.
B. 150 metres.
C. 0.15 metres.
D. 15 metres.

BASIC PRINCIPLES 36.
What is the wavelength of a radio signal with a frequency of 375 kHz?

A. 1.25 metres.
B. 12.5 metres.
C. 800 metres.
D. 80 metres.

BASIC PRINCIPLES 37.
A frequency of 2400 kHz is equivalent to a wavelength of?

A. 8 metres.
B. 0.8 metres.
C. 125 metres.
D. 105 metres.

BASIC PRINCIPLES 38.
The wavelength of a non-directional beacon (NDB) at a frequency of 300 kHz is?

A. 1 metres.
B. 10 metres.
C. 100 metres.
D. 1000 metres.

300 MHz × 10⁶
3 to GHz To 9 3 .

BASIC PRINCIPLES 39.
The wavelength of a radio signal is 200 metres. What is its frequency?

A. 1.5 kHz.
B. 1.5 MHz.
C. 1.5 GHz.
D. 15 MHz.

BASIC PRINCIPLES 40.
A radio signal has a frequency of 3 GHz, What is its wavelength?

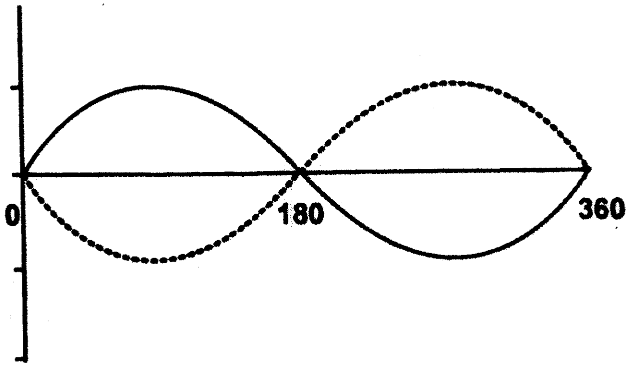
A. 1 metres.
B. 10 centimetres.
C. 100 centimetres.
D. 1.0 centimetres.

BASIC PRINCIPLES 41.
The VHF frequency band has a wavelength limit of?

A. 100 m to 10 m.
B. 1 m to 100 cm.
C. 10 m to 1 m.
D. 100 cm to 10 cm.

BASIC PRINCIPLES 42.
In the diagram, the phase difference between the two signals is?

A. 90 degrees.
B. 180 degrees.
C. 270 degrees.
D. 360 degrees.



BASIC PRINCIPLES 43.
A half wave dipole aerial suitable for transmitting an RF signal at 18 MHz should have an effective length of?

A. 8.33 metres.
B. 16.67 metres.
C. 83.33 metres.
D. 166.67 metres.

BASIC PRINCIPLES 44.
The gain of an aerial is its ability to?

A. Focus power.
B. Compensate for attenuation.
C. Transmit intelligence.
D. Overcome transmitter line resistance.

BASIC PRINCIPLES 45.
A horizontally polarised electromagnetic wave?

A. Has the E field horizontal.
B. Has the E field vertical.
C. Has the Z field horizontal.
D. Has the H field horizontal.

BASIC PRINCIPLES 46.
Which of the following statements is correct in respect to a RF signal?

A. The plane of polarisation is dictated by the oscillator unit in the transmitter.
B. The electrical component of the signal is parallel to the aerial.
C. The magnetic component of the signal is parallel to the aerial.
D. Both the electrical component and the magnetic component of the signal are parallel to the aerial.

BASIC PRINCIPLES 47.
A radio wave with a horizontal magnetic component would be best received by a ...... aerial?

A. Vertical.
B. Horizontal.
C. Parabolic.
D. Magnetic.

BASIC PRINCIPLES 48.
An electromagnetic wave has two types of energy field?

A. An H electrical field and an E magnetic field.
B. A Z electrical field and an H magnetic field.
C. A Z magnetic field and an E electrical field.
D. An E electrical field and an H magnetic field.

(3)

BASIC PRINCIPLES 49.
Feeder lines are of the following types?

A. Co-axial – up to 3000 MHz, wave guides - above 3000 MHz.
B. Co-axial - above 3000 MHz, wave guides – up to 3000 MHz.
C. Co-axial – up to 300 kHz, wave guides – above 300 kHz.
D. Wave guides – up to 20 MHz, co-axial – above 20 MHz.

BASIC PRINCIPLES 50.
Comparing a parabolic reflector with a flat plate antenna of the same size?

A. The flat plate has a considerably smaller beam width.
B. The parabolic reflector has a considerably smaller beam width.
C. The flat plate antenna generates less side lobes than the parabolic reflector.
D. The parabolic reflector generates less side lobes that the flat plate antenna.

BASIC PRINCIPLES 51.
What causes the so called "night effect"?

A. The difference in velocity of the EM waves over land and over sea at night.
B. A change in the direction of the plane of polarisation due to reflections in the ionosphere.
C. Interference between ground waves and space waves.
D. The absence of the surface wave at distances larger than the skip distance.

BASIC PRINCIPLES 52.
A Doppler shift will occur?

A. If a receiver is moving during reception of transmission from a fixed position transmitter.
B. If a transmitter is moving during transmission to a fixed position transmitter
C. When the distance between a transmitter and a receiver is changing during a transmission.
D. All of the options are correct.

BASIC PRINCIPLES 53.
An apparent increase in the transmitted frequency which is proportional to the transmitter velocity will occur when?

A. Both transmitter and receiver move towards each other.
B. The transmitter moves away from the receiver.
C. The transmitter moves towards the receiver.
D. The receiver moves towards the transmitter.

BASIC PRINCIPLES 54.
An apparent decrease in the transmitted frequency, which is proportional to the transmitter velocity, will occur when?

A. Both transmitter and receiver move away from each other.
B. The transmitter moves away from the receiver.
C. The transmitter moves towards the receiver.
D. The transmitter and the receiver move towards each other.

BASIC PRINCIPLES 55.
When a transmitter is moving towards a receiver, the correct description of Doppler effect is?

A. There is an increase in apparent wavelength, which is independent of transmitter velocity.
B. There is a decrease in apparent wavelength, which is independent of transmitter velocity.
C. There is an increase in apparent wavelength, which is dependent of transmitter velocity.
D. There is a decrease in apparent wavelength, which is dependent of transmitter velocity.

BASIC PRINCIPLES 56.
Refraction of an electromagnetic radiation is?

A. Loss of power through reflection from objects.
B. The bending of its propagation path as it passes through or over areas of different electrical conductivity.
C. The loss of power as it passes through or over areas of different electrical conductivity.
D. Bending resultant from reflection from objects.

BASIC PRINCIPLES 57.
Which statement is true?

A. The lower the frequency the greater the ionospheric attenuation.
B. The attenuation of an HF ground wave is worse over the land than over ice.
C. The ionosphere will attenuate and refract signals up to 30 GHz.
D. None of the above options are true.

BASIC PRINCIPLES 58.
Attenuation of radio waves means?

A. The weakening of radiated waves.
B. The atmospheric bending of waves.
C. Only the scattering of waves in the troposphere.
D. Only the absorption of energy by the sea.

BASIC PRINCIPLES 59.
The term Doppler shift refers to?

A. The change in speed measured at the receiver.
B. The change in angle measured at the receiver.
C. The change in depression angle measured at the receiver.
D. The change in frequency measured at the receiver.

BASIC PRINCIPLES 60.
When an LF radio wave passes over the Earth's surface it?

A. Speeds up, picks up electrons and becomes stronger.
B. Slows down, picks up electrons and becomes stronger.
C. Slows down and is attenuated.
D. Speeds up and is attenuated.

BASIC PRINCIPLES 61.
To establish and maintain effective HF communication, frequency at a given range?

A. Should be decreased at night.
B. Should be increased at night.
C. Should remain constant.
D. Should only be varied by season, decreased in summer and increased in winter.

BASIC PRINCIPLES 62.
Skip distance is the?

A. Thickness of the ionosphere.
B. Highest critical frequency distance.
C. Range from the transmitter to the first returning sky wave.
D. Wavelength distance of a certain frequency.

BASIC PRINCIPLES 63.
Diffraction of an FR signal is a displacement of its propagation path due to?

A. Passing through ionised regions of the upper atmosphere.
B. Reflection from the surface.
C. Passing over or through mediums of different conductivity.
D. Passing over obstacle with dimensions close to the wavelength.

BASIC PRINCIPLES 64.
Using a medium frequency band when is fading likely to occur?

A. Night with sky and ground waves.
B. night time when snowing.
C. Day time when snowing.
D. Day with sky and ground waves.

BASIC PRINCIPLES 65.
Complete the following statement. ….. radio signals have a ….. range by ….. wave over ….. than over …..?

A. MF, shorter, sky, sea, land.
B. MF, greater, ground, sea, land.
C. VHF, shorter, sky, sea, land.
D. MF, greater, ground, land, sea.

BASIC PRINCIPLES 66.
The frequency at which sky waves should least affect reception?

A. VLF.
B. LF.
C. MF.
D. HF.

BASIC PRINCIPLES 67.
The skip distance of HF transmissions will increase with?

A. Lower frequency and lower position of the reflecting layer.
B. Lower frequency and higher position of the reflecting layer.
C. Higher frequency and higher position of the reflecting layer.
D. Higher frequency and lower position of the reflecting layer.

BASIC PRINCIPLES 68.
Attenuation is a generic term for?

A. Loss of power but is only relevant to space waves.
B. increase in power.
C. refraction.
D. loss of power.

BASIC PRINCIPLES 69.
Reflection from the ionospheric layers is used in the following radio frequencies?

A. VLF.
B. HF.
C. VHF.
D. UHF.

BASIC PRINCIPLES 70.
MF fading is most common?

A. During the day due to the reception of both sky waves and ground waves.
B. During the day and during heavy rain.
C. At night and during heavy rain.
D. At night due to the reception of both sky waves and ground waves..

BASIC PRINCIPLES 71.
As the frequency of a transmitter is increased, the range of the ground wave will?

A. Increase.
B. Decrease.
C. Decrease by night only.
D. Increase over the sea.

BASIC PRINCIPLES 72.
Skip distance is longest by …. and with a …. frequency?

4

A. Day, low.
B. Day, high.
C. Night, low.
D. Night, high.

BASIC PRINCIPLES 73.
Attenuation of a radio wave is the?

A. Reduction of its power by absorption, scattering or spreading.
B. Increase of its power by the combination of mutli-path signals.
C. Change of its frequency by use of sidebands.
D. Change of amplitude by use of sidebands.

BASIC PRINCIPLES 74.
A radio signal loses strength as the range from the transmitter increases. This effect is

called?

A. Ducting.
B. Amplification.
C. Attenuation.
D. Refraction.

BASIC PRINCIPLES 75.
In the propagation of MF waves, the phenomenon of FADING is particularly found?

A. By day and when raining.
B. At night and when raining.
C. By day due to the combination of sky waves and ground waves.
D. At night, due to the combination of sky waves and ground waves.

BASIC PRINCIPLES 76.
Fading happens?

A. In daytime when ground waves and sky waves interfere with each other.
B. At night when ground waves and sky waves interfere with each other.
C. At night when the signal is received by ground waves only.
D. At daytime when the signal is received by sky waves only.

BASIC PRINCIPLES 77.
Which of the following statements is true?

A. A transmission's bandwidth is affected by the design of the aerial.
B. Bandwidth must be reduced in order to reduce noise.
C. A narrow bandwidth improves beam width.
D. A broad bandwidth gives a narrow beam width.

BASIC PRINCIPLES 78.
Diffraction is the process by which?

A. A direct wave is bent around the form of the Earth.
B. A space wave penetrates the ionosphere.
C. Radio waves travel over and around objects.
D. A ground wave is attenuated over rough ground.

BASIC PRINCIPLES 79.
What is the lowest frequency where freedom from static interference can be guaranteed?

A. 3 MHz.
B. 30 MHz.
C. 300 MHz.
D. 3 GHz.

BASIC PRINCIPLES 80.
An HF transmitter is tuned to a frequency that refracts from the E layer in the ionosphere. The maximum distance of the first returning sky wave is?

A. 599 km.
B. 1500 km.
C. 599 nm.
D. 1500 nm.

BASIC PRINCIPLES 81.
The approximate maximum range of ground waves of LF and MF are (by day) ….. and ….. respectively, with ….. suffering more from atmospheric attenuation?

A. 1500 nm, 1000 nm, MF.
B. 1000 nm, 500 nm, LF.
C. 1000 nm, 300 nm, MF.
D. 500 nm, 100 nm, LF.

BASIC PRINCIPLES 82.
An aircraft travelling at 300 metres per second transmits a radio signal at 10 GHz to a stationary receiver. If the aircraft is flying directly towards the receiver and they are approximately at the same height, the received signal frequency will be?

A. 11 MHz.
B. 10.000011 GHz.
C. 9.999989 GHz.
D. 11 GHz.

VDF 1.
What is the approximate maximum theoretical range at which an aircraft at FL130 could receive information from a VDF facility, which is sited 1024 FT above MSL?

A. 180 NM
B. 220 NM
C. 120 NM
D. 150 NM

FL13000

VDF 2.
VDF accuracy may be decreased by?

A. Diurnal variation.
B. Site and propagation errors.
C. Night effect.
D. Coastal effect.

VDF 3.
VDF is not affected by the other options listed in this question.

The maximum theoretical range at which an aircraft at FL80 can obtain bearings from a ground VDF facility sited 325 FT above MSL is:

A. 158 NM
B. 107 NM
C. 114 NM
D. 134 NM

VDF 4.
What is the minimum level that an aircraft, at a range of 113 NM, must fly in order to contact the tower on R/T for a VDF bearing from an airport sited 169 FT above MSL?

A. FL60
B. FL50
C. FL80
D. FL100

$113 = 1.05 (\sqrt{169} + \sqrt{x})$

$\frac{113}{1.05} - \sqrt{169} = \sqrt{x}$

$90.1 - 13 = \sqrt{x}$

VDF 5.
What is the approximate maximum theoretical range at which an aircraft at FL140 could receive information from a VDF facility, which is sited 1050 FT above MSL?

A. 220 NM
B. 125 NM
C. 155 NM
D. 193 NM

VDF 6.
What is the approximate maximum theoretical range at which an aircraft at FL240 could receive information from a VDF facility, which is sited 1023 FT above MSL?

A. 120 NM
B. 150 NM
C. 223 NM
D. 210 NM

VDF 7.
What is the approximate maximum theoretical range at which an aircraft at FL120 could receive information from a VDF facility, which is sited 6000 FT above MSL?

A. 234 NM
B. 210 NM
C. 175 NM
D. 150 NM

VDF 8.
What is the approximate maximum theoretical range at which an aircraft at FL200 could receive information from a VDF facility, which is sited 6000 FT above MSL?

A. 210 NM

B. 295 NM
C. 250 NM
D. 274 NM

VDF 9.
What is the minimum level that an aircraft, at a range of 153 NM, must fly in order to contact the tower on R/T for a VDF bearing from an airport sited 169 FT above MSL?

A. FL120
B. FL150
C. FL180
D. FL100

VDF 10.
What is the minimum level that an aircraft, at a range of 170 NM, must fly in order to contact the tower on R/T for a VDF bearing from an airport sited 169 FT above MSL?

A. FL190
B. FL180
C. FL100
D. FL151

VDF 11.
What is the minimum level that an aircraft, at a range of 112 NM, must fly in order to contact the tower on R/T for a VDF bearing from an airport sited 144 FT above MSL?

A. FL100
B. FL60
C. FL90
D. FL100

VDF 12.
What is the minimum level that an aircraft, at a range of 133.5 NM, must fly in order to contact the tower on R/T for a VDF bearing from an airport sited 144 FT above MSL?

A. FL90
B. FL60
C. FL80
D. FL100

VDF 13.
An aircraft is "homing" to a radio beacon whilst maintaining a relative bearing of zero. If the magnetic heading increases, the aircraft is experiencing?

A. Right drift
B. Left drift
C. Zero drift

D. A wind from the west

VDF 14.
What airborne equipment, if any, is required to be fitted in order that a VDF let-down may be flown?

A. VHF radio
B. VOR
C. None
D. VOR/DME

VDF 15.
Which of the following is an advantage of Ground/DF (VDF) let-down?

A. It only requires a VHF radio to be fitted to the aircraft
B. It is pilot interpreted and does not require the assistance of ATC
C. It does not require any special equipment to be fitted to the aircraft
D. It does not require any special equipment, apart from a VHF radio, to be installed in the aircraft or on the ground

VDF 16.
In which one of the following circumstances is ground direction finding (VDF) likely to be used to fix an aircraft's position?

A. On first contact with ATC on crossing an international FIR boundary
B. When contacting ATC to join controlled airspace from the open FIR
C. When declaring an emergency on any frequency
D. When using the emergency VHF frequency 121.5 MHz

VDF 17.
What is a VDF referenced to?

A. Relative bearing to the aircraft.
B. True north at the aircraft.
C. Magnetic north at the station.
D. Magnetic north at the aircraft.

VDF 18
What is the approximate maximum theoretical range at which an aircraft at FL 130 could receive information from a VDF facility, which is sited 1024 ft above MSL?

A. 180 nm.
B. 150 nm.
C. 120 nm.
D. 220 nm.

VDF 19.
In ISA conditions, what is the maximum theoretical range at which an aircraft at FL80 can expect to obtain bearings from a ground VDF facility sited 325 ft above msl?

A. 107 nm.
B. 158 nm.
C. 114 nm.
D. 134 nm.

VDF 20.
What is the maximum level that an aircraft at a range of 113 nm, must fly in order to contact the tower on R/T for a VDF bearing from an airport sited at 169 ft above MSL?

A. FL60.
B. FL80.
C. FL50.
D. FL100.

VDF 21.
A radio beacon has an operational range of 10 nm. By what factor should the transmitter power be increased in order to achieve an operational range of 20 nm?

A. Four.
B. Eight.
C. Two.
D. Six.

VDF 22.
VDF is the abbreviation for?

A. VDF Direction Finder.
B. Very Direction Finder.
C. Very High Frequency Deviation Finding Station.
D. VHF Direction Finder.

VDF 23.
To provide a pilot with the position of the aircraft in the absence of radar, ATC must have at its disposal at least?

A. Two VDFs at different locations, able to take bearings simultaneously on the transmitted frequency.
B. Three VDFs at different locations, able to take bearings simultaneously on different frequencies.
C. Two co-located VDFs, able to take bearings simultaneously on the transmitted frequency.
D. One VDF able to take bearings simultaneously on different frequencies.

VDF 24.
Range of VDF depends on?

1. Line of sight formula.
2. Power of transmitter.
3. Intervening high ground.

The combination regrouping all of the correct statements is?

A. 2.
B. 1, 2 and 3.
C. 1 and 2.
D. 1 and 3.

VDF 25.
Range of VDF depends on?

1. Loudness of the voices of the pilots and the operator when transmitting.
2. power of airborne and ground transmitters.
3. power of pilot voice when transmitting.
4. aircraft altitude and ground transmitter elevation.

The combination regrouping all of the correct statements is?

A. 2 and 4.
B. 2
C. 1
D. 3 and 4.

VDF 26.
One of the uses of the VDF is providing aircraft with?

A. Ground speed.
B. Homing
C. Altitude.
D. Heading.

VDF 27.
A VDF may be used?

A. To provide the ATC controller with bearings of aircraft in the absence of radar.
B. In emergency type situations when the aircraft is unable to transmit on VHF.
C. In combination with radar to solve a 180 degree ambiguity.
D. In lieu of ILS for precision approach purposes.

VDF 28.
What is the effect of multipath signals (coming from the same aircraft) at the

Ground VHF Direction Finder Station?

A. It reduces the range at which the Ground VDF Direction Finder station receives signals from the aircraft.
B. Regardless of the difference in distance travelled by these signals, it results in their extinction of the signals at the Ground VHF Direction Finder station.
C. It may result in an increase in the distance at which Ground Direction Finder station receive signals from the aircraft, if the Ground Station is situated in the skip zone.
D. They may result in bearing errors.

VDF 29.
In flight, a pilot can improve the range of his transmission with a VDF operator by?

A. Speaking louder.
B. Flying out of clouds.
C. Increasing altitude.
D. Decreasing altitude.

VDF 30.
An aircraft is "homing" to a radio beacon whilst maintaining a relative bearing of zero. If the magnetic heading decreases, the aircraft is experiencing?

A. Right drift
B. Left drift
C. Zero drift
D. A wind from the west

VDF 31.
Given :

Compass heading 270°.
Deviation 2°W.
Variation 30°E.
Relative bearing of VDF station from the aircraft 316°.

What is the QDR?

A. 044°
B. 226°
C. 046°
D. 224°

VDF 32.
By selecting one VHF frequency, in the range 108 to 112 MHz, on the Nav receiver?

A. Rho-theta information from an enroute VOR/DME can be obtained.
B. Rho-theta information from an ILS/DME can be obtained.

C. Rho-theta information from a terminal VOR/DME can be obtained.
D. Rho-theta information from enroute VORs can be obtained.

VDF 33.
VDF measures the bearing of the aircraft with?

A. Reference to the aircraft relative bearing.
B. Reference to the true and magnetic north at the station.
C. Reference to the true and magnetic north at the aircraft.
D. Reference to magnetic north at the aircraft.

VDF 34.
The VDF Class B bearing is accurate to within?

A. +/- 1 degrees.
B. +/- 5 degrees.
C. +/- 3 degrees.
D. +/- 2 degrees.

VDF 35.
When would VDF be used for a position fix?

A. When declaring an emergency on 121.5 MHz.
B. When the aircraft declares an emergency on any frequency.
C. When first talking to an FIR on crossing an international boundary.
D. When joining controlled airspace from uncontrolled airspace.

VDF 36.
What airborne equipment, if any, is required to be fitted on order that a VDF let-down may be flown?

A. VOR/DME.
B. VHF Radio.
C. None.
D. VOR.

VDF 37.
An aircraft wishing to use the VDF service must?

A. By within 10 nautical miles of the VDF aerial.
B. Transmit a signal for a long enough period for the bearing to be established.
C. Be equipped with a VOR indicator unit.
D. Ask the controller to transmit for a long enough period to establish the bearing.

VDF 38.
What equipment does an aircraft need when carrying out a VDF let-down?

A. None.

B. VOR.
C. VOR/DME.
D. VHF Radio.

VDF 39.
The minimum airborne equipment required for operation of a VHF Direction Finder is a?

A. VHF Transmitter-receiver operating in the 118 MHz to 136 MHz range.
B. VHF Compass operating in the 200 kHz to 1750 kHz range.
C. Cathode ray tube.
D. VHF receiver operating in the 118 MHz to 136 MHz range.

VDF 40.
When conducting a QGH approach responsibility for interpreting the procedure rests with .... And on a QDM approach responsibility rests with ......?

A. The controller, the controller.
B. The pilot, the pilot.
C. The pilot, the controller.
D. The controller, the pilot.

VDF 41.
Ground direction finding at aerodromes utilises which frequencies?

A. VHF at civil aerodromes, VHF at military aerodromes.
B. VHF at civil aerodromes, UHF at military aerodromes.
C. UHF at civil aerodromes, VHF at military aerodromes.
D. UHF at civil aerodromes, UHF at military aerodromes.

VDF 42.
The range at which you can obtain a VDF bearing can be influenced by?

A. Intensity of ionisation.
B. Surface type.
C. Aircraft height.
D. Time of day.

VDF 43.
What is the purpose of a ground direction finder?

A. To map airfields.
B. To aid ground movements.
C. To aid pilot navigation.
D. To assist planners in the construction of airfield approaches.

VDF 44.
Which of the following affects VDF range?

A. Coastal refraction.
B. The height of the transmitter and the receiver.
C. The strength of the pilot's voice when transmitting.
D. Sky wave propagation.

VDF 45.
Abnormal long ranges may be experienced on VDF channels, caused by?

A. Efficient VDF antennas.
B. Intermodulation with signals on frequencies close to the one being used by the VDF station.
C. Super refraction of the signals in the atmosphere.
D. The VDF station using a relay station for communication to the aircraft.

VDF 46.
In VDF service the report "QDR 235, Class C" means?

A. The magnetic bearing from the aircraft to the station is 235 +/- 10 degrees.
B. The magnetic bearing from the station to the aircraft is 235 +/- 15 degrees.
C. The true bearing from the station to the aircraft is 235 +/- 10 degrees.
D. The magnetic bearing from the station to the aircraft is 235 +/- 10 degrees.

VDF 47.
If, when you are requesting a QDM from an airfield, you are offered a QGH, it means?

A. The service will be limited to bearings, no position will be given by the DF station.
B. The VDF unit is prepared to give you assistance during an approach to the airfield, based on VDF bearings.
C. The VDF service will be handled by a different DF unit, operating on the same frequency.
D. The bearing will only be accurate when the aircraft is flying above the QGH level.

VDF 48.
Which Q code would give a magnetic heading from a VDF station?

A. QDM.
B. QDR.
C. QUJ.
D. QTE.

VDF 49.
Which Q code would give a true track from a VDF station?

A. QDM.

B. QDR.
C. QUJ.
D. QTE.

VDF 50.
Which Q code would give a magnetic heading to steer (in nil wind) to a VDF station?

A. QDM.
B. QDR.
C. QUJ.
D. QTE.

VDF 51.
With reference to a VDF bearing, the true bearing of the aircraft from the ground station is a?

A. QUJ.
B. QTE.
C. QDR.
D. QDM.

VDF 52.
You intercept a QDM with aright crosswind component. Is your intercept heading greater or smaller than it would be without wind influence?

A. Greater.
B. Smaller.
C. Remains the same.
D. Not enough information to give an answer.

VDF 53.
If a ground D/F controller passes a bearing thus: "your true bearing is 256 degrees, class Alpha." This means?

A. QTE accurate to +/- 2 degrees.
B. QTE accurate to +/- 5 degrees.
C. QDR accurate +/- 2 degrees.
D. QUK accurate +/- 3 degrees.

VDF 54.
What is QTE?

A. Magnetic track to the station.
B. Magnetic track from the station.
C. True track from the station.
D. True track to the station.

VDF 55.
In the VDF system directional antennas are used?

A. At the ground installation.
B. In the aircraft.
C. In the aircraft and at the ground installation.
D. No directional antennas are used.

VDF 56.
The pilot of an aeroplane requesting a VDF bearing should?

A. Avoid banking when transmitting.
B. Not pass over the VDF station.
C. Transmit on 121.5 MHz.
D. Ensure that radio silence is maintained.

VDF 57.
Which of the following statements regarding VHF Direction Finding (VDF) is most accurate?

A. It is simple and only requires a VHF radio on the ground.
B. It is simple and requires a VHF radio and direction finding equipment in the aeroplane.
C. It is simple and requires a VHF radio on the ground and in the aeroplane.
D. It uses line of sight propagation.

VDF 58.
Which of the following is an advantage of VDF?

A. No equipment is required in the aircraft.
B. No special equipment is required in the aircraft or on the ground.
C. Only a VHF radio is required in the aircraft.
D. It is pilot interpreted, so ATC is not required.

VDF 59.
With reference to ground DF, the controller can refuse to give a bearing if?

A. The requesting aircraft is not from a consenting country.
B. The pilot does not use the prescribed terminology.
C. Conditions are poor and bearings do not fall the station's classifications limits.
D. None of the above.

VDF 60.
An aircraft receives a Class a true bearing from a VDF station. This is?

A. QTE accurate to +/- 2 degrees.
B. QUJ accurate to +/- 2 degrees.
C. QUJ accurate to +/- 5 degrees.

D. QTE accurate to +/- 5 degrees.

VDF 61.
A Class C magnetic bearing is received from a station. This is?

A. QUJ accurate to +/- 5 degrees.
B. QDM accurate to +/- 10 degrees.
C. QTE accurate to +/- 5 degrees.
D. QDR accurate to +/- 10 degrees.

VDF 62.
When the pilot is conducting a QDM/QGH procedure, he will require?

A. No operator on the ground for either VDF or QGH procedures.
B. An operator on the ground only for VDF procedure.
C. An operator on the ground only for QGH procedure.
D. An operator on the ground for both VDF and QGH procedures.

VDF 63.
The VDF homer service provides?

A. Accurate bearings on demand.
B. Bearings, which may be affected by synchronous transmissions.
C. A QGH procedure to transiting aircraft.
D. Bearings, which will normally be within +/- 5 degrees accuracy to a 20 nm range.

VDF 64.
The minimum airborne equipment required for operation of a VHF Direction Finder is a?

A. VHF Compass operating in the 500 kHz to 1000 kHz range.
B. Course Deviation Indicator (CDI).
C. VHF receiver operating in the 118 MHz to 136 MHz range.
D. VHF Transmitter-receiver operating in the 118 MHz to 136 MHz range

VDF 65.
At a height of 5000 feet you might expect to receive a VHF signal, from a transmitter located at sea level, at a range of?

A. 88.4 nm.
B. 88.4 km.
C. 70.7 nm.
D. 200 km.

VDF 66.
What is the maximum range at which a VDF station at 235 feet can provide a service to an aircraft at FL100?

A. 91 nm.
B. 114 nm.
C. 134 nm.
D. 144 nm.

VDF 67.
A Class B bearing has accuracy limits of plus or minus?

A. 2 degrees.
B. 3 degrees.
C. 5 degrees.
D. 7 degrees.

VDF 68.
VDF for aeronautical use provides service in the frequency range?

A. 108 to 118 MHz.
B. 108 to 136 MHz.
C. 118 to 136 MHz.
D. 130 to 300 MHz.

VDF 69.
In flight a pilot can improve the range of his transmission with a VDF operator by?

A. Increasing altitude.
B. Decreasing altitude.
C. Speaking louder.
D. Flying out of clouds.

VDF 70.
What is the Q code for a magnetic bearing from a VDF station?

A. QNH.
B. QTE.
C. QDR.
D. QDM.

ADF 1.
A radio beacon has an operational range of 10 NM. By what factor should the transmitter power be increased in order to achieve an operational range of 20 NM?

A. Six
B. Eight
C. Two
D. Four

ADF 2.
Night Effect' which causes loss of signal and fading, resulting in bearing errors from NDB transmissions, is due to:

A. Skywave distortion of the null position and is maximum at dawn and dusk.
B. Interference from other transmissions and is maximum at dusk when east of the NDB.
C. Static activity increasing at night particularly in the lower frequency band.
D. The effect of the Aurora Borealis.

ADF 3.
Quadrantal errors associated with aircraft Automatic Direction Finding (ADF) equipment are caused by:

A. Skywave/ground wave contamination.
B. Signal bending by the aircraft metallic surfaces.
C. Signal bending caused by electrical interference from aircraft wiring.
D. Misalignment of the loop aerial.

ADF 4.
An aeroplane is tracking away from an NDB maintaining track 020 degrees with 5 degrees starboard (right) drift. The relative bearing indicator (RBI) should indicate a bearing of?

A. 185 degrees relative.
B. 175 degrees relative.
C. 180 degrees relative.
D. 015 degrees relative.

ADF 5.
What is the wavelength of an NDB transmitting on 365 kHz?

A. 8.2 m.
B. 82 m.
C. 822 m.
D. 8200 m.

$\lambda = \frac{3\times10^8}{365\times10^3}$

ADF 6.
Which of the following is likely to have the greatest effect on ADF accuracy?

A. Interference from other NDBs, particularly at night.
B. Frequency drift at the ground station.
C. Interference from other NDBs, particularly during the day.
D. Mutual interference between aircraft aerials.

ADF 7.
There are two NDBs, one 20 NM inland, and the other 50 NM inland from the coast.

Assuming that the error caused by coastal refraction is the same for both propagations, the extent of the error in a position line plotted by an aircraft that is over water will be?

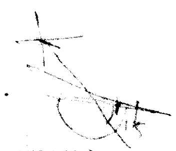
A. The same from both beacons when the aircraft is on a relative bearing of 180° and 360°.
B. Greater from the beacon that is 20 NM inland.
C. The same from both beacons when the aircraft is on a relative bearing of 090° and 270°.
D. Greater from the beacon that is 50 NM inland.

ADF 8.
Errors caused by the effect of coastal refraction on bearings at lower altitudes are maximum when the NDB is:

A. Inland and the bearing crosses the coast at an acute angle.
B. Near the coast and the bearing crosses the coast at right angles.
C. Inland and the bearing crosses the coast at right angles.
D. Near the coast and the bearing crosses the coast at an acute angle.

ADF 9.
An aeroplane is tracking towards an NDB maintaining track 120 degrees with 15 degrees starboard (right) drift. The relative bearing indicator (RBI) should indicate a bearing of?

A. 105 degrees relative.
B. 345 degrees relative.
C. 015 degrees relative.
D. 135 degrees relative.



ADF 10.
What is the wavelength of an NDB transmitting on 375 kHz? 120

A. 800 m
B. 8000 m
C. 8 m
D. 80 m

ADF 11.
An aeroplane is tracking away from an NDB maintaining track 120 degrees with 15 degrees starboard (right) drift. The relative bearing indicator (RBI) should indicate a bearing of?

A. 180 degrees relative.
B. 015 degrees relative.
C. 185 degrees relative.
D. 175 degrees relative.

ADF 12.
ADF bearings by an aeroplane by day within the published protection range should be accurate to within a maximum error of:

A. +/-2°.
B. +/-5°.
C. +/-10°.
D. +/-2.5°.

ADF 13.
Which of the following is the ICAO allocated frequency band for ADF receivers?

A. 200 - 1750 kHz
B. 255 - 455 kHz
C. 300 - 3000 kHz
D. 200 - 2000 kHz

ADF 14.
In order to obtain an ADF bearing the:

A. Signal must be received by both the sense and loop aerials.
B. Sense aerial must be tuned separately.
C. Mode selector should be switched to 'loop'.
D. BFO switch must be selected to 'ON'.

ADF 15.
Factors liable to affect most NDB/ADF system performance and reliability include:

A. Static interference - station interference - latitude error.
B. Height error - station interference - mountain effect.
C. Coastal refraction - lane slip - mountain effect.
D. Static interference - night effect - absence of failure warning system.

ADF 16.
Which one of the following disturbances is most likely to cause the greatest inaccuracy in ADF bearings?

A. Coastal effect.
B. Quadrantal error.
C. Precipitation interference.
D. Local thunderstorm activity.

ADF 17.
The BFO selector on an ADF receiver is used to:

A. Hear the IDENT of some NDB stations radiating a continuous wave signal.

B. Stop loop rotation.
C. Hear the IDENT and must always be switched ON.
D. Find the loop 'null' position.

ADF 18.
An NDB transmits a signal pattern in the horizontal plane which is :

A. Omnidirectional.
B. Bi-lobal circular.
C. A cardioid balanced at 30 Hz.
D. A beam rotating at 30 Hz.

ADF 19.
If a failed RMI rose is stuck on 090 degrees, and the ADF pointer indicates 225 degrees, the relative bearing to the station will be?

A. 225 degrees.
B. 315 degrees.
C. Impossible to read, due to the RMI failure.
D. 135 degrees.

ADF 20.
What actually happens in the ADF receiver when the BFO position is selected?

A. The BFO circuit is activated.
B. The BFO circuit imposes a tone onto the carrier wave to make the NDB's ident audible.
C. The BFO is activated, and the receiver accepts only A1A modulated signals.
D. The BFO circuit oscillates at an increased frequency in order to allow identification of A2A NDB's.

ADF 21.
An NDB is on a relative bearing of 316 degrees from an aircraft. Given: Compass heading 270. Deviation = 2W. Variation at the aircraft = 30E. Variation at the station = 28E. Calculate the true bearing of the NDB from the aircraft?

A. 072 degrees.
B. 252 degrees.
C. 074 degrees.
D. 254 degrees.

C D M V T
070 2W ~~268~~ ~~296~~

ADF 22.
A VOR and an NDB are co-located. An aircraft equipped with an RMI is flying away from the beacons on a radial of 090 degrees through an area where magnetic variation is changing rapidly. Which statement is correct?

A. The VOR needle moves, the ADF needle does not.
B. Both VOR and ADF needles move.
C. Neither the VOR nor the NDB needles move.
D. The ADF needle moves, the VOR needle does not.

ADF 23.
If a failed RMI rose is stuck on 090 and the ADF pointer indicates 225, the relative bearing of the station will be?

A. 225 degrees.
B. Impossible to read, due to the RMI failure.
C. 135 degrees.
D. 315 degrees.

ADF 24.
An NDB is on a relative bearing of 316 degrees from the aircraft. Given: Compass heading 265 degrees. At aircraft deviation = 3W, Variation = 36E. At station variation = 34E. Calculate the true bearing of the NDB from the aircraft?

A. 254 degrees.
B. 252 degrees.
C. 074 degrees.
D. 072 degrees.

225
90

ADF 25.
What is the wavelength of an NDB transmitting on 375 KHz?

A. 8 m.
B. 8000 m.
C. 80 m.
D. 800 m.

ADF 26.
Which of the following is likely to have the greatest effect on ADF accuracy?

A. Frequency drift at the ground station.
B. Interference from other NDBs, particularly at night.
C. Interference from other NDBs, particularly during the day.
D. Mutual interference between aircraft aerials.

ADF 27.
You are on a magnetic heading of 055 degrees, and your ADF indicates a relative bearing of 325 degrees. The QDM is?

A. 020 degrees.
B. 235 degrees.

C. 200 degrees.
D. 055 degrees.

ADF 28.
Given: W/V (T) = 230/20 kts. Variation = 6E. TAS = 80 kts. What relative bearing from an NDB should be maintained in order to achieve an outbound course of 257(M) from overhead the beacon?

A. 008 degrees.
B. 352 degrees.
C. 172 degrees.
D. 188 degrees.

ADF 29.
On the QDR of 075 degrees, (in the vicinity of the station) with magnetic heading of 295 degrees, the relative bearing on the ADF indicator is?

A. 040 degrees.
B. 220 degrees.
C. 320 degrees.
D. 140 degrees.

ADF 30.
A VOR and an NDB are co-located. You cross the VOR radial of 240 on a heading of 360 (M). In the vicinity of the station you should read an ADF bearing of?

A. 300
B. 120
C. 240
D. 60

ADF 31.
What does ADF stand for?

A. Automatic Direction Finding.
B. Airport Direction Finding.
C. Airborne Direction Finding.
D. Aeroplane Direction Finding.

ADF 32.
On which of the following displays are you able to get a direct read-out (no calculation is necessary from the pilot) of the magnetic bearing from the aircraft to the NDB?

A. Moving and fixed card ADF.
B. Fixed card AF only.
C. Fixed card ADF and RMI.

D. Moving card ADF and RMI.

ADF 33.
The quadrantal error of an ADF?

A. Is caused by the refraction from the aircraft's fuselage and is compensated for.
B. Is caused by interference from sky waves.
C. Is caused by aircraft magnetism and varies with the deviation as shown on the deviation table.
D. May be caused by interference of VORs within range of the ADF receiver and cannot be compensated for.

ADF 34.
Night effect in an ADF may cause?

A. Noise in the received EM-wave, which hardly will be noticed by the pilots looking at the RMI.
B. Fluctuating indications of the needle on the rim.
C. A constant error in the indicated heading.
D. No bearing error because of the built-in compensator unit.

ADF 35.
The reading of the RMI bearing is 300 degrees. At the tip of the needle. The magnetic variation at the DR position is 24W, the magnetic variation at the NDB is 22W and deviation is -2 degrees. The compass heading is 020 degrees. The true bearing is?

A. 294 degrees.
B. 094 degrees.
C. 272 degrees.
D. 274 degrees.

C D M V T
20 2W 18 22W 356
Hdg +

ADF 36.
With regard to the range of NDBs and the accuracy of the bearings they provide it can be stated that in general at night?

A. The range increases and the accuracy decreases.
B. The range and the accuracy both decreases.
C. The range and the accuracy both increases.
D. The range decreases and the accuracy increases.

ADF 37.
Which statement with respect to the range of an NDB?

A. With propagation over sea the range will be greater than the range with propagation over land.

B. In order to double the range of an NDB, the transmission power should be increased by a factor of 16.
C. The range depends on the altitude of the aircraft.
D. During the night the range of an NDB will decrease due to the interference of the direct and earth reflected waves.

ADF 38.
Which statement with respect to the range of an NDB in an area with constant wind and constant magnetic variation?

A. The relative bearing of the NDB should be equal to the QDM.
B. The relative bearing of the NDB should be kept 000 degrees.
C. The relative bearing of the NDB should be equal (in magnitude and sign) to the applied wind correction angle.
D. The relative bearing of the NDB should be equal (in magnitude and sign) to the experienced drift angle.

ADF 39.
Which statement is correct for tracking towards an NDB in an area with constant wind and constant magnetic variation?

A. The relative bearing of the NDB should be equal (in magnitude and sign) to the experienced drift angle.
B. The relative bearing of the NDB should be equal (in magnitude and sign) to the applied wind correction angle.
C. The relative bearing of the NDB should be kept 000 degrees.
D. The relative bearing of the NDB should be equal to the QDM.

ADF 40.
Allocated frequencies for NDB are?

A. 19 Hz to 17500 Hz.
B. 1.90 kHz to 17.50 kHz.
C. 190 kHz to 1750 kHz.
D. 1900 kHz to 17500 kHz.

ADF 41.
ADF is the abbreviation for?

A. Automatic Direction Finder.
B. Automatic Detection Finder.
C. Aircraft Direction Finder.
D. Aircraft direction Finding.

ADF 42.
The ADF indication in the cockpit is a?

A. True bearing on an RMI.
B. Relative bearing on an RMI.
C. Relative bearing on a fixed card.
D. Magnetic heading on a fixed card indicator.

ADF 43.
NDB is the abbreviation for?

A. Non Directional Beacon.
B. Night Directional Beacon.
C. Non Directional Bearing.
D. Navigation Director Beacon.

ADF 44.
Concerning ADF and NDB?

A. NDB is a locator and ADF is an en route nav-aid.
B. ADF is a ground equipment and NDB can be a ground equipment or an airborne equipment.
C. ADF is a civilian equipment whereas NDB is a military equipment used by civilians too.
D. NDB is a ground equipment, and ADF is an airborne equipment.

ADF 45.
What causes the so called "night effect"?

A. A change in the direction of the plane of the polarisation due to reflection in the ionosphere.
B. The difference in velocity of the EM waves over land and over sea at night.
C. The absence of the surface wave at distances larger than the skip distance.
D. Interference between the ground and space waves.

ADF 46.
Which statement about the errors and effects on NDB radio signals is correct?

A. Shore line effects may cause a huge bearing error due to reflection of the radio signals onto steep coasts.
B. Lightning during atmospheric disturbances may cause a reduction of the signal strength that may result in only slight bearing errors.
C. Night effect is a result of interference of the surface wave and the space wave causing a reduction is range.
D. The mountain effect is caused by reflections onto steep slopes of mountainous terrain which may cause big errors in the bearing.

VOR 1.
A VOR is sited at position A (45°00'N, 010°00'E). An aircraft is located at position B (44°00'N, 010°00'E). Assuming that the magnetic variation at A is 10°W and at B is 15°W, the aircraft is on VOR radial:

A. 195°.
B. 190°.
C. 185°.
D. 180°.

VOR 2.
An RMI indicates aircraft heading. To convert the RMI bearings of NDBs and VORs to true bearings the correct combination for the application of magnetic variation is:

A.	NDB: beacon position.	VOR: beacon position.
B.	NDB: beacon position.	VOR: aircraft position.
C.	NDB: aircraft position.	VOR: beacon position.
D.	NDB: aircraft position.	VOR: aircraft position.

VOR 3.
An aircraft is flying on the true track 090° towards a VOR station located near the equator where the magnetic variation is 15°E. The variation at the aircraft position is 8°E.

The aircraft is on VOR radial?

A. 255°
B. 278°
C. 262°
D. 285°

VOR 4.
Given:
Magnetic heading 280°.
VOR radial 090°.

What bearing should be selected on the omni-bearing selector in order to centralise the VOR deviation needle with a "TO" indication?

A. 270°
B. 280°
C. 100°
D. 090°

VOR 5.
A VOR is sited at position 58°00'N 073°00'W where the magnetic variation equals 32°W.
An aircraft is located at position 56°00'N 073°00'W where the magnetic variation equals

28°W. The aircraft is on VOR radial?

A. 208
B. 212
C. 360
D. 180

VOR 6.
The principle used in VOR bearing measurement is:

A. Phase comparison
B. Envelope matching
C. Beat frequency discrimination
D. Difference in depth of modulation

VOR 7.
A VOR is sited at position A (35°00'N, 020°00'E). An aircraft is located at position B (34°00'N, 020°00'E). Assuming that the magnetic variation at A is 15°W and at B is 20°W, the aircraft is on VOR radial:

A. 195°
B. 175°
C. 185°
D. 180°

VOR 8.
A radial is the ......(i) bearing ....(ii) a VOR ground station?

A.	Magnetic	To.
B.	Relative	From.
C.	Magnetic	From.
D.	True	From.

VOR 9.
Tuned to a VOR station, with OBS needle central, the instrument reads 140 degrees with FROM indicated. Relative to the VOR station the receiver is in the?

A. Northwest sector.
B. Northeast or Southeast sector, depending on the heading of the aircraft when the reading is taken.
C. Southwest sector.
D. Southeast sector.

VOR 10.
The VOR to obtain CDI (course deviation indicator) indications in the correct sense when tracking towards a VOR on radial 255 degrees, the pilot should set on the OBS (Omni bearing selector)?

A. 075 degrees with TO indicated.
B. 235 degrees with FROM indicated.
C. 055 degrees with FROM indicated.
D. 235 degrees with TO indicated.

VOR 11.
In order to obtain CDI (Course Deviation Indicator) indications in the correct sense when tracking towards a VOR on radial 235 degrees, the pilot should set on the OBS (omni bearing selector)?

A. 235 degrees with FROM indicated.
B. 055 degrees with TO indicated.
C. 055 degrees with FROM indicated.
D. 235 degrees with TO indicated.

VOR 12.
A VOR is sited at position A (35°00'N, 020°00'E). An aircraft is located at position B (34°00'N, 020°00'E). Assuming that the magnetic variation at A is 15°E and at B is 20°E, the aircraft is on VOR radial:

A. 165°
B. 195°
C. 160°
D. 180°

VOR 13.
The VOR system is limited to about 1° of accuracy. One degree at 250 NM represents a width of:

A. 2.0 NM.
B. 2.5 NM.
C. 4.4 NM.
D. 3.0 NM.

VOR 14.
The VOR system is limited to about 1° of accuracy. One degree at 300 NM represents a width of:

A. 5.2 NM.
B. 4.0 NM.
C. 4.5 NM.

D. 3.0 NM.

VOR 15.
The two signals transmitted by a conventional VOR ground station are 180° out of phase on magnetic:

A. East.
B. West.
C. North.
D. South.

VOR 16.
The two signals transmitted by a conventional VOR ground station are 270° out of phase on magnetic:

A. West.
B. East.
C. South.
D. North.

VOR 17.
Which frequency band is used by VOR transmissions?

A. UHF.
B. VHF.
C. SHF.
D. HF.

VOR 18.
Transmissions from VOR facilities may be adversely affected by:

A. Static interference.
B. Night effect.
C. Uneven propagation over irregular ground surfaces.
D. Quadrantal error.

VOR 19.
If VOR bearing information is used beyond the published protection range, errors could be caused by:

A. Interference from other transmitters.
B. Noise from precipitation static exceeding the signal strength of the transmitter.
C. Sky wave interference from the same transmitter.
D. Sky wave interference from distant transmitters on the same frequency.

VOR 20.

An aircraft is 100 NM from a VOR facility. Assuming no error when using a deviation indicator where 1 dot = 2° deviation, how many dots deviation from the centre line of the instrument will represent the limits of the airway boundary? (Assume that the airway is 10 NM wide)

A. 1.5.
B. 1.15.
C. 1.7.
D. 2.5.

VOR 21.

The two signals transmitted by a conventional VOR ground station are in phase on magnetic:

A. East.
B. North.
C. South.
D. West.

VOR 22.

An airway 12 NM wide is to be defined by two VORs each having a resultant bearing accuracy of plus or minus 5.5°.

In order to ensure accurate track guidance within the airway limits the maximum distance apart for the transmitter is approximately?

A. 50 NM.
B. 165 NM.
C. 210 NM.
D. 124 NM.

$5.5 = \frac{6 \times 60}{x}$

$x = \frac{6 \times 60}{5.5}$

VOR 23.

An airway 15 NM wide is to be defined by two VORs each having a resultant bearing accuracy of plus or minus 5.5°.

In order to ensure accurate track guidance within the airway limits the maximum distance apart for the transmitter is approximately?

A. 50 NM.
B. 165 NM.
C. 210 NM.
D. 155 NM.

VOR 24.

An airway 20 NM wide is to be defined by two VORs each having a resultant bearing accuracy of plus or minus 5.5°.

In order to ensure accurate track guidance within the airway limits the maximum distance apart for the transmitter is approximately?

A. 208 NM.
B. 50 NM.
C. 165 NM.
D. 210 NM.

VOR 25.

An aeroplane flying on a heading of 280 degrees magnetic is on a bearing of 180 degrees magnetic from of VOR.

The bearing to the VOR that should be selected on the OMNI bearing selector to centralise the VOR/ILS deviation needle is?

A. 360.
B. 270.
C. 180.
D. 90.

VOR 26.

An aeroplane flying on a heading of 280 degrees magnetic is on a bearing of 180 degrees magnetic from of VOR.

The bearing from the VOR that should be selected on the OMNI bearing selector to centralise the VOR/ILS deviation needle is?

A. 90.
B. 180.
C. 270.
D. 360.

VOR 27.

Given:
VOR station position N66° E025°, variation 20°E;
Estimated position of an aircraft N56° E025°, variation 25°E.

What VOR radial is the aircraft on?

A. 160°.
B. 345°.
C. 165°.
D. 195°.

VOR 28.
An airway 10 NM wide is to be defined by two VORs each having a resultant bearing accuracy of plus or minus 5.5°.

In order to ensure accurate track guidance within the airway limits the maximum distance apart for the transmitter is approximately?

A. 50 NM.
B. 105 NM.
C. 165 NM.
D. 210 NM.

VOR 29.
An aircraft is required to approach a VOR via the 104° radial. Which of the following settings should be made on the VOR/ILS deviation indicator?

A. 284° with the FROM flag showing.
B. 284° with the TO flag showing.
C. 104° with the TO flag showing.
D. 104° with the FROM flag showing.

VOR 30.
An aircraft on a heading of 280°(M) is on a bearing of 090°(M) from a VOR.

The bearing you should select on the OMNI bearing selector to centralise the VOR/ILS left/right deviation needle with a 'TO' indication is?

A. 270°.
B. 090°.
C. 100°.
D. 280°.

VOR 31.
Given:
Aircraft heading 045°(M),
Aircraft is on radial 080° from a VOR,
Selected course on HSI is 090°.

The HSI indications are deviation bar?

A. Behind the aeroplane symbol with the FROM flag showing.
B. Behind the aeroplane symbol with the TO flag showing.
C. Ahead of the aeroplane symbol with the FROM flag showing.
D. Ahead of the aeroplane symbol with the TO flag showing.

VOR 32.
Given:
Aircraft heading 300°(M),
Aircraft is on radial 280° from a VOR,
Selected course on HSI is 270°.

The HSI indications are deviation bar?

A. Behind the aeroplane symbol with the TO flag showing.
B. Ahead of the aeroplane symbol with the FROM flag showing.
C. Ahead of the aeroplane symbol with the TO flag showing.
D. Behind the aeroplane symbol with the FROM flag showing.

VOR 33.
Given:
Aircraft heading 150°(M),
Aircraft is on radial 100° from a VOR,
Selected course on HSI is 090°.

The HSI indications are deviation bar?

A. Behind the aeroplane symbol with the TO flag showing.
B. Ahead of the aeroplane symbol with the FROM flag showing.
C. Ahead of the aeroplane symbol with the TO flag showing.
D. Behind the aeroplane symbol with the FROM flag showing.

VOR 34.
What is the maximum distance between VOR and DME/TACAN ground installations if they are to have the same morse code identifier?

A. 2000 m.
B. 60 m.
C. 300 m.
D. 600 m.

VOR 35.
A VOR and DME are co-located. You want to identify the DME by listening to the callsign. Having heard the same callsign 4 times in 30 seconds the?

A. DME callsign is the one with the higher pitch that was broadcast only once
B. DME callsign was not transmitted, the distance information is sufficient proof of correct operation
C. DME callsign is the one with the lower pitch that was broadcast several times
D. VOR and DME callsigns were the same and broadcast with the same pitch

VOR 36.
In order to plot a bearing from a VOR station, a pilot needs to know the magnetic variation:

A. At the aircraft location.
B. At the VOR.
C. At the halfway point between the aircraft and the station.
D. At both the VOR and aircraft.

VOR 37.
An aircraft is required to approach a VOR station via the 244° radial. In order to obtain correct sense indications the deviation indicator should be set to:

A. 064° with the FROM flag showing.
B. 064° with the TO flag showing.
C. 244° with the FROM flag showing.
D. 244° with the TO flag showing.

VOR 38.
What is the maximum theoretical range that an aircraft at FL150 can receive signals from a VOR situated 609 feet above MSL?

A. 220 NM.
B. 147 NM.
C. 184 NM.
D. 156 NM

13

VOR 39.
An RMI slaved to a remote indicating compass has gone unserviceable and is locked on to a reading of 090°. The tail of the VOR pointer shows 135°. The available information from the VOR is:

A. Radial 135°, relative bearing unknown.
B. Radial unknown, relative bearing 225°.
C. Radial unknown, relative bearing 045°.
D. Radial 315°, relative bearing unknown.

VOR 40.
Which of the following statements concerning the variable, or directional, signal of a conventional VOR is correct?

A. The transmitter varies the amplitude of the variable signal by 30 Hz each time it rotates.
B. The rotation of the variable signal at a rate of 30 times per second gives it the characteristics of a 30 Hz amplitude modulation.
C. The transmitter changes the frequency of the variable signal by 30 Hz either side of the allocated frequency each time it rotates.
D. The receiver adds 30 Hz to the variable signal before combining it with the reference signal.

VOR 41.
The maximum theoretical range at which an aircraft at FL230 may receive signals from a VOR facility sited at mean sea level is:

A. 190 NM.
B. 230 NM.
C. 170 NM.
D. 151 NM

VOR 42.
If an aircraft flies along a VOR radial it will follow a:

A. Rhumbline track.
B. Line of constant bearing.
C. Great circle track.
D. Constant magnetic track.

VOR 43.
An aircraft at 6400 FT will be able to receive a VOR ground station at [illegible] FT above MSL at an approximate maximum range of :

A. 90 NM.
B. 100 NM.
C. 110 NM.
D. 120 NM.

VOR 44.
A VOR and NDB are co-located. An aeroplane fitted with an RMI is flying away from the beacons on a radial of 090 degrees. The variation is changing rapidly

Which of the following statements is true?

A. The ADF needle will not move, but the VOR needle will move as the variation changes.
B. The VOR needle will not move, but the ADF needle will move as the variation changes.
C. Both the VOR needle and the ADF needle will move as the variation changes.
D. Neither the VOR needle nor the ADF needle will move.

VOR 45.

A VOR and NDB are co-located. An aeroplane fitted with an RBI is flying away from the beacons on a radial of 090 degrees. The variation is changing rapidly.

Which of the following statements is true?

A. The VOR needle will not move, but the ADF needle will move as the variation changes.
B. The ADF needle will not move, but the VOR needle will move as the variation changes.
C. Both the VOR needle and the ADF needle will move as the variation changes.
D. Neither the VOR needle nor the ADF needle will move.

VOR 46.

An aeroplane flying on a heading of 180 degrees magnetic is on a bearing of 270 degrees magnetic from of VOR. The bearing to the VOR that should be selected on the OMNI bearing selector to centralise the VOR/ILS deviation needle is?

A. 90.
B. 270.
C. 180.
D. 360.

VOR 47.

An aeroplane flying on a heading of 180 degrees magnetic is on a bearing of 270 degrees magnetic from of VOR. The bearing from the VOR that should be selected on the OMNI bearing selector to centralise the VOR/ILS deviation needle is?

A. 90.
B. 180.
C. 270.
D. 360.

VOR 48.

An aircraft at FL 100 should be able to receive a VOR ground station at 100 FT above MSL at an approximate maximum range of :

A. 135 NM.
B. 123 NM.
C. 130 NM.
D. 142 NM.

VOR 49.

The maximum theoretical range at which an aircraft at FL210 may receive signals from a VOR facility sited 340 feet above mean sea level is approximately:

A. 245 NM.
B. 163 NM.
C. 183 NM.
D. 204 NM.

VOR 50.

In which frequency band do VOR transmitters operate?

A. UHF.
B. VHF.
C. SHF.
D. EHF.

VOR 51.

The two signals transmitted by a conventional VOR ground station are 90° out of phase on magnetic:

A. South.
B. East.
C. West.
D. North.

VOR 52.

An aircraft is flying on a heading of 270°(M). The VOR OBS is also set to 270° with the full left deflection and FROM flag displayed. In which sector is the aircraft from the VOR ground station?

A. SW.
B. NW.
C. SE.
D. NE.

VOR 53.

An Omni-bearing selector (OBS) shows full deflection to the left when within range of a serviceable VOR. What angular deviation are you from the selected radial?

A. 10° or more.
B. Less than 10°.
C. 1.5° or more.
D. 2.5 or more.

VOR 54.

An aircraft is on radial 120 with a magnetic heading of 300°, the track selector (OBS) reads : 330. The indications on the Course Deviation Indicator (CDI) are 'fly':

A. Left with 'TO' showing.

B. Right with 'TO' showing.
C. Right with 'FROM' showing.
D. Left with 'FROM' showing.

VOR 55.
Given:
Course Deviation Indicator (CDI) for a VOR is selected to 090°.
From/To indicator indicates "TO".
CDI needle is deflected halfway to the right.

On what radial is the aircraft?

A. 85.
B. 265.
C. 95.
D. 275.

VOR 56.
The frequency range of a VOR receiver is:

A. 108 to 111.95 MHz.
B. 108 to 117.95 MHz.
C. 118 to 135.95 MHz.
D. 108 to 135.95 MHz.

VOR 57.
If the reference phase differs 30° with the variable phase the radial from the VOR station will be:

A. 030°.
B. 330°.
C. 210°.
D. 150°.

VOR 58.
Given:
VOR station position N61° E025°, variation 13°E;
Estimated position of an aircraft N59° E025°, variation 20°E.

What VOR radial is the aircraft on?

A. 167°.
B. 347°.
C. 160°.
D. 193°.

VOR 59.
The captain of an aircraft flying at FL100 wishes to obtain weather information at the destination airfield from the airfield's VOR. At what maximum theoretical range will it be possible to obtain this information?

A. 123 km.
B. 12.3 NM.
C. 125 NM.
D. 1230 km.

VOR 60.
Given:
Aircraft heading 160°(M),
Aircraft is on radial 240° from a VOR,
Selected course on HSI is 250°.

The HSI indications are deviation bar?

A. Behind the aeroplane symbol with the FROM flag showing.
B. Behind the aeroplane symbol with the TO flag showing.
C. Ahead of the aeroplane symbol with the FROM flag showing.
D. Ahead of the aeroplane symbol with the TO flag showing.

VOR 61.
You are on a compass heading of 090 degrees on the 255 radial from a VOR. You set the course 190 degrees on your OBS. The deviation bar will show?

A. Full scale deflection right with a "from" indication.
B. Full scale deflection left with a "to" indication.
C. Full scale deflection right with a "to" indication.
D. Full scale deflection left with a "from" indication.

VOR 62.
How does a VOR/DME Area Navigation system select the DME station to be used for positioning?

A. The pilot tunes the closest VOR/DME stations within range on the VOR/DME Area Navigation control panel.
B. The VOR/DME Area Navigation system has its own NAV tuner and the system itself tunes the DME stations closest to the aircraft.
C. The VOR/DME Area Navigation system has its own NAV tuner and the system itself tunes the DME stations providing the most accurate position.
D. The VOR/DME Area Navigation system uses whatever stations are tuned on the aircraft's normal VHF NA selector.

VOR 63.
In order to measure the radial from a VOR, the aircraft VOR receiver?

A. Measures the phase difference between the reference phase and the variable phase of the signal.
B. Measures the time difference between sending the interrogation signal and receiving the transponder signal.
C. Uses the pulse technique to determine the radial.
D. Measures the time difference between reception of the two signals transmitted from the ground station.

VOR 64.
Apart from radials and distances from VOR/DME stations, what information is required by the VOR/DME Area Navigation computer in order to calculate the wind?

A. True airspeed from the Air Data Computer.
B. Heading from the aircraft compass system.
C. Vertical speed from the air data computer.
D. Heading from the aircraft compass system and true airspeed from the Air Data Computer.

VOR 65.
An aircraft, on a heading of 180(M) is on a bearing of 270 (M) from a VOR. The bearing you should select on the OMNI bearing selector to centralise the VOR/ILS left/right needle with a TO indication is?

A. 090 degrees.
B. 360 degrees.
C. 270 degrees.
D. 180 degrees.

VOR 66.
An aircraft at FL100 should be able to receive a VOR ground station at 100 ft above msl at an approximate maximum range of?

A. 145 nm.
B. 123 nm.
C. 130 nm.
D. 137 nm.

VOR 67.
An aircraft at 6400 ft should be able to receive a VOR ground station at 100 ft above msl at an approximate maximum range of?

A. 113 nm.
B. 90 nm.
C. 123 nm.
D. 98 nm.

VOR 68.
An OBS is set to 048 with a TO flag showing. The VOR deviation bar is showing full right deflection. Approximately what radial are you on?

A. 058 degrees.
B. 238 degrees.
C. 218 degrees.
D. 038 degrees.

VOR 69.
An aircraft on a heading of 180 (M) is on bearing 270 (M) from a VOR. The bearing you should select on the OMNI Bearing Selector to centralise the VOR/ILS left/right deviation bar is?

A. 360 degrees.
B. 270 degrees.
C. 090 degrees.
D. 180 degrees.

VOR 70.
Given: Aircraft heading 160 (M), aircraft is on radial 240 from a VOR. Selected course on the HSI is 250 degrees. The HSI indications are deviation bar?

A. Behind the aeroplane symbol with the FROM flag showing.
B. Ahead of the aeroplane symbol with the FROM flag showing.
C. Behind the aeroplane symbol with the TO flag showing.
D. Ahead of the aeroplane symbol with the TO flag showing.

VOR 71.
Under which of the following circumstances does a VOR/DME Area Navigation System switch to Dead Reckoning Mode?

A. The system is receiving information from only one VOR and one DME.
B. The system is receiving information from only one VOR.
C. The system is receiving information from the two DME's.
D. The system is receiving information from one VOR and two DME's.

VOR 72.
A pilot flying an aircraft at FL80, tunes in a VOR, which has an elevation of 313m. Given ISA conditions, what is the maximum theoretical distance at which the pilot might expect to receive the VOR signals?

A. 10 nm.
B. 180 nm.
C. 120 nm.
D. 151 nm.

VOR 73.
An aircraft is on the 120 degree radial from a VOR. Course 340 degrees is selected on the HSI (Horizontal Situation Indicator). If the magnetic heading is 070 degrees, the deviation bar relative to the aeroplane model will be?

A. Behind.
B. In front.
C. Right.
D. Left.

VOR 74.
The OBS is set to 048 degrees. "TO" appears in the window. The needle is close to full right deflection. The VOR radial is approximately?

A. 238 degrees.
B. 038 degrees.
C. 058 degrees.
D. 218 degrees.

VOR 75.
The OBS is set to 235 degrees. "TO" appears in the window. The needle is close to half scale left deflection. The VOR radial is approximately?

A. 230 degrees.
B. 060 degrees.
C 240 degrees.
D. 050 degrees.

VOR 76.
Your aircraft is heading 075(M). The OBI is set to 025. The VOR indications are "TO" with the needle showing right deflection. Relative to the station, you are situated in a quadrant defined by the radials?

A. 025 degrees and 115 degrees.
B. 205 degrees and 295 degrees.

C. 295 degrees and 025 degrees.
D. 115 degrees and 205 degrees.

VOR 77.
You are on compass heading 090 on the 255 radial from a VOR. You set the course 190 on your OBS. The deviation bar will show?

A. Full scale deflection left with a "TO" indication.
B. Full scale deflection right with a "FROM" indication.
C. Full scale deflection left with a "FROM" indication.
D. Full scale deflection right with a "TO" indication.

VOR 78.
An aircraft is flying on the true track 090 degrees, towards a VOR station located near the equator where the magnetic variation is 15 degrees East. The variation at the aircraft position is 8 degrees East. The aircraft is on the VOR radial?

A. 255 degrees.
B. 278 degrees.
C. 262 degrees.
D. 285 degrees.

VOR 79.
Given: Magnetic heading 280 degrees, VOR radial 090 degrees. What bearing should be selected on the omni-bearing selector in order to centralise the VOR deviation needle with a £TO" indication?

A. 100 degrees.
B. 270 degrees.
C. 280 degrees.
D. 090 degrees.

VOR 80.
A VOR is sited at position (58 00 N, 073 00 W), where the magnetic variation is 32 degrees West. An aircraft is located at position (58 00 N, 073 00 W), where the magnetic variation is 28 degrees West. The aircraft is on VOR radial?

A. 208 degrees.
B. 212 degrees.
C. 360 degrees.
D. 180 degrees.

VOR 81.
A VOR is sited at position A, (45 00 N, 010 00 E). An aircraft is located at position B, (44 00 N, 010 00 E). Magnetic variation at position A = 10 degrees West, and at position B it is 15 degrees West. The aircraft is on VOR radial?

A. 180 degrees.
B. 195 degrees.
C. 190 degrees.
D. 185 degrees.

VOR 82.
An airway 10 nm wide is to be defined by two VORs, each having a resultant bearing accuracy of plus or minus 5.5 degrees. In order to ensure accurate track guidance within the airway limits, the maximum distance apart from the transmitter is approximately?

A. 105 nm.
B. 210 nm.
C. 50 nm.
D. 165 nm.

VOR 83.
An aircraft is required to approach a VOR via the 104 degrees radial. Which of the following settings should be made on the VOR/ILS deviation indicator?

A. 284 degrees with the TO flag showing.
B. 104 degrees with the TO flag showing.
C. 284 degrees with the FROM flag showing.
D. 104 degrees with the FROM flag showing.

VOR 84.
An aircraft is required to approach a VOR via the 244 degrees radial. Which of the following settings should be made on the VOR/ILS deviation indicator?

A. 244 degrees with the TO flag showing.
B. 064 degrees with the TO flag showing.
C. 284 degrees with the FROM flag showing.
D. 064 degrees with the FROM flag showing.

VOR 85.
What is the maximum theoretical range that an aircraft at FL 150 can receive signals from a VOR situated at 609 ft above MSL?

A. 220 nm.
B. 156 nm.
C. 184 nm.

D. 147 nm.

VOR 86.
An RMI slaved to a remote indicating compass has gone unserviceable and is locked on to a reading of 090 degrees. The tail of the VOR needle shows 135 degrees. The available information from the VOR is?

A. Radial unknown, relative bearing 045 degrees.
B. Radial unknown, relative bearing 225 degrees.
C. Radial 135, relative bearing unknown.
D. Radial 315, relative bearing unknown.

VOR 87.
An aircraft at 6400 ft will be able to receive a VOR ground station at 100 ft above MSL at an approximate range of?

A. 113 nm.
B. 90 nm.
C. 98 nm.
D. 123 nm.

135
90
T.
225

225

VOR 88.
An aircraft at FL 100 ft will be able to receive a VOR ground station at 100 ft above MSL at an approximate range of?

A. 137 nm.
B. 130 nm.
C. 145 nm.
D. 123 nm.

VOR 89.
An aircraft is on radial 120 with a magnetic heading of 300 degrees. The track selector (OBS) reads 330 degrees. The indications on the Course Deviation Indicator (CDI) are "fly"?

A. Left with "FROM" showing.
B. Left with "TO" showing.
C. Right with "TO" showing.
D. Right with "FROM" showing.

VOR 90.
Given: Course Deviation Indicator (CDI) for a VOR is elected to 090 degrees. From/To indicator indicates "TO". CDI needle is deflected halfway to the right. On what radial is the aircraft?

A. 85.
B. 95.
C. 275.
D. 265.

VOR 91.
The maximum theoretical range at which an aircraft at FL 230 can receive signals from a VOR facility sited at MSL is?

A. 190 nm.
B. 170 nm.
C. 230 nm.
D. 151 nm.

VOR 92.
The VOR system is limited to about 1 degree of accuracy. One degree at 200 nm range represents a width of?

A. 2.5 nm.
B. 3.5 nm.
C. 2.0 nm.
D. 3.0 nm.

VOR 93.
An aircraft is situated at 30N 005E, with magnetic variation of 10W. A VOR is located at 30N 013E with a magnetic variation of 15W. The aircraft is situated on the VOR radial?

A. 101.
B. 281.
C. 286.
D. 256.

VOR 94.
An aeroplane flies over position, A which is due north of a VOR station sited at position B. The magnetic variation at A = 18W. The magnetic variation at B = 10W. What radial from B is the aircraft on?

A. 010 degrees,
B. 342 degrees.
C. 350 degrees.
D. 018 degrees.

VOR 95.
Under which of the following circumstances does a VOR/DME Area Navigation System switch to Dead Reckoning mode?

A. VOR/DME Area Navigation computer is not receiving information from the Air Data Computer.
B. VOR/DME Area Navigation computer is receiving neither radial nor distance data information from the VOR/DME stations.
C. When "DR" is selected by the pilot.
D. VOR/DME Area Navigation computer is not receiving information from the aircraft compass system.

VOR 96.
The identification of a DME in combination,with a collocated VOR is as follows?

A. In a period of 40 seconds the DME ident will be heard once on an audio frequency of 1350 Hz.
B. Every 30 seconds the DME ident will be repeated.
C. The VOR ident and the DME ident are the same and no difference can be heard.
D. The DME ident will repeat three times every period of30 seconds.

VOR 97.
Two aircraft are located on (arbitrary) different radials but at equal distances from a VOR station. Which statement is true?

A. At a certain moment of time the phase of the reference signals is equal and the phases of the variable signals is equal for both.
B. At a certain moment of time, both the phase of the reference signals and the phase of the variable signals are equal for both aircraft.
C. At a certain moment of time, both the phase of the reference signals and the phase of the variable signals are unequal for both aircraft.
D. At a certain moment of time the phase of the reference signals is equal and the phases of the variable signals is unequal for both.

VOR 98.
Two aircraft are located on the same radial but at (arbitrary) different distances from a VOR station. Which statement is true?

A. At a certain moment of time the phase of the reference signals is equal and the phases of the variable signals is unequal for both.
B. At a certain moment of time the phase of the reference signals is equal and the phases of the variable signals is equal for both.
C. At a certain moment of time, both the phase of the reference signals and the phase of the variable signals are equal for both aircraft.
D. At a certain moment of time, both the phase of the reference signals and the phase of the variable signals are unequal for both aircraft.

VOR 99.
An aircraft has a magnetic heading of 290 degrees and is on VOR radial 280. Which value has to be selected on the OBS to get a TO indication and the CDI centred?

A. 280.
B. 290.
C. 100.
D. 110.

VOR 100.
Given: Aircraft position 34 15 N 098E, magnetic variation 28W, FL280, PTC VOR/DME position 36 12 N 098E, magnetic variation 13E. In order to read the most accurate ground speed given by the DME receiver from his present position, the pilot must fly on which PTC Radial?

A. 193.
B. 167.
C. 332.
D. Aircraft will not receive DME information from PTC due to the line of sight rule.

VOR 101.
An aircraft is flying on a MH of 210 degrees. The magnetic variation at the VOR is 5W and at the aircraft is 10W. According to the HSI in the diagram, the aircraft is on radial?

A. 025 radial.
B. 205 radial.
C. 195 radial.
D. 015 radial.

VOR 102.
Unless otherwise specified a radial is?

A. The magnetic great circle direction from the beacon.

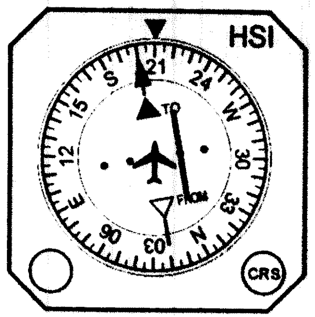
B. The true great circle direction from the beacon.
C. The magnetic great circle direction to the beacon.
D. The true great circle direction to the beacon.

VOR 103.
On the RMI the tip of a VOR needle indicates 060. With the CRS set on 055 the indications on the HSI are?

A. TO half-scale deflected to the left.
B. FROM half-scale deflected to the right.
C. FROM half-scale deflected to the left.
D. TO half-scale deflected to the right.

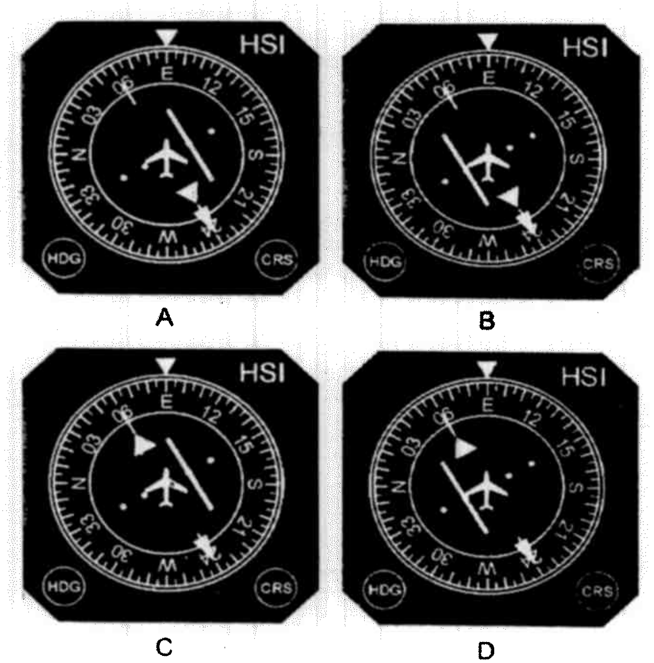
VOR 104.
An aircraft is flying on a MH of 210 degrees. The magnetic variation at the VOR is 5W and at the aircraft is 10W. According to the CDI in the diagram, the aircraft is on radial?

A. 205 radial.
B. 195 radial.
C. 015 radial.
D. 025 radial.



VOR 105.
An aircraft is on the 065 radial with a heading of 090M. The Course Reference Selector ICRSO is set on 240. Which HSI in the diagram shows the correct indications?

A. Diagram A.
B. Diagram B.
C. Diagram C.
D. Diagram D.



VOR 106.
Which statement is correct about the different types of VOR?

A. A TVOR has a limited range.
B. A VOT is located along an airway with the purpose to provide an in-flight check of the airborne equipment.
C. A CVOR is primarily used for instrument approaches.
D. A DVOR is less accurate than a CVOR.

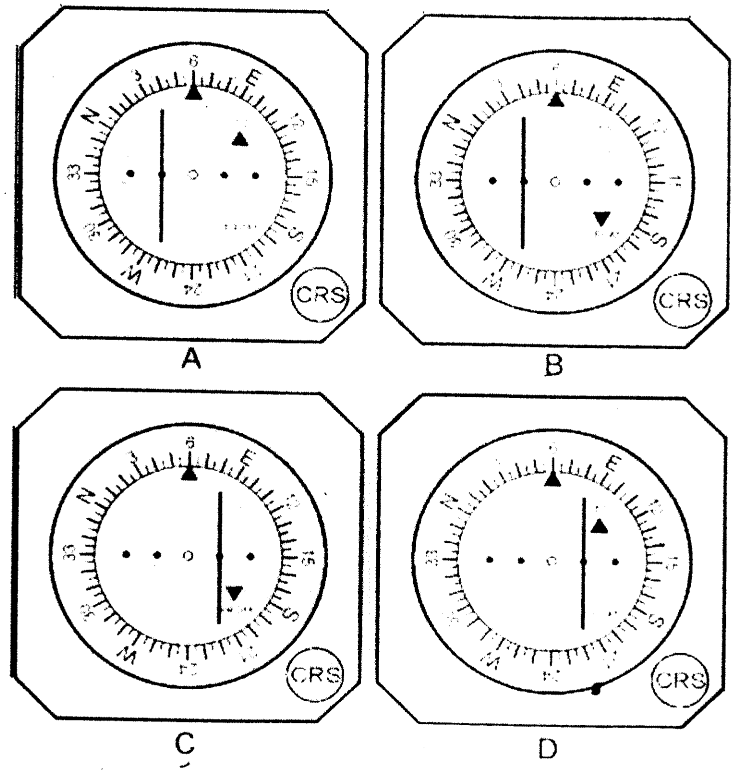
VOR 107.
A VOR and an NDB are located at the same position. Both the VOR and the ADF readings are displayed on the RMI. The aircraft is tracking away from the beacons along the 090 radial. The magnetic variation is changing rapidly. Which of the following is correct?

A. The direction of the VOR pointer will change, the direction of the ADF pointer will not change.
B. The direction of the ADF pointer will change, the direction of the VOR pointer will not change.

C. Both the direction of the ADF pointer and the direction of the VOR pointer will change.
D. Neither the direction of the ADF pointer nor the direction of the VOR pointer will change.

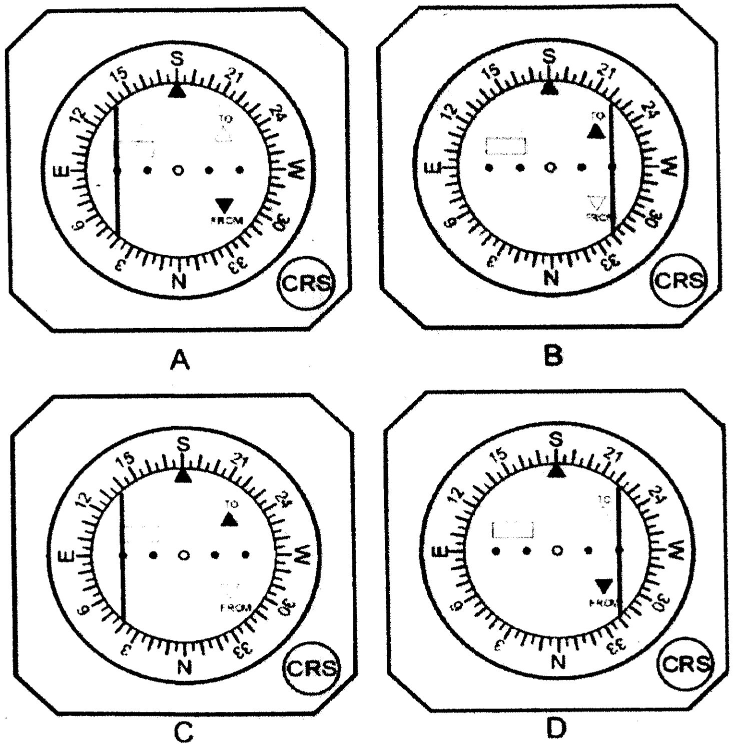
VOR 108.
An aircraft is flying on the 245 radial with a MH of 250 degrees. On the CDI the CRS is set to 060. Which of the CDIs in the diagram shows the correct indications?

A. Figure A.
B. Figure B.
C. Figure C.
D. Figure D.



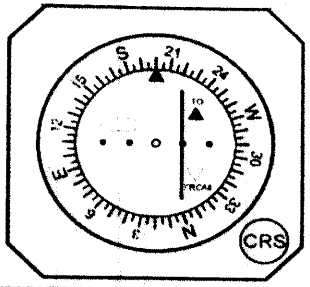
VOR 109.
An aircraft is flying on the 170 radial with a MH of 315 degrees. On the CDI the CRS is set to 180. Which CDI shows the correct indications?

A. Figure A.
B. Figure B.
C. Figure C.
D. Figure D.

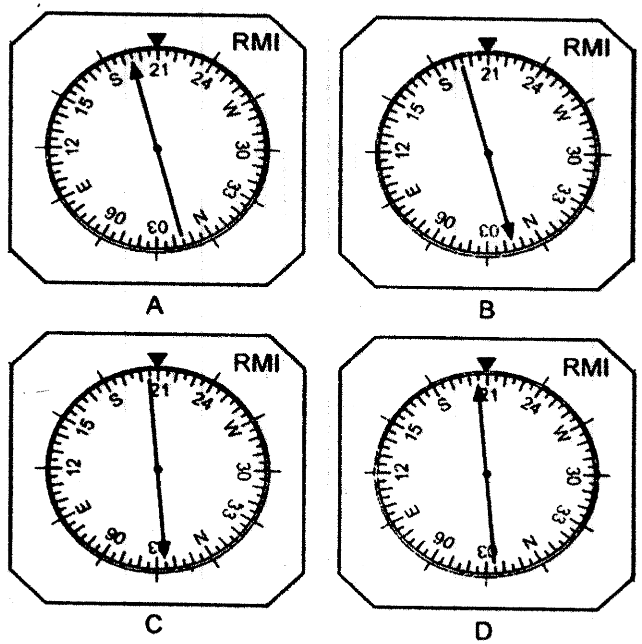


VOR 110.
An aircraft is flying on a MH of 210 degrees. The magnetic variation at the VOR is 5W and at the aircraft 10W. Which VOR RMI corresponds to the indications on the CDI shown in the diagram?

A. Figure A.
B. Figure B.
C. Figure C.
D. Figure D.

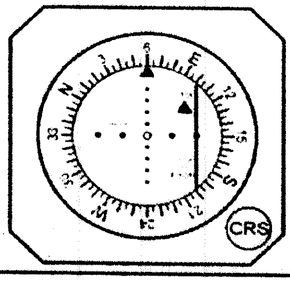


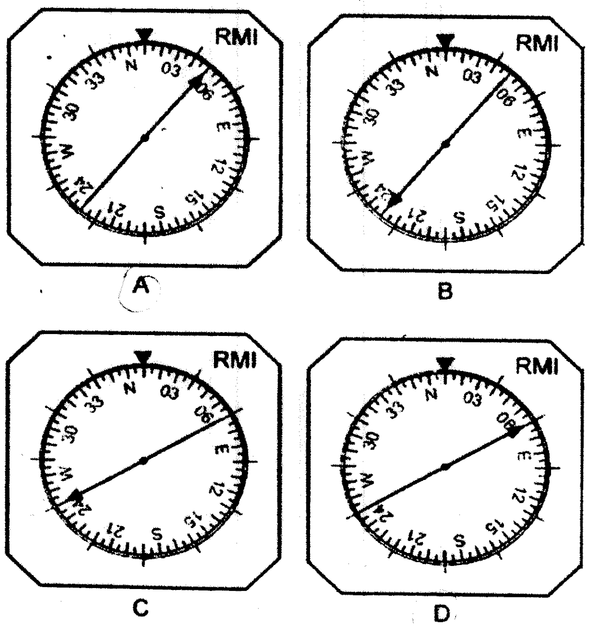
cc = 200



VOR 111.
An aircraft is flying on a MH of 010 degrees. The magnetic variation at the VOR is 10W and at the aircraft 12W. Which VOR RMI corresponds to the indications on the CDI shown in the diagram?

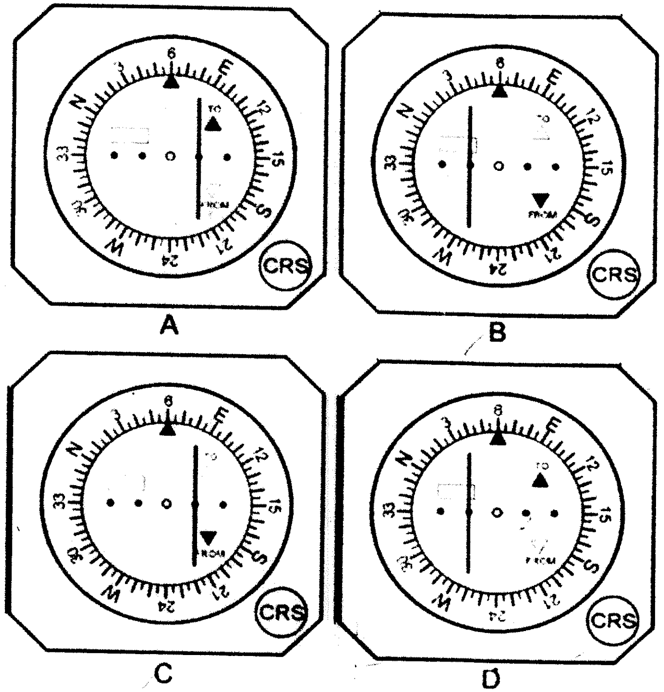
A. Figure D.
B. Figure A.
C. Figure C.
D. Figure B.





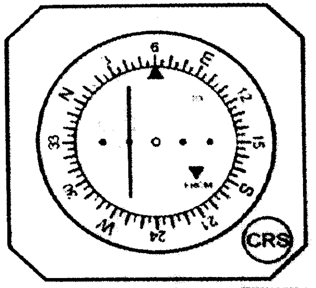
VOR 112.
An aircraft is flying on the 245 radial with a MH of 250 degrees. On the HSI the CRS is set to 060. Which HSI shows the correct indications in the diagram?

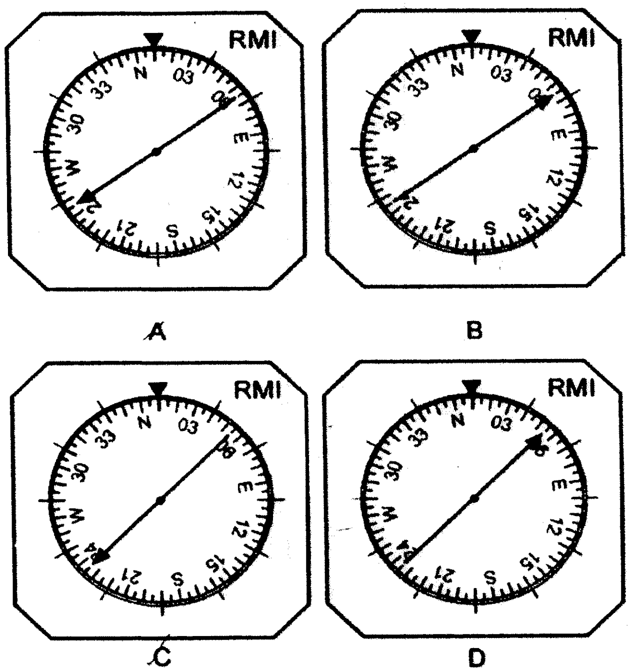
A. Figure A
B. Figure B.
C. Figure C.
D. Figure D.



VOR 113.
An aircraft is flying on a MH of 010 degrees. The magnetic variation at the VOR is 10W and at the aircraft 12W. Which VOR RMI corresponds to the indications on the CDI in the diagram?

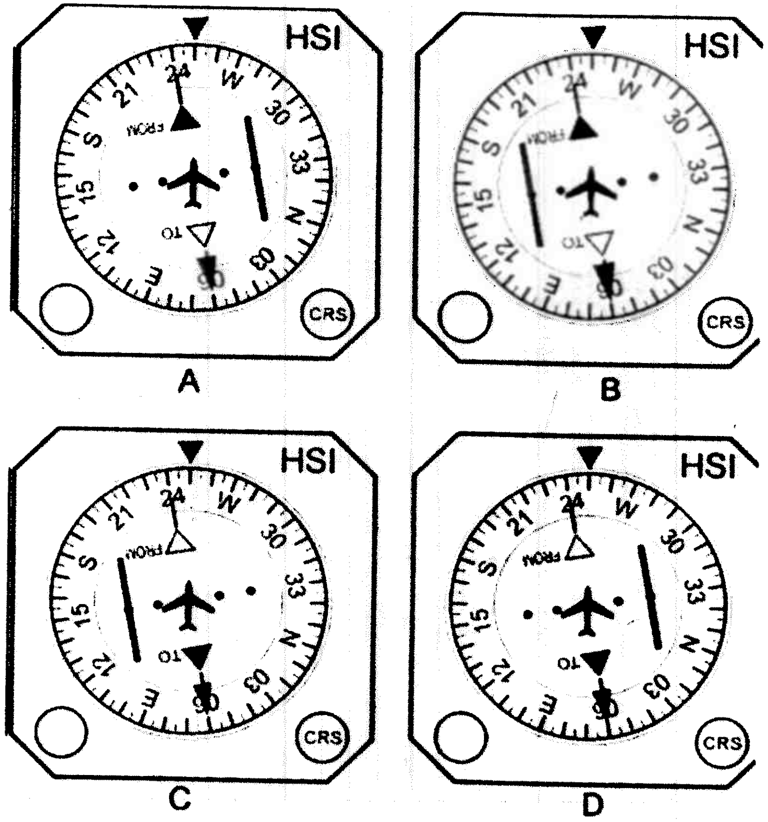
A. Figure A.
B. Figure B.
C. Figure C.
D. Figure D.





VOR 114.
An aircraft is flying on the 050 radial with a MH of 250 degrees. On the HSI the CRS is set to 060. Which HSI in the diagram shows the correct indications?

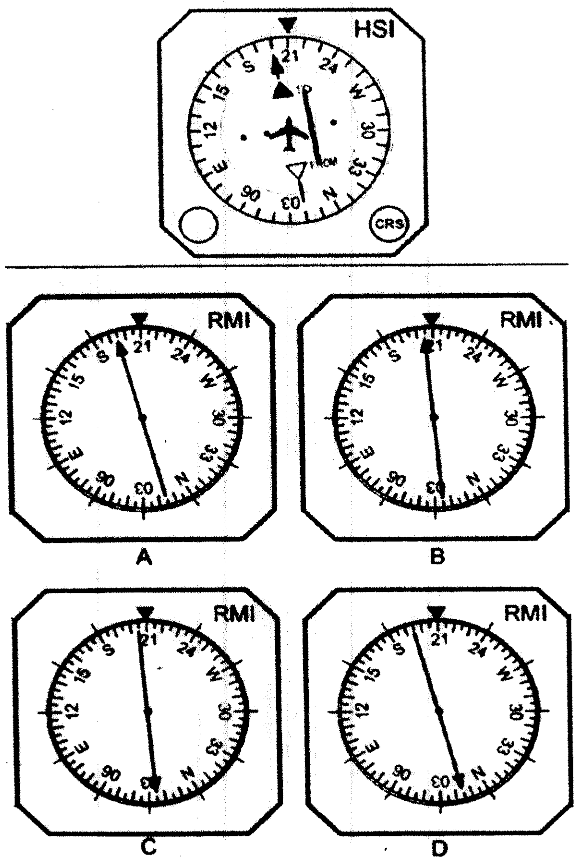
A. Figure A.
B. Figure B.
C. Figure C.
D. Figure D.



VOR 115.
An aircraft is flying on a MH of 210. The magnetic variation at the VOR is 5W and at the aircraft it is 10W: Which VOR RBI corresponds to the indications on the HSI in the

diagram?

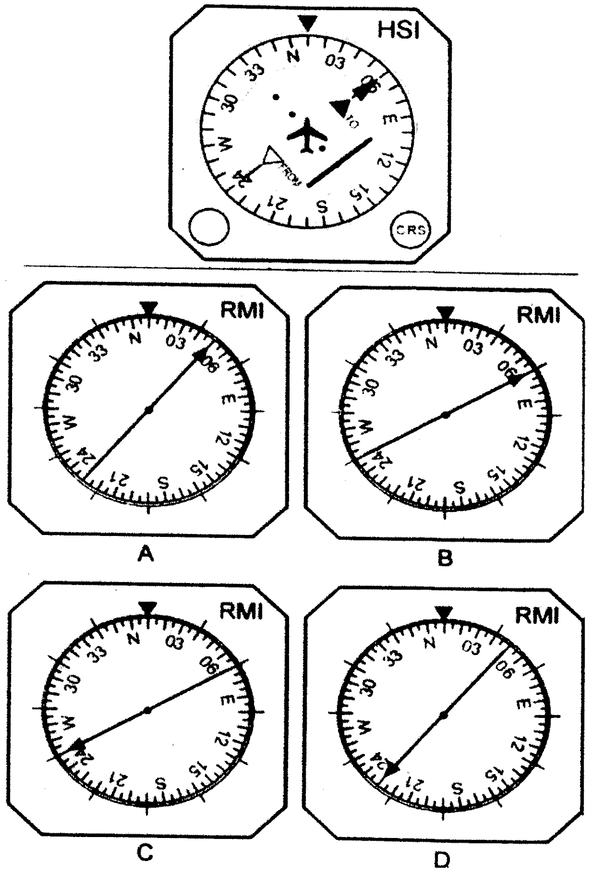
A. Figure A.
B. Figure B.
C. Figure C.
D. Figure D.



VOR 116.
An aircraft is flying with a MH of 010. The magnetic variation at the VOR is 10W and at

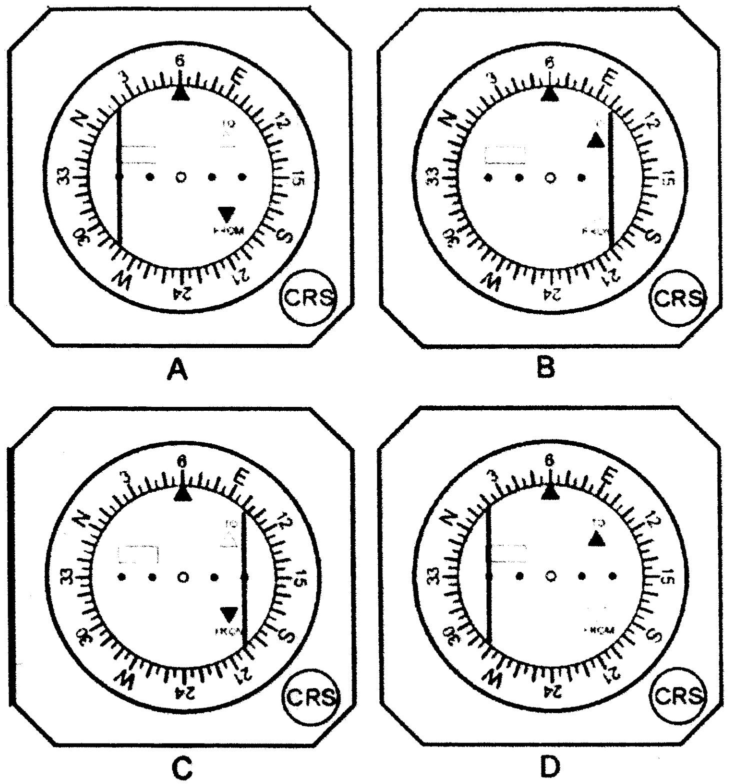
the aircraft it is 12W. Which VOR RMI in the diagram corresponds to the indications on the VOR HSI?

A. Figure B.
B. Figure A.
C. Figure C.
D. Figure D.



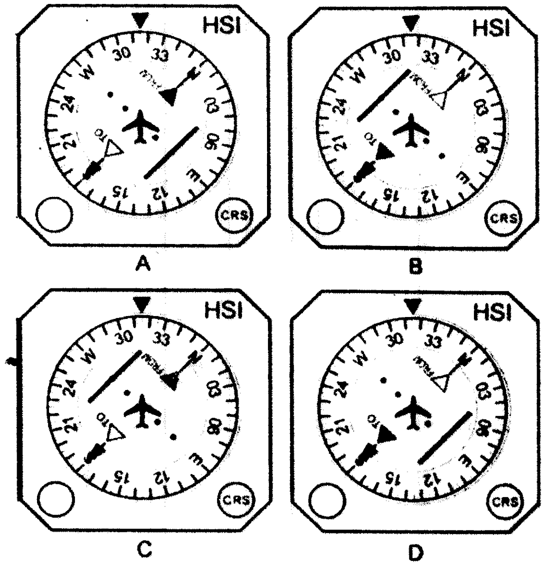
VOR 117.
An aircraft is flying on the 050 radial with a MH of 250. On the CDI the CRS is set to 060. Which CDI in the diagram shows the correct indications?

A. Figure A.
B. Figure B.
C. Figure C.
D. Figure D.



VOR 118.
An aircraft is flying on the 170 radial with a MH of 315. On the HSI the CRS is set to 180. Which HSI in the diagram shows the correct indications?

A. Figure A.
B. Figure B.
C. Figure C.
D. Figure D.



VOR 119.
The three main components of VOR airborne equipment are?

A. Receiver, Phase comparator, Range gates.
B. Display, Pulse generator, Phase comparator.
C. Receiver, Antenna, Display.
D. Demodulator, Antenna, CPU.

VOR 120.
In the VOR receiver the radial is determined by measurement of the?

A. Time difference between the reception of the variable signal and the reference signal.
B. Doppler shift on the reference signal.
C. Phase of the variable signal.
D. Phase difference between the variable signal and the reference signal.

VOR 121.
On an RMI the font end of the VOR pointer indicates the?

A. Radial.
B. Magnetic heading from the station.
C. Radial plus 180 degrees.
D. Magnetic bearing from the station.

VOR 122.
Which of the following statements about the scalloping (path deflection) of VOR radials, in relation to the accuracy of navigation using a VOR/DME RNAV system is correct?

A. Scalloping has a negative effect on the accuracy of navigation.
B. Scalloping has a positive effect on the accuracy of navigation.
C. Scalloping has no effect on the accuracy of navigation because the accuracy is independent of VOR or DME measurements.
D. Scalloping has no effect on the accuracy of navigation because it only results in the movement of the needle of the Course Deviation Indicator.

VOR 123.
TVOR is a?

A. Test VOR transmitting such a signal that the reference and variable signals are always in phase.
B. High power VOR in the frequency used in the terminal area.
C. VOR with a limited range used in the terminal area.
D. Low power VOR in the frequency range 112 MHz to 118 MHz

VOR 124.
An aircraft is flying on a heading of 245 towards a VOR at FL300. The HSI displays a "selected course" of 255 with a TO indication. The variation at the VOR is 15E. Variation at the aircraft is 16E. Compass deviation is +1. When the pilot keeps the CDI on the left inner dot on a display with two dots on either side?

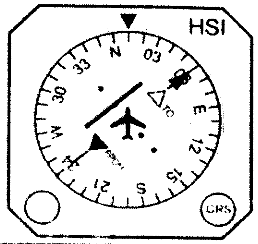
A. The VOR will be approached along the radial 070.
B. The VOR will be approached along the radial 080.
C. The aircraft will pass south of the VOR.
D. The aircraft will pass north of the VOR.

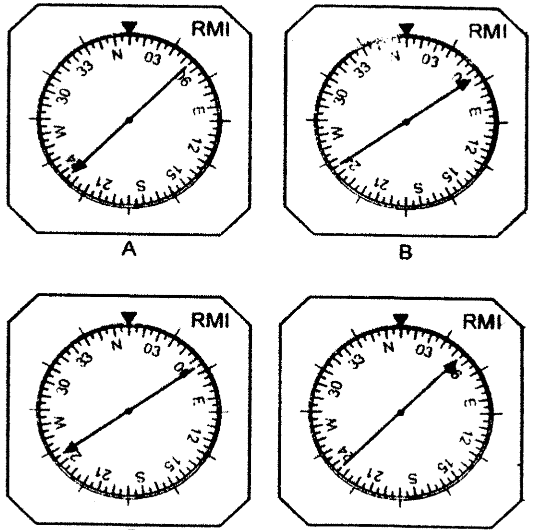
VOR 125.
Given: Aircraft position 52 09 S 024 E, magnetic variation 14W, FL310. BIT VOR/DME position 54 42 S 024 E. Magnetic variation 14E. In order to read the most accurate ground speed given by the DME receiver from this position, the pilot must follow which BIT radial?

A. 346 degrees.
B. 014 degrees.
C. 166 degrees.
D. 194 degrees.

VOR 126.
An aircraft is flying on a MH of 010. The magnetic variation at the VOR is 10W and at the aircraft it is 12W. Which VOR RMI in the diagram shows the correct indications?

A. Figure C.
B. Figure A.
C. Figure B.
D. Figure D.





A
B
C
D

VOR 127.
You are flying along an airway, which is 10 nm wide (5 nm either side of the centreline). The distance to the VOR/DME you are using is 100 nm. If you are on the airway

boundary, how many dots deviation will the VOR needle show if 1 dot represents 2 degrees?

A. 4.5.
B. 3.0.
C. 6.0.
D. 1.5.

VOR 128.
Which statement is true about the use of the Doppler VOR?

A. The Doppler effect is used to create a signal, which is received by the aircraft's VOR receiver as a frequency modulated signal.
B. The Doppler effect is used to create a signal which is received by the aircraft's VOR receiver as an amplitude modulated signal.
C. By using Doppler effect it is also possible to determine the aircraft's approach speed to the VOR.
D. By using Doppler effect it is also possible to determine the range of the aircraft from the VOR. Station more accurately.

VOR 129.
The VOR system is limited to about 1° of accuracy. One degree at 200 NM represents a width of:

A. 2.0 NM
B. 2.5 NM
C. 3.0 NM
D. 3.5 NM

DME 1.
A DME station is located 1000 feet above MSL.

An aircraft flying at FL 370, 15 NM away from the DME station, will have a DME reading of?

A. 14 NM.
B. 15 NM
C. 16 NM
D. 17 NM

DME 2.
Which of the following will give the most accurate calculation of aircraft ground speed?

A. An ADF sited on the flight route.
B. A DME station sited on the flight route.

C. A VOR station sited on the flight route.
D. A DME station sited across the flight route.

DME 3:
In which situation will speed indications on an airborne Distance Measuring Equipment (DME) most closely represent the groundspeed of an aircraft flying at FL400?

A. When tracking directly towards the station at a range of 100 NM or more.
B. When passing abeam the station and within 5 NM of it.
C. When overhead the station, with no change of heading at transit.
D. When tracking directly away from the station at a range of 10 NM.

DME 4.
The time taken for the transmission of an interrogation pulse by a Distance Measuring Equipment (DME) to travel to the ground transponder and return to the airborne receiver was 2000 microsecond. The slant range from the ground transponder was?

A. 165 NM.
B. 186 NM.
C. 296 NM.
D. 330 NM

$S = D/T$ $D = S \times T$ $= 3\times10^8 \times 2000$

DME 5.
The time taken for the transmission of an interrogation pulse by a Distance Measuring Equipment (DME) to travel to the ground transponder and return to the airborne receiver was 3000 microsecond. The slant range from the ground transponder was?

A. 186 NM.
B. 243 NM.
C. 296 NM.
D. 330 NM.

DME 6.
The time taken for the transmission of an interrogation pulse by a Distance Measuring Equipment (DME) to travel to the ground transponder and return to the airborne receiver was 4000 microsecond. The slant range from the ground transponder was?

A. 186 NM.
B. 296 NM.
C. 324 NM.
D. 330 NM.

DME 7.
A DME station is located 1000 feet above MSL. An aircraft flying at FL 310, 20 NM away from the DME station, will have a DME reading of?

A. 20.61 NM.

B. 21.35 NM.
C. 15 NM.
D. 17 NM.

DME 8.
A DME station is located 7000 feet above MSL. An aircraft flying at FL 430, 20 NM away from the DME station, will have a DME reading of?

A. 15 NM.
B. 17 NM.
C. 20.88 NM.
D. 21.35 NM.

DME 9.
A DME station is located 2000 feet above MSL. An aircraft flying at FL 200, 10 NM away from the DME station, will have a DME reading of?

A. 10.44 NM.
B. 11.35 NM.
C. 13.44 NM.
D. 12 NM.

DME 10.
An aircraft DME receiver does not lock on to its own transmissions reflected from the ground because:

A. DME transmits twin pulses.
B. They are not on the receiver frequency.
C. The pulse recurrence rates are varied.
D. DME uses the UHF band.

DME 11.
The DME (Distance Measuring Equipment) operates within the following frequencies:

A. 108 to 118 MHz.
B. 329 to 335 MHz.
C. 962 to 1213 kHz.
D. 962 to 1213 MHz.

DME 12.
A DME is located at MSL. An aircraft passing vertically above the station at flight level FL 360 will obtain a DME range of approximately?

A. 7 NM.
B. 11 NM.
C. 6 NM.

D. 8 NM.

DME 13.
During a flight at FL 210, a pilot does not receive any DME distance indication from a DME station located approximately 220 NM away. The reason for this is that the?

A. Aeroplane is below the 'line of sight' altitude
B. Aeroplane is circling around the station
C. Altitude is too high
D. Range of a DME system is always less than 200 NM

DME 14.
A typical frequency employed in Distance Measuring Equipment (DME) is:

A. 10 MHz.
B. 1000 MHz.
C. 100 MHz.
D. 100 GHz.

DME 15.
Distance Measuring Equipment (DME) operates in the:

A. VHF band and uses the principle of phase comparison.
B. UHF band and is a primary radar system.
C. SHF band and uses frequency modulation techniques.
D. UHF band and is a secondary radar system.

DME 16.
For a conventional DME facility 'Beacon Saturation' will occur whenever the number of simultaneous interrogations exceeds:

A. 100.
B. 200.
C. 60.
D. 80.

DME 17.
On a DME, display counters rotating throughout their range indicates:

A. Airborne equipment failure.
B. The airborne receiver is conducting a range search.
C. Ground equipment failure.
D. The airborne equipment is conducting a frequency search.

DME 18.
The aircraft DME receiver is able to accept replies to its own transmissions and reject replies to other aircraft interrogations because:

A. Pulse pairs are amplitude modulated with the aircraft registration.
B. Pulse pairs are discreet to a particular aircraft.
C. Aircraft interrogation signals and transponder responses are 63 MHz removed from each other.
D. Transmission frequencies are 63 MHz different for each aircraft.

DME 19.
The aircraft DME receiver cannot lock on to interrogation signals reflected from the ground because:

A. Aircraft transmitter and DME ground station are transmitting on different frequencies.
B. Reflections are subject to doppler frequency shift.
C. DME transmits twin pulses.
D. DME pulse recurrence rates are varied.

DME 20.
The design requirements for DME stipulate that, at a range of 100 NM, the maximum systematic error should not exceed:

A. + or - 1.5 NM.
B. + or - 3 NM.
C. + or - 0.25 NM.
D. + or - 1.25 NM.

DME 21.
Distance Measuring Equipment (DME) uses radar principles to measure distance?

A. Horizontally.
B. Vertically.
C. Slant range.
D. Plan Range.

DME 22.
ICAO specifications are that range errors indicated by Distance Measuring Equipment (DME) should not exceed:

A. + or - 0.5 NM or 3% of the distance measured whichever is the greater.
B. + or - 0.25 NM plus 1.25% of the distance measured.
C. + or - 1.25 NM plus 0.25% of the distance measured.
D. + or - 0.25 NM plus 3% of the distance measured up to a maximum of 5 NM.

DME 23.
What is the maximum distance between VOR and DME/TACAN ground installations if they are to have the same morse code identifier?

A. 600 m.
B. 2000 m.
D. 60 m.
D. 300 m.

DME 24.
A DME in tracking mode subsequently experiences a reduction in signal strength will switch the equipment in the first instance to:

A. Memory mode.
B. Search mode.
C. Standby mode.
D. Signal controlled search.

DME 25.
Of what use, if any, is a military TACAN station to civil aviation?

A. It is of no use to civil aviation.
B. It can provide a DME distance and magnetic bearing.
C. It can provide DME distance.
D. It can provide a magnetic bearing.

DME 26.
A DME that has difficulty obtaining a "lock-on"?

(NOTE: PRF = pulse recurrence frequency, PPS = pulses per second)

A. Stays in search mode without a reduction in PRF.
B. Stays in search mode but reduces PRF to max. 60 PPS after 100 seconds.
C. Alternates search mode with periods of memory mode lasting 10 seconds.
D. Stays in search mode but reduces PRF to max. 60 PPS after 15000 pulse pairs have been transmitted.

DME 27.
DME channels utilise frequencies of approximately:

A. 1000 MHz.
B. 300 MHz.
C. 110 MHz.
D. 600 MHz.

DME 28.
A VOR and DME are co-located. You want to identify the DME by listening to the callsign. Having heard the same callsign 4 times in 30 seconds the?

A. DME callsign was not transmitted, the distance information is sufficient proof of correct operation.
B. DME callsign is the one with the lower pitch that was broadcast several times VOR and DME callsigns were the same and broadcast with the same pitch.
C. The VOR IDENT is transmitted three times followed by the DME IDENT transmitted once.
D. DME callsign is the one with the higher pitch that was broadcast only once.

DME 29.
Which one is the most correct statement regarding the range of the DME system?

A. Operates on the principle of phase comparison.
B. Range within "line of sight" and maximum 200 nm.
C. Operates on VHF.
D. Has unlimited range due to ground wave propagation.

Taking all of the above factors into account it can be seen that "Range within "line of sight" and maximum 200 nm" is the most accurate option. It should however be noted that this range will not be available in all cases.

DME 30.
The indicated range from a DME station is?

A. Slant range.
B. Ground range only if the beacon is co-located with a VOR.
C. 0 when passing overhead the station.
D. Ground range.

DME 31.
Regarding the DME system, which one of the following statements is true?

A. The DME measures the phase difference between the reference and the variable signals to calculate the distance.
B. DME operates in the VHF frequency band.
C. The transponder reply carrier frequency differs by 63 MHz from that of the interrogation signal.
D. When passing overhead the DME station the DME will indicate 0.

DME 32.
The design requirements for DME stipulate that, at a range of 100 nm the maximum systemic error should not exceed?

A. Not more than +/- 1.25 nm.
B. Not more than +/- 1.5 nm.
C. Not more than +/- 3 nm.
D. Not more than +/- 0.25 nm.

DME 33.
A DME is located at MSL. An aircraft passing vertically above the station at flight level 360 will obtain a DME range of approximately?

A. 11 nm.
B. 8 nm.
C. 7 nm.
D. 6 nm.

DME 34.
A DME station is located 1000 ft above MSL. An aircraft which is flying at FL 370 in ISA conditions, is 15 nm away from the DME station, will have a DME reading of?

A. 14 nm.
B. 15 nm.
C. 16 nm.
D. 17 nm.

DME 35.
In which situation will speed indications on an airborne Distance Measuring Equipment (DME) most closely represent the groundspeed of an aircraft flying at FL440?

A. When tracking directly towards the station at a range of 10 nm or less.
B. When tracking directly towards the station at a range of 100 nm or more.
C. When passing abeam the station within 5 nm of it.
D. When overhead the station, with no change of heading at transit.

DME 36.
The time taken for the transmission of an interrogation pulse by a Distance Measuring Equipment (DME) to travel to the ground transponder and return to the airborne receiver was 2000 microseconds. The slant range from the ground transponder is?

A. 158 nm.
B. 330 nm.
C. 296 nm.
D. 186 nm.

DME 37.

An aircraft passes overhead a DME station at 12000 ft above the station. At that time the DME reading will be?

A. FLAG/OFF, the aircraft is within the cone of silence.
B. Approximately 2 nm.
C. Fluctuating and not significant.
D. 0 nm.

DME 38.

When flying 6000 ft above a ground level, the DME indicates 5 nm. What is the horizontal distance from the aircraft to overhead the DME?

A. 4.9 nm.
B. 4.3 nm.
C. 4.6 nm.
D. 5.2 nm.

DME 39.

Distance Measuring Equipment (DME) operates in the?

A. UHF band and uses one frequency.
B. VHF band and uses the principle of phase comparison.
C. UHF band and uses two frequencies.
D. SHF and uses the frequency modulation techniques.

DME 40.

An aircraft at FL 300, with a groundspeed of 300 kts, is about to pass overhead a DME station at MSL. The dame receiver is capable of determining ground speed. One minute before the overhead, DME speed and distance indication respectively are?

A. 300 kts and 5 nm.
B. Less than 300 kts and 5 nm.
C. 300 kts and 7 nm.
D. Less than 300 kts and 7 nm.

[illegible]

An aircraft at FL410 is passing overhead a DME station at mean sea level. The DME indication will be approximately?

A. 6.8 nm.
B. 6.1 nm.
C. 6.8 km.
D. 6.1 km.

DME 42.

An aircraft is flying directly overhead a DME station at FL380. The indicated range will be approximately?

A. 6.3 nm.
B. 6.3 km.
C. 5.1 nm.
D. 5.1 km.

DME 43.

Which one of the statements below is correct regarding the DME?

A. The indicated distance is the ground distance measured from the aircraft's projected position on the ground to the DME ground installation.
B. The DME operating frequencies are in the UHF frequency band.
C. Two lines of position obtained from two different DME's give an unambiguous fix.
D. The DME ground station is always co-located with a VOR station.

DME 44.

The selection of the DME frequency for a ILS/DME installation is as follows?

A. The pilot has to insert the channel number and also the X or Y.
B. When an ILS/DME is flown then the selection of the DME has always to be done manually.
C. The DME frequency has to be selected by the pilot.
D. The DME frequency is paired with the localiser frequency so only the localiser frequency is set.

DME 45.

The effect of masking the DME antenna of the aircraft from the ground installation is that interruption of reception of DME signals results in?

A. The ground installation not sending any pulse-pairs.
B. The airborne installation switching to the memory mode for about 10 to 15 seconds.
C. The airborne installation switching directly to the search mode.
D. The signal controlled search circuit (SCS) blanking the DME display.

DME 46.

Which statement about the interrogation by DME interrogator is correct?

A. The interrogation starts when the interrogator has been warmed up sufficiently, whether pulse-pairs are received or not.
B. The interrogation does not start before pulse-pairs of the tuned DME station are

received.
C. The interrogation can only take place if the Echo Protection Circuit has been locked.
D. The interrogation starts directly after the correct DME frequency has been selected on the frequency-selecting panel by the pilot.

DME 47.
The ident of a DME in case of collocation with a VOR is as follows?

A. In 30 seconds the DME ident comes up 3 times at an audio frequency of 1350 Hz.
B. In 40 seconds the DME ident will sound once.
C. In case of collocation the DME ident is not necessary if the VOR ident is present.
D. The DME ident comes every 10 seconds at an audio frequency of 1020 Hz.

DME 48.
With respect to the principle of distance measurement equipment DME it can be stated that:

1. The interrogation signal is transmitted on the same frequency as the reply signal.
2. The DME station always has a transponder delay of 50 milliseconds.
3. The time between the pulse pairs of the interrogation signal is at random.
4. In the search mode more pulse pairs per second are transmitted than in the tracking mode.

Which of the above given statements are correct?

A. 1, 2, 3 and 4.
B. 1 and 2.
C. 2, 3 and 4.
D. 3 and 4.

DME 49.
A fix obtained by rho-rho navigation is based on information from two?

A. NDBs.
B. VDFs.
C. DMEs
D. VORs.

DME 50.
The reason for using different frequencies for the airborne and ground equipment of DME is?

A. To avoid second trace returns when a DME is more than 200 nm away.
B. That more DME frequencies are available from different beacons.

C. That side lobes can be suppressed by the Side Lobe Suppressor (SLS).
D. To prevent that DME interrogation pulse pairs from being received by the aircraft after reflection on the earth's surface.

DME 51.
How can a DME interrogator distinguish between its own reply pulse-pairs and the reply pulse-pairs of other aircraft in the area, using the same DME station?

A. The pulse repetition frequency of the pulse-pairs transmitted by the interrogator varies, for each interrogator there is a unique rhythm.
B. On the Y-channel the time interval between the pulses of an interrogator pulse-pair is 36 m/sec an of a transponder pulse-pair 30 m/sec.
C. The DME transponder uses a slightly different, randomly varying, delay for each interrogating aircraft.
D. The time-interval between both pulses of consecutive pulse-pairs transmitted by the interrogator varies, for each interrogator there is a unique rhythm.

DME 52.
The DME Line Of Position is a circle with radius?

A. The slant range and centre the aircraft.
B. The slant range and centre the DME station.
C. A ground distance and centre the DME station.
D. The ground distance and centre the aircraft.

DME 53.
What is the function of the Echo Protection Circuit (EPC)?

A. The EPC has to detect if the interrogator-receiver has been locked on, by reflected pulse-pairs.
B. The EPC has to detect if unwanted squitter-pulses are interfering with the well functioning of the interrogator-receiver.
C. The EPC has to detect if pulse-pairs reflected by the ionosphere are interfering with directly received pulse-pairs.
D. The EPC has to protect the transponder-receiver against reflected pulse-pairs.

DME 54.
During a flight at FL260, a pilot does not receive any DME distance indication from a DME station located approximately 220 nm away. The reason for this is that?

A. Altitude is too high.
B. Aeroplane is circling around the station.
C. Range to DME stations is always less than 200 nm.
D. Aeroplane is below the line-of-sight altitude.

DME 55.
An aircraft flying at FL180 is 190 nm from a DME (located at 0 feet AMSL). The

aircraft equipment fails to lock on, this is because?

A. The aircraft is too low to receive the signal.
B. The beacon is saturated.
C. DME is limited to 200 nm.
D. The aircraft is too high to receive the signal.

DME 56.
DME is a radar type of facility and its maximum range is limited by?

A. The receiver sensitivity.
B. The pulse repetition interval.
C. The height of the aeroplane.
D. The transmitter power only.

DME 57.
An aircraft at FL310 cannot receive a signal from a DME 240 nm away. Why?

A. The DME is saturated.
B. The aircraft is too high.
C. DME is never more than 200 nm.
D. The aircraft is not in line-of-sight of the DME .

DME 58.
The time interval between a transmitted DME pulse and the reply pulse is 120 microsecond. The slant range is?

A. 5.7 nm.
B. 5.7 km.
C. 9.7 nm.
D. 9.7 km.

DME 59.
When an aircraft at FL360 it is directly above a DME, at mean sea level, the range display will be?

A. 0 nm.
B. 6 nm.
C. 9 nm.
D. 12 nm.

DME 60.
An aircraft flying at FL430 obtains a DME range of 25 nm. The true range from the DME is between?

A. 24.5 and 25.5 nm.
B. 23.25 and 24.75 nm.
C. 25.2 and 26.8 nm.
D. 22.5 and 23.5 nm.

DME 61.
The time from the transmission of a DME interrogation pulse to the receipt of the reply from the DME ground station is 1000 microseconds (ignore the delay in the DME ground station). The slant range is?

A. 81 nm.
B. 162 nm.
C. 300 nm.
D. 300 km.

DME 62.
Given: Aircraft height = 32000 feet, DME indicated range = 16 nm. The actual true range is?

A. 6.6 nm.
B. 15.1 nm.
C. 16.6 nm.
D. 22.8 nm.

DME 63.
The design requirements for DME stipulate that, at a range of 100 NM, the maximum systematic error should not exceed:

A. + or – 3.5 NM.
B. + or - 2.25 NM.
C. + or - 1.5 NM.
D. + or - 1.25 NM.

DME 64.
The DME in an aircraft flying at FL430 shows a range of 15 nm from a beacon at an elevation of 167 feet. The plan range is?

A. 13.3 nm.
B. 15 nm.
C. 16.5 nm.
D. 17.6 nm.

DME 65.
An aircraft flying at FL360 is 10 nm plan range from a DM. The DME reading in the aircraft will be?

A. 8 nm.
B. 10 nm.
C. 11.7 nm.
D. 13.6 nm.

DME 66.
An enroute DME and VOR that have the same morse code identification are associated and are?

A. Within 600 feet of each other.
B. Within 100 feet of each other.
C. Always co-located.
D. Within 2000 feet of each other.

DME 67.
Which of the following provides distance information?

A. VOR.
B. ADF.
C. VDF.
D. DME.

DME 68.
The airborne DME equipment will transmit pulse pairs at a comparatively high PRF?

A. When first switched on and after channel change.
B. At all times, except when the panel control "LO" is operated.
C. When the distance presented is above 50 nm.
D. Whenever a stable signal is being received from the selected ground station.

DME 69.
When VOR and DME stations are associated?

A. Their aerials will be mounted on top of each other.
B. Their IDS will be in all respects identical.
C. They may be separated by as much as 600 metres if they are meant for enroute Navigation.
D. Their signals must be tuned in by VOR and DME sets in the aircraft having common frequency control.

DME 70.
A DME transmitter is operating in the search-for-lock phase. Which of the following is true?

A. The PRF increases and the range counters count up to the maximum.
B. The PRF increases and the range counters count down from the maximum and the power decreases.
C. The PRF decreases and the range counters count down from the maximum and the power increases.
D. The PRF increases and the power is increased.

DME 71.
The DME counters are rotating continuously. This indicates?

A. The DME is trying to lock onto a frequency.
B. The DME is unserviceable.
C. The DME is trying to lock onto a range.
D. The DME is receiving no response from the ground station.

DME 72.
Where a DME uses mechanical counters for displaying the range, continuous rotation of the counters means?

A. The DME is in the search mode.
B. The DME is in tracking mode due to a turn.
C. The DME is in memory mode.
D. None of the above.

DME 73.
Consider the following statements on horizontal/slant distance when using DME?

A. The horizontal distance is always slightly longer than the slant distance.
B. The difference between the two is automatically compensated for in all DME equipment.
C. The difference between the two distance will be negligible for enroute Navigation when the indicated distance in NM is more than the height of the aircraft in thousands of feet.
D. The operator in the aircraft should always make a mental increase to the indicated range, in order to compensate for the difference between the horizontal distance and slant distance.

DME 74.
A VOR and DME are frequency paired. The DME identification ends with Z. This denotes that?

A. The two beacons are greater than 2000 metres apart.
B. The two beacons are co-located.
C. The two beacons are supporting the same site, but are not co-located.
D. The beacons are at the same location but more than 1000 metres apart.

DME 75.
The most accurate measurement if ground speed by DME for an aircraft at 30000 feet will be when the aircraft is?

A. Overhead the beacon.
B. Passing abeam the beacon at 50 nm.
C. Tracking towards the beacon at 10 nm.
D. Tracking away from the beacon at 100 nm.

DME 76.
In which of the following bands does DME operate?

A. VHF.
B. UHF.
C. SHF.
D. EHF.

DME 77.
DME is a .... Radar which, provides .... Distances between the aircraft and a ground ....?

A. Primary, slant, transponder.
B. Secondary, earth, transponder.
C. Secondary, slant, transponder.
D. Primary, accurate, transmitter.

DME 78.
DME pulses are transmitted as pulse pairs. This is done?

A. To increase the range.
B. To prevent lock onto the ground.
C. So that pulses are square and easily identified.
D. So that any radar emissions do not interfere with the DME equipment.

DME 79.
By using a random PRG the airborne DME can?

A. Recognise a beacon's reply among a mass of ground returns.
B. Prevent interference from random transmissions.
C. Distinguish between its own replies and those replies triggered by other aircraft.
D. Reduce the effect of weather interference.

DME 80.
The aircraft DME receiver is able to accept replies to its own transmissions and reject replies to other aircraft interrogators because?

A. Pulse pairs are amplitude modulated with the aircraft registration.
B. Transmission frequencies are 63 MHz different for each aircraft.
C. Aircraft interrogation signals and transponder response signals are 63 MHz removed from each other.
D. The time interval between pulse pairs is unique to that aircraft.

DME 81.
What happens when a DME in the search mode fails to achieve lock-on?

A. It stays in the search mode at 150 PPPs.
B. It stays in the search mode, but reduces to 60 pulse-pairs per second (PPPS) after 100 seconds.
C. It stays in the search mode, but reduces to 60 pulse-pairs per second (PPPS) after 15000 pulse pairs.
D. It alternates between search and memory modes every 10 seconds.

DME 82.
Groundspeed measurement using DME equipment is most accurate when flying?

A. From the station at long range.
B. Towards the station at short range.
C. Directly over the station.
D. Past the station at short range.

DME 83.
Which of the following will give the most accurate calculation of aircraft ground speed?

A. A DME on the flight plan route.
B. A DME off the flight plan route.
C. A VOR on the flight plan route.
D. A VOR off the flight plan route.

DME 84.
What is the approved frequency band assigned to DME?

A. 108 to 118 MHz.
B. 329 to 335 MHz.
C. 962 to 1213 kHz.
D. 962 to 1213 MHz.

DME 85.
When in tracking mode, the DME airborne interrogator operates at? Note: PRR = Pulse Recurrence Rate.

A. A PRR of 2700 PPS (Pulse Per Second).

B. A PRR of 150 PPS.

C. A PRR variable between 5 and 25 PPS.

D. A PRR fixed at a rate selected from the range 5 to 25 PPS.

DME 86.
The DME ground transponder has a PRF of?

A. 2700 pulses per second.
B. 27 pulses per second.
C. 150 pulses per second.
D. 1500 pulses per second.

DME 87.
DME is a secondary radar operating in the (i) … band using frequencies between (ii)…..?

A. (i) UHF, (ii) 960 to 1215 GHz .
B. (i) SHF, (ii) 960 to 1215 GHz.
C. (i) UHF, (ii) 920 to 1215 MHz.
D. (i) SHF, (ii) 960 to 1215 MHz.

DME 88.
DME uses (i) ….. radar principles in the (ii) …. band?

A. (i) primary, (ii) UHF.
B. (i) primary, (ii) SHF.
C. (i) secondary, (ii) UHF.
D. (i) secondary, (ii) SHF.

DME 89.
Aircraft position 34 degrees 15 minutes N 098 degrees E, magnetic variation 28 degrees W, FL280.

PTV VOR/DME position 36 degrees 12' N 098 degrees E, magnetic variation 13 degrees E.

In order to read the most accurate ground speed given by the DME receiver from his present position, the pilot must fly on which PTC radial?

A. 167 degrees.
B. 332 degrees.
C. Aircraft will not receive DME information from PTC due to the line of sight.
D. 193 degrees.

DME 90.
Aircraft position 52 degrees 09 minutes S 024 degrees E, magnetic variation 14 degrees W, FL310.

BIT VOR/DME position 54 degrees 42' S 024 degrees E, magnetic variation 14 degrees E.

In order to read the most accurate ground speed given by the DME receiver from his present position, the pilot must fly on which BIT radial?

A. 346 degrees.
B. 194 degrees.
C. 166 degrees.
D. 166 degrees.

DME 91.
Aircraft position 36 degrees 15 minutes S 178 degrees E, magnetic variation 21 degrees W, FL310.

UEB VOR/DME position 36 degrees 15' S 178 degrees W, magnetic variation 21 degrees E.

In order to read the most accurate ground speed given by the DME receiver from his present position, the pilot must fly on which UEB radial?

A. 069 degrees.
B. 111 degrees.
C. 249 degrees.
D. 291 degrees.

DME 92.
The maximum number of aeroplanes that can be responded to by the DME ground facility is?

A. 10.
B. 100.
C. 150.
D. Unlimited.

DME 93.
What are the DME frequencies?

A. 960 to 1090 MHz.
B. 1030 to 1090 MHz.
C. 690 to 1215 MHz.
D. 960 to 1215 MHz.

DME 94.
In a certain VORTAC installation the VOR station is identified as "STN" and the DME station is identified as "STZ". This means that the distance between the two beacons is in excess of?

A. 100 m.
B. 300 m.
C. 600 m.
D. 2000 m.

DME 95.
How many aircraft will DME accommodate before reaching saturation?

A. 50.
B. 100.
C. 120.
D. 150.

DME 96.
What is the slant range error for an aircraft at 9000 feet absolute altitude above a DME located at elevation 2000 feet, when the slant range is 12 nm?

A. 0.09 nm.
B. 0.31 nm.
C. 0.57 nm.
D. 1.42 nm.

DME 97.
The nominal maximum coverage of a DME station is?

A. 190 nm at 20 000 feet.
B. 215 nm at 25 000 feet.
C. 210 nm at 30 000 feet.
D. 230 nm at 30 000 feet.

DME 98.
Ground DME responders respond at a frequency?

A. 63 MHz higher than the interrogation signal.
B. 63 MHz lower than the interrogation signal.
C. The same as the interrogation signal.
D. 63 MHz different from the interrogation signal, above or below.

DME 99.
If a DME beacon becomes saturated by interrogations it?

A. Replies to the nearest 100 aircraft.
B. Adjusts its PRF to cope with all aircraft.
C. Switches off its identification.
D. Adjusts the gain to reply to the 100 strongest signals.

DME 100.
The reason for using different frequencies for transmitting and receiving in the DME system is to?

A. Avoid the reception in the aircraft of signals referring to other aircraft.
B. Prevent self-triggering of the receiving equipment by the transmitter.
C. Prevent overload of the system.
D. Permit more channels in the system.

ILS 1.
The amplitude modulation and the colour of an outer marker (OM) is:

A. 3000 Hz, blue.
B. 1300 Hz, blue.
C. 400 Hz, blue.
D. 400 Hz, amber.

ILS 2.
A Category 1 Instrument Landing System (ILS) ground installation provides accurate guidance from coverage limit down to:

A. 200 feet above the runway threshold.
B. 50 feet above ILS reference point.
C. Runway surface.
D. 200 feet above the inner marker.

ILS 3.
The reason why pre take-off holding areas are sometimes further from the active runway when ILS Category 2 and 3 landing procedures are in progress than during good weather operations is:

A. Heavy precipitation may disturb guidance signals.
B. To increase distance from the runway during offset approach operations.
C. Aircraft manoeuvring near the runway may disturb guidance signals.
D. To increases aircraft separation in very reduced visibility conditions.

ILS 4.

An aircraft tracking to intercept the Instrument Landing System (ILS) localiser inbound on the approach side, outside the published ILS coverage angle:

A. Will not normally receive signals.
B. May receive false course indications.
C. Will receive signals without identification coding.
D. Can expect signals to give correct indications.

ILS 5.

The MIDDLE MARKER of an Instrument Landing System (ILS) facility is identified audibly and visually by a series of:

A. Alternate dots and dashes and an amber light flashing.
B. Two dashes per second and a blue light flashing.
C. Dots and a white light flashing.
D. Dashes and an amber light flashing.

ILS 6.

The OUTER MARKER of an Instrument Landing System (ILS) facility transmits on a frequency of:

A. 200 MHz and is modulated by alternate dot/dash in morse.
B. 75 MHz and is modulated by alternate dot/dash in morse.
C. 300 MHz and is modulated by morse at two dashes per second.
D. 75 MHz and is modulated by morse at two dashes per second.

ILS 7.

What approximate rate of descent is required in order to maintain a 3° glide path at a groundspeed of 120 kt?

A. 550 FT/MIN.
B. 600 FT/MIN.
C. 800 FT/MIN.
D. 950 FT/MIN.

$\frac{3 \times 120 \times 10}{60}$ 5×120

ILS 8.

The outer marker of an ILS with a 3° glide slope is located 4.6 NM from the threshold. Assuming a glide slope height of 50 FT above the threshold, the approximate height of an aircraft passing the outer marker is:

A. 1400 FT.
B. 1350 FT.
C. 1450 FT.
D. 1300 FT.

h = tan α x d x 6080 ft

ILS 9.

What is the colour sequence when passing over an Outer, Middle and Inner Marker beacon?

A. Blue - amber – white.
B. Amber - white – green.
C. White - amber – blue.
D. Blue - green – white.

ILS 10.

What is the approximate angular coverage of reliable navigation information for a 3° ILS glide path out to a distance of 10 NM?

A. 1.35° above the horizontal to 5.25° above the horizontal and 8° each side of the localiser centreline.
B. 0.45° above the horizontal to 1.75° above the glide path and 8° each side of the localiser centreline.
C. 0.7° above and below the glide path and 2.5° each side of the localiser centreline
D. 3° above and below the glide path and 10° each side of the localiser centreline

ILS 11.

ILS is subject to false glide paths resulting from:

A. Spurious signals reflected by nearby obstacles.
B. Multiple lobes of radiation patterns in the vertical plane.
C. Back-scattering of antennas.
D. Ground returns ahead of the antennas.

ILS 12.

An aircraft carrying out an ILS approach is receiving more 90 Hz than 150 Hz modulation notes from both the localiser and glide path transmitters. The ILS indication will show:

A. Fly left and fly down.
B. Fly right and fly down.
C. Fly right and fly up.
D. Fly left and fly up.

ILS 13.

An aircraft carrying out a 3° glide path ILS approach experiences a reduction in groundspeed from 150 kt at the outer marker to 120 kt over the threshold. The effect of this change in groundspeed on the aircraft's rate of descent will be a decrease of approximately:

A. 250 FT/MIN.
B. 50 FT/MIN/

C. 150 FT/MIN.
D. 100 FT/MIN.

ILS 14.
The principle of operation of an ILS localiser transmitter is based on two overlapping lobes that are transmitted on (i).......... frequencies and carry different (ii)..........

A. (i) the same (ii) modulation frequencies.
B. (i) the same (ii) phases.
C. (i) different (ii) modulation frequencies.
D. (i) different (ii) phases.

ILS 15.
In which frequency band does an ILS glide slope transmit?

A. VHF.
B. SHF.
C. UHF.
D. EHF,

ILS 16.
Assuming a five dot display, what does each of the dots on either side of the ILS localizer cockpit display represent:

A. 0.5 degrees.
B. 1.5 degrees.
C 2.5 degrees.
D. 2.0 degrees.

ILS 17.
Outer marker transmits on 75 MHz and has an aural frequency of:

A. 1300 Hz.
B. 400 Hz.
C. 2000 Hz.
D. 3000 Hz.

ILS 18.
Every 10 kt decrease in groundspeed, on a 3° ILS glidepath, will require an approximate:

A. Increase in the aircraft's rate of descent of 50 FT/MIN.
B. Decrease in the aircraft's rate of descent of 50 FT/MIN.
C. Decrease in the aircraft's rate of descent of 100 FT/MIN.
D. Increase in the aircraft's rate of descent of 100 FT/MIN.

ILS 19.
Instrument Landing Systems (ILS) Glide Paths provide azimuth coverage (i) ....° each side of the localiser centre-line to a distance of (ii) .... NM from the threshold.

A. (i) 25 (ii) 17.
B. (i) 35 (ii) 25.
C. (i) 5 (ii) 8.
D. (i) 8 (ii) 10.

ILS 20.
The rate of descent required to maintain a 3.25° glide slope at a groundspeed of 140 kt is approximately:

A. 800 FT/MIN.
B. 850 FT/MIN.
C. 670 FT/MIN.
D. 700 FT/MIN.

ILS 21.
Where, in relation to the runway, is the ILS localiser transmitting aerial normally situated?

A. At the approach end of the runway about 300 m from touchdown on the Centreline.
B. On the non-approach end of the runway about 300 m from the runway on the extended centreline.
C. At the non-approach end about 150 m to one side of the runway and 300 m along the extended centreline.
D. At the approach end about 150 m to one side of the runway and 300 m from touchdown.

ILS 22.
A Cat III ILS glide path transmitter provides reliable guidance information down to:

A. A maximum height of 200 ft above the runway.
B. A maximum height of 100 ft above the runway.
C. A maximum height of 50 ft above the runway.
D. The surface of the runway.

ILS 23.
Which of the following is an ILS localiser frequency?

A. 108.25 MHz.
B. 109.15 MHz.
C. 110.20 MHz.

D. 112.10 MHz.

ILS 24.
What approximate rate of descent is required in order to maintain a 3° glide path at a groundspeed of 90 kt?

A. 450 FT/MIN.
B. 400 FT/MIN.
C. 600 FT/MIN.
D. 700 FT/MIN.

ILS 25.
The heading rose of an HSI is frozen on 200°.
Lined up on the ILS of runway 25, the localizer needle will be?

A. Left of centre.
B. Right of centre.
C. Centred with the 'fail' flag showing.
D. Centred.

ILS 26.
What is measured in order to establish aircraft position in relation to the localiser beam on an ILS?

A. The difference in depth between the 90 Hz and the 150 Hz modulations.
B. The difference in time between the 90 Hz and the 150 Hz modulations.
C. The bearing of the localiser antenna found by means of a loop antenna.
D. The difference in phase between the 90 Hz and the 150 Hz modulations.

ILS 27.
What are the modulation frequencies of the two overlapping lobes that are used on an ILS approach?

A. 90 Hz 150 Hz.
B. 63 MHz 123 MHz
C. 75 kHz 135 kHz.
D. 328 MHz 335 MHz

ILS 28.
Full scale deflection of the localiser needle indicates that the aircraft is approximately?

A. 2.5 degrees offset from the localiser centreline.
B. 10 degrees offset from the localiser centreline.
C. 1.25 degrees offset from the localiser centreline.
D. 5 degrees offset from the localiser centreline.

ILS 29.
On an ILS approach, the localiser needle is fully over to the left. How much deflection does this indicate?

A. 2.5 degrees.
B. 0.7 degrees.
C. 5 degrees.
D. 10 degrees.

ILS 30.
False beams on the ILS glide path are?

A. Only found below the correct glide slope.
B. Only found if more that 10 degrees left or right of localiser centreline.
C. Only found if flying the back beam ILS approach.
D. Only found above the correct glide slope.

ILS 31.
The middle market transmits on?

A. 1300 Hz.
B. 1300 MHz.
C. 75 Hz.
D. 75 MHz.

ILS 32.
A locator?

1. Is a low powered beacon.
2. Is a high powered beacon.
3. Has range of 10 nm to 25 nm.
4. Has a range of 10 nm to 200 nm.

A. 1 and 4.
B. 2 and 3.
C. 1 and 3.
D. 2 and 4.

ILS 33.
According to the ILS coverage areas as defined in ICAO Annex 10, in which of the following situations will the pilot be guaranteed a reliable signal from the localiser?

A. 19 nm from touchdown inbound and 13 degrees displaced from the localiser centreline.
B. 27 nm from touchdown inbound and 8 degrees displaced from the localiser

centreline.

C. 10 nm from touchdown inbound and 38 degrees displaced from the localiser centreline.

D. 20 nm from touchdown inbound and 8 degrees displaced from the localiser centreline.

ILS 34.

What is measured in order to establish aircraft position in relation to the localiser beam on an ILS?

A. The difference in phase between the 90 Hz and the 150 Hz modulations.
B. The difference in depth between the 90 Hz and the 150 Hz modulations.
C. The difference in time between the 90 Hz and the 150 Hz modulations.
D. The bearing to the localiser antenna found by means of a loop aerial.

ILS 35.

Which of the following alternatives is correct regarding audio and visual signals in the cockpit when passing overhead the middle marker?

A. Audio: 74 MHz 2 dots per second. Visual: Blue light flashes.
B. Audio: 1300 Hz alternating dots and dashes. Visual: Amber light flashes.
C. Audio: 400 Hz, 2 dashes per second, Visual: Blue light flashes.
D. Audio: 3000 Hz alternating dots and dashes. Visual: Amber light flashes.

ILS 36.

If you are flying a back course ILS, you are flying a?

A. Non precision approach on the precision approach runway.
B. Precision approach on the reciprocal runway of the precision approach runway.
C. Non precision approach on the reciprocal runway of the precision approach runway.
D. Precision approach on the precision approach runway.

ILS 37.

The audio modulation of the middle marker is keyed to give?

A. Alternating dots and dashes at a rate of 2 dashed per second and 6 dots per second.
B. Continuous dots at a rate of 6 dots per second.
C. Continuous dashes at a rate of 2 dashes per second.
D. A sequence of 3 dashes, 3 dots and 3 dashes every second.

ILS 38.

On an ILS approach, the glide slope needle is fully down. How much deflection does this indicate?

A. 0.7 degrees.
B. 2.5 degrees.
C. 5 degrees.
D. 10 degrees.

ILS 39.

Full deflection on a glide slope indicator indicates that the aircraft is?

A. 0.7 degrees above or below the correct glide path.
B. 1.25 degrees above or below the correct glide path.
C. 2.5 degrees above or below the correct glide path.
D. 0.5 degrees above or below the correct glide path.

ILS 40.

On what carrier frequency does the inner marker transmit?

A. Same frequency as the glide path.
B. 3000 Hz.
C. 75 MHz
D. Same frequency as the localiser.

ILS 41.

Assuming a five dot display on either side of the ILS localiser cockpit display. What is the angular displacement of the aircraft from the localiser centreline when the CDI is deflected 2 dots to the right?

A. 1.0 degrees to the left.
B. 1.0 degrees to the right.
C. 2.0 degrees to the left.
D. 2.0 degrees to the right.

ILS 42.

Which of the following correctly describes the Instrument Landing System (ILS) localiser radiation pattern?

A. Two overlapping lobes on the same VHF carrier frequency.
B. Two overlapping lobes on the same UHF carrier frequency.
C. Two overlapping lobes on different radio carrier frequencies but with the same modulation.
D. A pencil beam comprising a series of smaller beams each carrying different modulation.

ILS 43.
According to ICAO 8168, what is regarded as the maximum safe deviation below the glide path during ILS approaches?

A. One quarter scale deflection.
B. Full scale deflection.
C. Three quarters scale deflection.
D. Half scale deflection.

ILS 44.
Which of these markers has the highest audible frequency?

A. Outer.
B. Middle.
C. Airways.
D. Inner.

ILS 45.
Which of the following is an ILS Localiser frequency?

A. 108.25 MHz.
B. 109.15 MHz.
C. 110.20 MHz.
D. 112.10 MHz.

ILS 46.
The heading rose of an HSI is frozen on 200 degrees. Lined up with the ILS of runway 25, the localiser will be?

A. Right of centre.
B. Left of centre.
C. Centred.
D. Centred with the "Fail" flag showing.

ILS 47.
The rate of descent required to maintain a 3.25 degree glide slope at a ground speed of 140 kts is approximately?

A. 670 ft/min.
B. 700 ft/min.
C. 760 ft/min.
D. 850 ft/min.

ILS 48.
An aircraft is flying a 3 degree glide path and experiences a reduction in groundspeed from 150 kts at the outer marker to 120 kts over the threshold. The effect of this change

in groundspeed on the aircraft's rate of descent will be a decrease of approximately?

A. 50 ft/min.
B. 150 ft/min.
C. 100 ft/min.
D. 250 ft/min.

ILS 49.
What is the approximate angular coverage of reliable navigation information for a 3 degree glide path out to a minimum distance of 10 nm?

A. 0.70 degrees above the glide path and 2.5 degrees each side of the localiser centreline.
B. 0.45 degrees above the horizontal to 1.75 degrees above the glide path, and 8 degrees each side of the localiser centreline.
A. 3 degrees above the horizontal to 5.25 degrees above the horizontal, and 8 degrees each side of the localiser centreline.
A. 1.35 degrees above the horizontal to 5.25 degrees above the horizontal, and 8 degrees each side of the localiser centreline.

ILS 50.
What according to ICAO Annex 10, is the range of a locator?

A. 100 to 300 nm.
B. 10 to 25 nm.
C. 25 to 50 nm.
D. 50 to 100 nm.

ILS 51.
According to ICAO Annex 10, in which frequency band(s) does the locator normally transmit?

A. MF/HF.
B. HF.
C. HF/VHF.
D. LF/MF.

ILS 52.
Which facility associated with the ILS may be identified by a two-letter identification group?

A. Locator.
B. Glide Path.
C. Outer Marker.
D. Inner Marker.

ILS 53.
The ILS marker identified visually by a white flashing light is the?

A. Outer marker.
B. Inner marker.
C. Middle marker.
D. Locator.

ILS 54.
The ILS marker with the higher aural frequency is the?

A. Inner marker.
B. Outer marker.
C. Middle marker.
D. Locator.

ILS 55.
In an ILS system, concerning the glide path principle of operation, the difference in depth of modulation (DDM).

1. Decreases with angular displacement below the glide path.
2. Increases with angular displacement above the glide path.
3. Decreases with angular displacement above the glide path.
4. Increases with angular displacement below the glide path.

A. 2 and 4.
B. 1 and 4.
C. 1 and 3.
D. 2 and 3.

ILS 56.
On final on ILS approach, at 0.6 nm from the threshold, which marker are you likely to hear?

A. The outer marker.
B. The middle marker.
C. The inner marker (if available).
D. NO markers can be located at this distance.

ILS 57.
Regarding ILS which of the following is true?

A. All markers transmit at 75 MHz
B. The glide path transmitter is located 300m from the departure end of the runway.
C. The DME paired with the ILS channels are usually zero referenced next to the departure end of the runway.

D. The localiser part of the frequency band is shared with the DME.

ILS 58.
The three different markers can be used in the ILS to determine the distance to the ILS touchdown point of the runway as follows?

A. The outer marker indicates the position where normally the descent has to commence.
B. The inner marker warns the pilot of the last chance to commence the missed approach procedure.
C. The markers are only important in the situation when glide path transmission has ceased.
D. The middle marker indicates the position for the decision for a missed approach during a CAT1 approach due to bad visibility.

ILS 59.
The UHF band is assigned to the.

1. Locator.
2. Localiser.
3. Outer Marker.
4. Glide Path.

The combination regrouping all of the correct statements is?

A. 1.
B. 3 and 4.
C. 4.
D. 1 and 3.

ILS 60.
One of the possible disturbances of the ILS signals is "scalloping". Which statement is correct?

A. Scalloping are minor changes or bends, which can be followed by the aircraft.
B. Scalloping are major changes or bends, which cannot be followed by the aircraft.
C. Scalloping are rapid changes or bends, which can be followed by the aircraft.
D. Scalloping causes rapid indicator changes from side to side of the intended approach path, which can not be followed by the aircraft.

ILS 61.
The ILS marker identified visually by an amber flashing light is the?

A. Middle marker.
B. Outer marker.
C. Inner marker.
D. Locator.

ILS 62.
An ILS marker beacon operates in the?

A. VHF band.
B. UHF band.
C. LF/MF band.
D. HF band.

ILS 63.
If the (angular) displacement of an aircraft (with respect to the localiser centreline) doubles, (e.g. From 1 degree to 2 degrees) measured difference in the depth of modulation?

A. Doubles.
B. Remains unchanged.
C. Is halved.
D. Increases fourfold.

ILS 64.
Concerning the localiser principle of operation in an ILS system, the difference in depth of modulation (DDM)?

A. Decreases with respect to the angular displacement from the centreline.
B. Increases linearly with respect to the angular displacement from the centreline.
C. Decreases proportionally with respect to the angular displacement from the centreline.
D. Increases linearly with respect to the distance from the centreline.

ILS 65.
The ILS marker identified visually by a blue flashing light is the?

A. Outer marker.
B. Middle marker.
C. Inner marker.
D. Locator.

ILS 66.
The ILS marker identified audibly by a series of two dashes per second is the?

A. Outer marker.
B. Middle marker.
C. Inner marker.
D. Locator.

ILS 67.
The ILS marker with an aural frequency of 400 Hz is?

A. Outer marker.
B. Inner marker.
C. Middle marker.
D. Locator.

ILS 68.
The ILS receiver of an aircraft flying down the exact runway centreline will receive?

A. 90 Hz and 150 Hz lobes at equal depth.
B. No modulated signal because the left and right lobes cancel each other along the centreline.
C. The same frequency modulated signal from both lobes with the maximum of magnitude.
D. The maximum magnitude of the difference between the 90 Hz and the 150 Hz amplitudes.

ILS 69.
The ILS receiver of an aircraft on approach and flying on the glide path will receive?

A. The modulation from both lobes at equal depth.
B. The same modulation frequency signal from both lobes with the maximum of magnitude.
C. No modulated signal because the left and right lobes cancel each other along the centreline.
D. The maximum magnitude of the difference between the two amplitudes.

ILS 70.
The principle of operation of an ILS is?

A. The difference in depth of modulation.
B. Modulation of the ILS frequency by amplitude of two modulating signals.
C. The phase comparison.
D. The difference between the frequencies of the tow tones.

ILS 71.
The back CRS of an ILS may give?

A. Precision approach guidance for the reciprocal of the main approach runway.
B. Non-precision approach guidance for the main approach runway.
C. Precision approach guidance for the main approach runway.
D. Non-precision approach guidance for the reciprocal of the main approach runway.

ILS 72.
Which answer states the typical distances along the centreline of the runway of the various ILS components?

A. Localiser transmitter 300 metres behind end of runway. Glide Path transmitter 300 metres behind the threshold. Middle marker 1000 metres from the threshold. Outer marker 4 nm from the threshold. (0.6nm)

B. Localiser transmitter 300 metres behind end of runway. Glide Path transmitter 300 metres behind the threshold. Middle marker 1.5 nm from the threshold. Outer marker 10 nm from the threshold.

C. Localiser transmitter 100 metres behind end of runway. Glide Path transmitter 300 metres behind the threshold. Middle marker 1000 metres from the threshold. Outer marker 4 nm from the threshold.

D. Localiser transmitter 100 metres behind end of runway. Glide Path transmitter 100 metres behind the threshold. Middle marker 1.5 nm from the threshold. Outer marker 10 nm from the threshold.

ILS 73.
The ILS marker identified by a series of alternate dots and dashes is the?

A. Middle marker.
B. Inner marker.
C. Outer marker.
D. Locator.

ILS 74.
The ILS marker with the lower aural frequency is the?

A. Outer marker.
B. Inner marker.
C. Middle marker.
D. Centreline marker.

ILS 75.
"Beam bends" in the ILS approach path are?

A. Curves in the normal approach because of noise abatement.
B. Curves in the glide path that are visible on the indicator, but change too fats to be followed by large aircraft.
C. Curved approaches made with the aid of the instrument landing system.
D. Slight curves that can be followed by large aircraft.

ILS 76.
Locators are?

A. LF/MF NDBs used as an aid for the approach.
B. Low powered ADFs use for airfield or runway approach.
C. Beacons with a range of 10 to 250 nm.
D. High powered NDBs used for en route and airways navigation.

ILS 77.
The UHF band is the assigned frequency band of the?

A. ILS glide path transmitter.
B. All the 3 ILS marker beacons.
C. ILS localiser transmitter.
D. Outer marker beacon.

ILS 78.
Performing an ILS approach, you will fly overhead the markers in a specific order. The order is?

A. OM, IM (if available), MM.
B. OM, MM, IM (if available).
C. MM, IM (if available), OM.
D. IM (if available), MM, OM.

ILS 79.
The type of modulation used for the ILS frequency carrier is?

A. Amplitude modulation.
B. Phase modulation.
C. Dual modulation.
D. Frequency modulation.

ILS 80.
In an ILS, concerning the localiser principle of operation, the difference in depth of modulation (DDM) will?

A. Increase with displacement from the centreline.
B. Decrease with displacement from the centreline.
C. Increase with left displacement from the centreline, and decrease with right displacement from the centreline.
D. Increase from centre position to half full scale of the needle of the indicator and decrease until full scale of the needle.

ILS 81.
In an ILS, concerning the glide path principle of operation, the difference in depth of modulation (DDM) will?

A. Increase with displacement above or below the glide path.
B. Decrease with displacement above or below the glide path.
C. Increase with above displacement from the glide path, and decrease with displacement below the glide path
D. Increase from centre position to half full scale of the needle of the indicator and decrease until full scale of the needle.

ILS 82.
The ILS outer marker modulation frequency is?

A. 400 Hz.
B. 3000 Hz.
C. 1500 Hz.
D. 1300 Hz.

ILS 83.
On final on an ILS approach, you are flying overhead the outer marker. You can expect to be at?

A. 4 nm from the threshold.
B. 25 nm from the threshold.
C. 10 nm from the threshold.
D. 1 nm from the threshold.

ILS 84.
The basic principle of operation of the ILS is the difference in depth of modulation (DDM) between the two lobes.

1. If the aircraft strays right, the higher tone lobe will be received at a higher intensity than the lower tone lobe.
2. A DDM of zero indicates the exact runway centreline.
3. The depth of modulation increases away from the centreline.
4. A DDM of zero indicates a balance between modulations.

The combination that regroups all of the correct statements is?

A. 1, 2, 3 and 4.
B. 1 and 3.
C. 2, 3 and 4.
D. 2 and 3.

ILS 85.
The basic principle of operation of the ILS is the difference in depth of modulation (DDM) between the 90 Hz and the 150 Hz lobes. A DDM of zero indicates:

1. The higher tone lobe is received at a higher strength than the lower tone lobe.
2. The exact runway centreline.
3. Aircraft is on the glide path.
4. A balance between modulations.

A. 1, 2 and 4.
B. 1 and 3.
C. 2 and 3.
D. 2, 3 and 4.

ILS 86.
Which of the following list use the VHF band?

1. Locator.
2. Localiser.
3. Outer Marker.
4. Glide path.

The combination that regroups all the correct statements is?

A. 2 and 3.
B. 2 and 4.
C. 1, 2, 3 and 4.
D. 1 and 3.

ILS 87.
The audio frequency modulation of the middle marker shall be keyed as follows?

A. A continuous series of alternate dots and dashes, the dashes keyed at a rate of 2 dashes per second, and the dots keyed at a rate of 6 dots per second.
B. 2 dashes per second continuously.
C. 3 dashes, 3 dots, and 3 dashes per second continuously.
D. 6 dots per second continuously.

ILS 88.
The localiser transmitters operate in a frequency band between?

A. 108 MHz and 111.975 MHz
B. 111.975 MHz and 117.975 MHz
C. 329.15 MHz and 335 MHz
D. 108 MHz and 117.975 MHz

ILS 89.
The ILS inner marker (if available) modulation frequency is?

A. 3000 Hz.
B. 1300 Hz.
C. 240 Hz.
D. 400 Hz.

ILS 90.
According to ICAO Annex 10 a locator has a range of?

A. 75 to 250 nm.
B. 10 to 25 nm.
C. 75 to 150 nm.
D. 7.5 to 15 nm.

ILS 91.
The ILS middle marker modulation frequency is?

A. 1300 Hz.
B. 3000 Hz.
C. 400 Hz.
D. 800 Hz.

ILS 92.
Inner marker beacon of an ILS transmit at?

A. 75 MHz
B. 150 MHz
C. 90 Hz.
D. It depends on the modulating frequency.

ILS 93.
All ILS marker beacons transmit at?

A. 75 MHz
B. 150 MHZ.
C. 90 MHz
D. It depends on the modulating frequency.

ILS 94.
Middle marker beacon of an ILS transmit at?

A. 75 MHz
B. 150 MHz
C. 90 Hz.
D. It depends on the modulating frequency.

ILS 95.
ILS produces?

A. A radiation pattern which is amplitude modulated by the VHF frequency of the ILS.
B. A radiation pattern which is amplitude modulated by a 90 Hz and a 150 Hz signal.
C. Two lobes modulated in frequency by 90 Hz and 150 Hz signals.
D. A 90 Hz lobe and a 150 Hz lobe which are amplitude modulated by the VHF frequency of the ILS.

ILS 96.
The ILS receiver of an aircraft on approach and flying on the right of the exact runway centreline will receive?

A. The left lobe modulation only.
B. The modulation from both lobes at equal amplitude.
C. A modulated signal and will shift the localiser needle to the right according to the magnitude of the difference between the two amplitudes.
D. More 150 Hz localiser signal than the 90 Hz localiser signal.

ILS 97.
On an ILS approach, when flying overhead the middle marker the colour of the flashing light will be?

A. Amber.
B. Blue.
C. Green.
D. White.

ILS 98.
On an ILS approach, when flying overhead the middle marker the colour of the flashing light will be?

A. White.
B. Blue.
C. Green.
D. Amber.

ILS 99.
A VOR is situated at the far end of the runway on which an aircraft is making an ILS approach. Nav 1 is switched to the localiser frequency and Nav 2 to the VOR frequency. At the moment that the needle of #1 indicator reaches the outer dot the deflection needle of #2 indicator will be at?

A. Approximately a halfway the scale.
B. The outer dot.
C. Approximately a three quarters of the scale.
D. Approximately a quarter of the scale.

ILS 100.
On an ILS approach, when flying overhead the outer marker the colour of the flashing light will be?

A. Blue.
B. Green.
C. White.
D. Amber.

ILS 101.
108.35 MHz can only be?

A. An ILS frequency.
B. A VOR frequency.
C. An ATC frequency.
D. A NDB frequency.

ILS 102.
Outer-marker beacon of an ILS transmit at?

A. 75 MHz
B. 150 MHz
C. 90 Hz.
D. It depends on the modulating frequency.

ILS 103.
The audio frequency modulation of the outer marker shall be keyed as follows?

A. 2 dashes per second continuously.
B. A continuous series of alternate dots and dashes.
C. 6 dots per second. Continuously.
D. 3 dashes, 3 dots, and 3 dashes per second continuously.

ILS 104.
The audio frequency modulation of the inner marker shall be keyed as follows?

A. 6 dots per second. Continuously.
B. A continuous series of alternate dots and dashes.
C. 2 dashes per second continuously.
D. 3 dashes, 3 dots, and 3 dashes per second continuously.

ILS 105.
The localiser transmits in?

A. The VHF band.
B. The UHF band.
C. Both the UHF and the VHF bands.
D. The HF band.

ILS 106.
The transmission of the glide slope beacon is characterised by?

A. UHF frequency with a minimum range of 10 nm.
B. 300 to 3000 Hz Amplitude Modulation fro the ATIS.
C. UHF carrier frequency with a possible "voice ident".
D. VHF frequency modulated with a 90 Hz AM and 150 Hz AM navigation signal.

ILS 107.
Classify the marker from lower aural frequency to higher aural frequency:

1. Inner marker (if available).
2. Middle marker.
3. Outer marker.

A. 3, 2, 1.
B. 1, 3, 2.
C. 2, 1, 3.
D. 1, 2, 3.

ILS 108.
Locators are:

1. High powered NDBs used for en route and airways.
2. Low powered NDBs used for airfield runway approach.
3. Beacons with a usually range of 10 to 250 nm.
4. Beacons with a usually range of 10 to 25 nm.

The combination regrouping all of the correct statements is?

A. 2 and 3.
B. 1 and 4.
C. 1 and 3.
D. 2 and 4.

ILS 109.
Concerning the localiser principle of operation in an ILS, the difference in depth of modulation (DDM):

1. Decreases with respect to the angular displacement from the centreline.
2. Increases with right displacement from the centreline.
3. Decreases with left displacement from the centreline.
4. Increases linearly with displacement from the centreline.

The combination regrouping all of the correct statements is?

A. 2 and 4.
B. 1 and 4.
C. 1 and 3.
D. 2 and 3.

ILS 110.
What is the function of the FM-immune filter?

A. To make the ILS localiser receiver less susceptible to interference from earth-reflected localiser signals.

B. To make both the ILS localiser and the glide slope receiver less susceptible to interference from earth-reflected localiser signals.
C. To make both the ILS localiser and the glide slope receiver less susceptible to interference from commercial FM-stations (radio and television).
D. To make the ILS localiser receiver less susceptible to interference from commercial FM-stations (radio and television).

ILS 111.
A locator beacon differs from an NDB with respect to:

1. Operational use.
2. Transmission power.
3. Presentation in the cockpit.
4. Frequency band.

From the above stated differences the following numbers are correct?

A. 1 and 4.
B. 1 and 2.
C. 2, 3 and 4.
D. 1, 2 and 3.

ILS 112.
ILS transmitters use the?

A. UHF and VHF bands.
B. VHF, UHF, and HF bands.
C. VHF band only.
D. UHF band only.

ILS 113.
What is the effect of FM broadcast stations that transmit on frequencies just below 108 MHz on the performance of ILS?

A. These transmissions may interfere with the ILS localiser and glide path signal which may lead to erroneous deviation indications.
B. These transmissions may activate the FM immune filter which results in the appearance of the localiser and glide path failure flag.
C. These transmissions may activate the FM immune filter which results in the appearance of the localiser failure flag.
D. These transmissions may interfere with the ILS localiser signal which may lead to erroneous deviation indications.

ILS 114.
Concerning the localiser principle of operation in an ILS, the needle of the aircraft indicator is centred when the difference in depth of modulation (DDM) is?

A. Null.

B. More than 150 Hz.
C. Maximum.
D. Less than 90 Hz.

ILS 115.
Concerning the glide path principle of operating in an ILS, the needle of the aircraft indicator is centred when the difference in depth of modulation (DDM) is?

A. Null.
B. More than 150 Hz.
C. Maximum.
D. Less than 90 Hz.

ILS 116.
An ILS receiver?

A. Measures the difference in depth of modulation of the transmitted signals.
B. Measures the phase difference of the transmitted signals.
C. Measures the difference in frequency of modulation of the transmitted signals.
D. Measures the phase rotation of the two transmitted signals.

ILS 117.
The ILS marker with an aural frequency of 3000 Hz is the?

A. Inner marker (if available).
B. Middle marker.
C. Outer marker.
D. Centreline marker.

ILS 118.
The ILS marker identified by a series of dots (6/sec) is the?

A. Inner marker.
B. Outer marker.
C. Middle marker.
D. Locator.

ILS 119.
The ILS marker with an aural frequency of 1300 Hz is the?

A. Middle marker.
B. Outer marker.
C. Inner marker.
D. Locator.

MLS 1.
The azimuth transmitter of a Microwave Landing System (MLS) provides a fan-shaped horizontal approach zone which is usually:

A. + or - 50° of the runway centre-line.
B. + or - 40° of the runway centre-line.
C. + or - 60° of the runway centre-line.
D. + or - 30° of the runway centre-line.

MLS 2.
Which one of the following is an advantage of a Microwave Landing System (MLS) compared with an Instrument Landing System (ILS)?

A. It does not require a separate azimuth (localiser) and elevation (azimuth) transmitter.
B. The installation does not require to have a separate method (marker beacons or DME) to determine range.
C. There is no restriction on the number of ground installations that can be operated because there is an unlimited number of frequency channels available.
D. It is insensitive to geographical site and can be installed at sites where it is not possible to use an ILS.

MLS 3.
MLS installations notified for operation, unless otherwise stated, provide azimuth coverage of:

A. + or - 40° about the nominal courseline out to a range of 20 NM.
B. + or - 20° about the nominal courseline out to a range of 20 NM.
C. + or - 40° about the nominal courseline out to a range of 30 NM.
D. + or - 20° about the nominal courseline out to a range of 10 NM.

MLS 4.
In which frequency band does the Microwave Landing System (MLS) operate?

A. EHF.
B. VHF.
C. SHF.
D. UHF.

MLS 5.
Which one of the following methods is used by a Microwave Landing System (MLS) to indicate distance from the runway threshold?

A. A DME co-located with the MLS transmitters.

B. Timing the interval between the transmission and reception of primary radar pulses from the aircraft to MLS station.
C. Measurement of the frequency shift between the MLS azimuth and elevation transmissions.
D. Timing the interval between the reception of sequential secondary radar pulses from the MLS station to the aircraft.

MLS 6.
Which one of the following correctly lists the major ground based components of a Microwave Landing System (MLS)?

A. Separate azimuth and elevation transmitters, outer and middle marker beacons.
B. Separate azimuth and elevation transmitters, DME facility.
C. Combined azimuth and elevation transmitter, DME facility.
D. Combined azimuth and elevation transmitter, outer and inner marker beacon.

MLS 7.
A MLS without DME-P provides?

A. An ILS-like approach.
B. A staged approach but not with a curved path.
C. An approach with a curbed path but not staged.
D. A category 3 approach.

MLS 8.
MLS is primarily being installed at airports where?

A. The main approach paths lead over water.
B. Topographical conditions preclude the installation of ILS marker beacons.
C. Meteorological conditions are likely to cause ILS ducting by super refraction.
D. ILS encounters difficulties because of surrounding buildings and/or terrain or interference from local music stations.

MLS 9.
The MLS frequencies and available channels are?

A. In the SHF band for MLS elements and the VHF band for the DME, 100 available channels.
B. In the SHF band, 300 kHz frequency separation giving 200 available channels.
C. In the range 5060 to 5090 MHz, 200 kHz separation giving 150 available channels.
D. In the VHF and UHF bands, 40 available channels.

MLS 10.
MLS can minimise multi path errors because?

A. The transmissions can be interrupted to avoid reflection by stationary objects.

B. MLS has a larger beam width than ILS.
C. The frequency of MLS is much higher than the frequency of ILS.
D. The transmission reverts to circular polarisation when the beam is reflected by stationary objects.

MLS 11.
The addition of DME-P to MLS is necessary to?

A. Obtain three dimensional positions.
B. Allow linear approaches.
C. Support the time referenced scanning beam.
D. Assure a constant angular velocity of the azimuth and elevation sweeps.

MLS 12.
MLS not equipped with DME P?

A. Provides basically the same approach capabilities as ILS.
B. Provides the capability for segmented approaches but not curved approaches.
C. provides the capability for CAT3 approaches.
D. Provides the capability for curved approaches but not segmented approaches.

MLS 13.
In an MLS system, the azimuth coverage is?

A. +/- 10 degrees.
B. +/- 8 degrees.
C. +/- 35 degrees.
D. +/- 40 degrees.

MLS 14.
The frequency band of MLS is?

A. UHF.
B. VHF.
C. SHF.
D. VLF.

MLS 15.
Which of the following is an advantage of MLS?

A. Can be used in inhospitable terrain.
B. Uses the same aircraft equipment as ILS.
C. Has a selective access capability.
D. Is not affected by heavy precipitation.

MLS 16.
In an MLS the azimuth information is available in the approach sector?

A. To a distance of 10 NM in an 80 degrees wide sector.
B. To a distance of 20 NM in an 80 degree wide sector.
C. To a distance of 10 NM in a 110 degree sector.
D. To a distance of 20 NM in a 110 degree sector.

MLS 17.
Making an MLS approach, the aircraft?

A. Receives elevation information 2 times per second.
B. Receives elevation information 13 times per second.
C. Receives elevation information 3 times as frequently as the azimuth information.
D. Receives elevation information 39 times as frequently as the azimuth information.

MLS 18.
Microwave Landing Systems (MLS) use guidance signals formed from?

A. Time referenced scanning beams.
B. Radar beams.
C. Intersecting modulated signals transmitted on very narrow beams.
D. Phase difference between an amplitude modulated reference signal and a frequency modulated variable signal.

MLS 19.
The MLS uses a technique based on?

A. frequency modulated duplex.
B. Pulse modulation.
C. Time referenced scanning beams.
D. Magnetic referenced scanning beam system.

MLS 20.
The MLS utilises a?

A. Frequency referenced scanning beam system.
B. Phase referenced scanning beam system.
C. Magnetic referenced scanning beam system.
D. Time referenced scanning beam system.

MLS 21.
The scanning beam of the MLS system is called?

A. Frequency referenced scanning beam system (FRSB).
B. Phase referenced scanning beam system (PRSB).
C. Magnetic referenced scanning beam system (MRSB).
D. Time referenced scanning beam system (TRSB).

MLS 22.
The principle of operation of MLS is?

A. Time referenced scanning beams.
B. Phase comparison directional beams.
C. Lobe comparison scanning beams.
D. Frequency comparison of reference beams.

MLS 23.
MLS consists of?

A. An azimuth transmitter and an elevation transmitter operating on a shared frequency and a DME.
B. An azimuth transmitter and an elevation transmitter operating on separate frequency and a DME.
C. A common azimuth and elevation transmitter.
D. Overlapping centre-line lobe transmission in azimuth angled to provide glide slope information.

MLS 24.
A microwave landing system operates?

A. On one of 200 channels in the band 5030 to 5090 GHz.
B. On one of 200 channels in the band 5.03 to 5.09 GHz.
C. On one of 400 channels in the band 5030 GHz to 5090 GHz.
D. On one of 400 channels in the band 5.03 to 5.09 GHz.

MLS 25.
Which answer correctly completes the following statement? The characteristics of an MLS station are that it uses.

A. An azimuth transmitter at the approach end of the runway, an elevation transmitter at the upwind end of the runway, and two frequencies.
B. An elevation transmitter at the approach end of the runway, an azimuth transmitter at the upwind end of the runway, and a single frequencies.
C. One transmitter for both azimuth and elevation and two frequencies.
D. One transmitter for both azimuth and elevation and a single frequency.

MLS 26.
In a MLS, the time that elapses between the passage of the TO scan and the FRO scan at the aircraft position is?

A. Not related to the angular position of the aircraft.
B. Directly proportional to the angular position of the aircraft.
C. Indirectly proportional to the angular position of the aircraft.
D. None of the above.

MLS 27.
Distance on MLS is measured by?

A. Co-located DME.
B. Measurement of the time taken for the primary radar pulse to travel from the

MLS transmitter to the aircraft receiver.
C. Measurement of the time taken for the secondary radar pulse to travel from the MLS transmitter to the aircraft receiver.
D. Phase comparison between the azimuth and elevation beams.

MLS 28.
Microwave Landing Systems allow the aircraft to fix its position accurately in three dimensions by means of?

A. Directional aerials and DME.
B. Information from four satellites transmitting microwaves.
C. Timing of the passage of two scanning beams integrated with DME.
D. Timing of the interval between pulses in azimuth and elevation and timing the delay for pulses to reach the aircraft to define range.

MLS 29.
Compared to the ILS, MLS has the following advantages?

A. No special receivers are required in the aircraft.
B. Many different approaches to the same runway may be defined by 1 set of ground equipment.
C. Aircraft separation will automatically be arranged by the ground equipment.
D. All approaches to all airfields will use the same channel, which means that the aircraft equipment will be a single channel receiver.

MLS 30.
Which one of the following is an advantage of a Microwave landing System (MLS) compared with an Instrument Landing System (ILS)?

A. There is no restriction on the number of ground installations that can be operated because there is an unlimited number of channels available.
B. It does not require a separate azimuth (localiser) and elevation (glideslope) transmitter.
C. It is insensitive to geographical site conditions and can be installed in sites where it is not possible to use an ILS.
D. The installation does not require a separate method (marker beacons or DME) to determine range .

MLS 31.
MLS frequencies and available channels are?

A. In the VHF and UHF band, 40 channels available.
B. In the range 5060 to 5090 MHz, 200 kHz spacing, giving 150 available channels.
C. In the SHF band, 300 kHz frequency separation, giving 200 channels available.
D. In the SHF band for the MLS elements and the VHF band for the DME, 100 channels available.

MLS 32.
Which of the following statements is true in respect to the Microwave Landing System (MLS)?

A. Range information is provided by precision DME operating in the UHF band.
B. A special precision DME, operating in the SHF band, provides range information.
C. Azimuth and elevation signals use the same aerial on a time sharing basis.
D. Azimuth and elevation signals are transmitted on the same UHF frequency.

MLS 33.
The coverage of MLS is ...... either side of the centreline to a distance of .....?

A. 40 degrees, 20 nm.
B. 40 degrees, 40 nm.
C. 20 degrees, 20 nm.
D. 20 degrees, 40 nm.

MLS 34.
MLS can minimise multi-path errors because?

A. The transmission reverts to circular polarisation when the beam is reflected by a stationary object.
B. The transmission can be interrupted to avoid reflection from stationary objects.
C. MLS has a larger beam width than ILS.
D. The frequency of MLS is much higher than the frequency of ILS.

MLS 35.
The addition of DME-P to MLS is necessary to?

A. Obtain three dimensional positions.
B. Allow linear approaches.
C. Support the time referenced scanning beams.
D. Assure a constant angular velocity of the azimuth and elevation sweep.

MLS 36.
MLS is primarily being installed in airports where?

A. Meteorological conditions are likely to cause ILS ducting by super refraction.
B. The main approach paths lead over water.
C. ILS encounters difficulties because of surrounding buildings and/or terrain or interference from local music station.
D. Topographical conditions preclude the installation of ILS marker beacons.

MLS 37.
MLS not equipped with DME-P?

A. Provides basically the same approach capabilities as ILS.
B. Provides the capability for CAT 3 approaches.
C. Provides the capability for segmented approaches but not for curved approaches.
D. Provides the capability for curved approaches but not for segmented approaches.

RADAR THEORY 1.
The minimum range of a primary radar, using the pulse technique, is determined by the (i)........ ; the maximum unambiguous range by the (ii).........

A. (i) pulse length (ii) pulse recurrence frequency
B. (i) transmission frequency (ii) transmitter power output
C. (i) pulse length (ii) length of the timebase
D. (i) transmission frequency (ii) pulse recurrence frequency

RADAR THEORY 2.
Which one of the following statements is correct concerning the use in primary radar of continuous wave transmissions as compared with pulse transmissions?

A. A smaller common transmitter and receiver aerial can be used.
B. It is less effective in short range radars but more effective in long range radars.
C. It eliminates the minimum target reception range.
D. The equipment required is more complex in continuous wave radar but this is offset by greater reliability and accuracy.

RADAR THEORY 3.
A Primary radar operates on the principle of:

A. Transponder interrogation.
B. Pulse technique.
C. Phase comparison.
D. Continuous wave transmission.

RADAR THEORY 4.
The main factor which determines the minimum range that can be measured by a pulsed radar is pulse:

A. Length.
B. Amplitude.
C. Repetition rate.
D. Frequency.

RADAR THEORY 5.
Ignoring pulse length, the maximum pulse repetition frequency (PRF) that can be used by a primary radar facility to detect targets unambiguously to a range of 200 NM is?
(pps = pulses per second)

A. 308 pps.
B. 375 pps.
C. 405 pps.
D. 782 pps.

RADAR THEORY 6.

The maximum range of primary radar depends on :

A. Wave length.
B. Frequency.
C. Pulse length.
D. Pulse recurrence frequency.

RADAR THEORY 7.

For any given circumstances, in order to double the effective range of a primary radar the power output must be increased by a factor of:

A. 2.
B. 4.
C. 8.
D. 16.

RADAR THEORY 8.

The prime factor in determining the maximum unambiguous range of a primary radar is the:

A. Power output.
B. Pulse recurrence rate.
C. Size of parabolic receiver aerial.
D. Height of the transmitter above the ground.

RADAR THEORY 9.

Which of the following types of radar systems are most suited for short range operation?

A. Primary continuous wave.
B. Centimetric pulse.
C. Millimetric pulse.
D. Secondary continuous wave.

RADAR THEORY 10.

In which frequency band do most airborne weather, and ground based ATC, radar systems operate?

A. UHF.
B. EHF.
C. VHF.
D. SHF.

RADAR THEORY 11.

In relation to radar systems that use pulse technology, the term 'Pulse Recurrence Rate (PRR)' signifies the:

A. Number of pulses per second.
B. Delay after which the process re-starts.
C. The number of cycles per second.
D. Ratio of pulse period to pulse width.

RADAR THEORY 12.

In a primary radar using pulse technique, pulse length determines:

A. Target discrimination.
B. Maximum measurable range.
C. Minimum measurable range.
D. Beam width.

RADAR THEORY 13.

In a primary radar using pulse technique, pulse recurrence frequency (PRF)/pulse recurrence rate (PRR) determines:

A. Maximum theoretical range.
B. Target discrimination.
C. Minimum range.
D. Beam width.

RADAR THEORY 14.

In a primary radar using pulse technique, the ability to discriminate between targets in azimuth is a factor of:

A. Aerial rotation rate.
B. Pulse Recurrence Rate (PRR).
C. Pulse length.
D. Beam width.

RADAR THEORY 15.

Which of the following radar equipments operate by means of the pulse technique?

1. Aerodrome Surface Movement Radar.
2. Airborne Weather Radar.
3. Secondary Surveillance Radar (SSR).
4. Aerodrome Surveillance (approach) Radar.

A. 1, 2, 3 and 4.
B. 1, 2 and 4 only.
C. 2, 3 and 4 only.

D. 2 and 4 only.

RADAR THEORY 16.

Assuming sufficient transmission power, the maximum range of a ground radar with a pulse repetition frequency of 450 pulses per second is: (Given: velocity of light is 300 000 km/second)

A. 666 km.
B. 1333 km.
C. 150 km.
D. 333 km.

$T = \frac{D}{S}$

$D = T \times S$

RADAR THEORY 17.

A radar facility transmitting at a Pulse Recurrence Frequency (PRF) of 1500 pulses/second will have a maximum unambiguous range of approximately:

A. 135 NM.
B. 54 NM.
C. 270 NM.
D. 27 NM.

$PRF = \frac{1}{1500}$

RADAR THEORY 18.

A ground radar transmitting at a PRF of 1200 pulses/second will have a maximum unambiguous range of approximately:

A. 67 NM.
B. 135 NM.
C. 270 NM.
D. 27 NM.

RADAR THEORY 19.

Complete the following statement. Aircraft Surface movement Radar operates on frequencies in the (i) .... band employing an antenna that rotates at approximately (ii) .... revolutions per minute; it is (iii) .... possible to determine the type of aircraft from the return on the radar screen.

A. (i) EHF (ii) 30 (iii) never.
B. (i) SHF (ii) 60 (iii) sometimes.
C. (i) SHF (ii) 10 (iii) always.
D. (i) EHF (ii) 100 (iii) never.

$T = \frac{D}{S} = \frac{185 km}{3 \times 10^3}$

RADAR THEORY 20.

The maximum pulse repetition frequency (PRF) that can be used by a primary radar facility in order to detect targets unambiguously at a range of 50 NM is?
(pps = pulses per second)

A. 3240 pps.
B. 610 pps.
C. 1620 pps.
D. 713 pps.

RADAR THEORY 21.

Ignoring pulse length and fly-back, a radar facility designed to have a maximum unambiguous range of 50 km will have a PRF (pulses per second) of:

A. 3000.
B. 6000.
C. 167.
D. 330.

RADAR THEORY 22.

Which combination of characteristics gives best screen picture in a primary search radar?

A. Long pulse length and wide beam.
B. Short pulse length and narrow beam.
C. Long pulse length and narrow beam.
D. Short pulse length and wide beam.

RADAR THEORY 23.

The maximum range obtainable from an ATC Long Range Surveillance Radar is approximately:

A. 300 NM.
B. 200 NM.
C. 100 NM.
D. 400 NM.

RADAR THEORY 24.

On which of the following radar displays is it possible to get an indication of the shape, and to some extent the type, of the aircraft generating the return?

A. Secondary Surveillance Radar (SSR).
B. Aerodrome Surveillance (approach) Radar.
C. Aerodrome Surface Movement Radar (ASMR).
D. Airborne Weather Radar (AWR).

RADAR THEORY 25.

Which of the following equipments uses primary radar principles?

A. Secondary Surveillance Radar (SSR).
B. Distance Measuring Equipment (DME).
C. Airborne weather radar (AWR).

D. Global Positioning System (GPS).

RADAR THEORY 26.
What information may be displayed on an ATC radar screen connected only to a primary radar system?

A. Aircraft position only.
B. Aircraft position and SSR code.
C. Aircraft position, SSR code and altitude.
D. Aircraft altitude.

RADAR THEORY 27.
In a primary pulse radar you have?

A. A directional aerial for transmission and an omni directional aerial for reception.
B. A directional aerial for transmission and another one for reception.
C. A directional aerial for both transmission and reception.
D. An omni directional aerial for transmission and a directional one for reception.

RADAR THEORY 28.
A radio altimeter employing a continuous wave signal would have?

A. A directional aerial for transmission and an omni directional aerial for reception.
B. A directional aerial for both transmission and reception.
C. An omni directional aerial for transmission and a directional one for reception.
D. A directional aerial for transmission and another one for reception.

RADAR THEORY 29.
Ignoring pulse length, the maximum pulse repetition frequency (PRF) that can be used by a primary radar facility to detect targets unambiguously to a range of 200 nm is?
(pps = pulses per second).

$T = \frac{D}{S} = 2.46 \times 10^{-3}$

A. 782 pps.
B. 405 pps.
C. 375 pps.
D. 308 pps.

RADAR THEORY 30.
The maximum pulse repetition frequency (PRF) that can be used by a primary radar facility to detect targets unambiguously to a range of 50 nm is?
(pps = pulses per second).

A. 713 pps.
B. 1620 pps.
C. 3240 pps.
D. 610 pps.

RADAR THEORY 31.
Assuming sufficient transmission power, the maximum range of a ground radar with a pulse repetition rate of 450 pulses per second is? (Given: Velocity of light = 300 000 km/sec).

A. 333km.
B. 1333 km.
C. 150 km.
D. 666 km.

RADAR THEORY 32.
Ignoring the pulse length and the fly-back, a radar facility designed to have a maximum unambiguous range of 50 km will have a PRF (pulses per second) of?

A. 330.
B. 167.
C. 3000.
D. 6000.

RADAR THEORY 33.
The maximum range obtainable from an ATC Long range Surveillance Radar is approximately?

A. 50 to 100 nm.
B. 100 to 200 nm.
C. 200 to 300 nm.
D. 300 to 400 nm.

1200 pps.

RADAR THEORY 34.
A ground radar transmitting at a PRF of 1200 pulses/second will have a maximum unambiguous range of approximately?

A. 67 nm.
B. 135 nm.
C. 27 nm.
D. 270 nm.

RADAR THEORY 35
Considering a primary radar system, what kind of aerials are used?

A. A directional antenna for transmitting, and an omni directional antenna for receiving.
B. One directional antenna both for transmitting and for receiving.
C. One directional antenna for transmitting and one for receiving.
D. An omni directional antenna for transmitting, and a directional antenna for receiving.

RADAR THEORY 36.
Comparing a parabolic reflector with a flat plate antenna of the same size?

A. The parabolic reflector generates less side lobes than the flat plate antenna.
B. The parabolic reflector has a considerably smaller beam width.
C. The flat plate antenna generates less side lobes than the parabolic reflector.
D. The flat plate antenna has a considerably smaller beam width.

RADAR THEORY 37.
When an operator increases the range on a radar display, in general?

A. The PRF becomes higher and the pulse length smaller.
B. The PRF becomes lower and the pulse length larger.
C. Both the PRF and the pulse length decrease.
D. Both the PRF and the pulse length increase.

RADAR THEORY 38.
Echoes that do not change in distance from the antenna (relative speed zero) of a ground radar with a Moving Target Indicator (MTI) are dangerous for the following reason?

A. The moving target indicator eliminates such echoes.
B. The radar is not able to display two echoes moving in the same direction.
C. The MTI does not recognise this as a moving object due to the blind speed.
D. The frequency of the transmitted radar signals changes too much by the Doppler effect.

RADAR THEORY 39.
The theoretical maximum range for an Airborne Weather Radar is determined by the:

A. Transmission power.
B. Size of the aerial.
C. Transmission frequency.
D. Pulse recurrence frequency.

RADAR THEORY 40.
The advantage of the use of slotted antennas in modern radar technology is to:

A. Virtually eliminate lateral lobes and as a consequence concentrate more energy in the main beam.
B. Simultaneously transmit weather and mapping beams.
C. Have a wide beam and as a consequence better target detection.
D. Eliminate the need for azimuth slaving.

GROUND RADAR 1.
What is the typical range of a Terminal area Surveillance Radar (TAR)?

A. Up to 25 nm.
B. Up to 80 nm.
C. Up to 250 nm.
D. Up to 2500 nm.

GROUND RADAR 2.
PAR at a military airfield has both an azimuth and an elevation element. It must be able to provide accuracy within?

A. +/- 20 feet elevation and azimuth.
B. +/- 30 feet elevation and azimuth.
C. +/- 30 feet elevation and +/- 20 feet azimuth.
D. +/- 20 feet elevation and +/- 30 feet azimuth.

GROUND RADAR 3.
What is a typical range for an Enroute Surveillance Radar (RSR)?

A. Up to 25 nm.
B. Up to 80 nm.
C. Up to 250 nm.
D. Up to 2500 nm.

GROUND RADAR 4.
In which frequency band do most Airfield Surface Movement radar systems operate?

A. VHF.
B. UHF.
C. SHF.
D. EHF.

GROUND RADAR 5.
A radar used by ATC has the following characteristics. Long wavelength and aerial rotation rate of 5 RPM. It is most likely to be?

A. Airfield surface movement radar.
B. Precision approach radar.
C. Enroute surveillance radar.
D. Terminal surveillance radar.

GROUND RADAR 6.
During a surveillance radar approach, the vertical position of the aeroplane, unless advised otherwise, is given in terms of?

A. Height above aerodrome QNH level.
B. Height above aerodrome level.
C. Height above QNH datum.
D. Height above QFE threshold.

GROUND RADAR 7.
An Aerodrome Ground Movements Radar is likely to operate in the ..... band with a

scan rate of ….. revolutions per minute.

A. UHF 20.
B. SHF 60.
C. EHF 20.
D. EHF 1000.

GROUND RADAR 8.
Why does surface movement radar use a frequency in the SHF band and not EHF?

A. EHF is potentially hazardous to personnel in the area. This was completely overcome by switching to SHF.
B. The power requirements of EHF were unsustainable in Europe.
C. SHF gives better definition of aircraft type than EHF.
D. EHF is absorbed and scattered by moisture in the air. Switching to SHF reduced this problem.

GROUND RADAR 9.
Surface movement radars operate mainly in the SHF band as opposed to the EHF band because?

A. EHF is more expensive.
B. EHF is likely to detect more moisture in the atmosphere.
C. The EHF band does not provide sufficient frequency spacing.
D. EHF radiated power is more dangerous to users' health.

GROUND RADAR 10.
A moving target indicator (MTI)?

A. Rejects all stationary targets.
B. Rejects all moving targets.
C. Is only effective if the target moves directly towards the ground unit.
D. Is not effective if the target moves directly towards the ground unit.

GROUND RADAR 11.
Short range aerodrome radars will have …… wavelengths?

A. Millimetric.
B. Centimetric.
C. Decimetric.
D. Metric.

GROUND RADAR 12.
Two types of radar approach may be available?

A. Surveillance approach and final approach.
B. Final approach and precision approach.
C. Surveillance approach and precision approach.
D. Terminal approach and surveillance approach.

GROUND RADAR 13.
Precision Approach radars (PAR) are required under the ICAO specifications to indicate an aircraft within the following parameters?

A. Azimuth 10 degrees, vertical 4 degrees range 7 nm.
B. Azimuth 20 degrees, vertical 7 degrees range 9 nm.
C. Azimuth 30 degrees, vertical 10 degrees range 10 nm.
D. Azimuth 40 degrees, vertical 15 degrees range 15 nm.

GROUND RADAR 14.
An area surveillance radar is most likely to have a frequency of?

A. 350 MHz.
B. 600 MHz.
C. 100 Hz.
D. 150 Hz.

GROUND RADAR 15.
The maximum range obtainable from an ATC en-route surveillance radar is approximately?

A. 50 to 100 nm.
B. 100 to 200 nm.
C. 200 to 300 nm.
D. 300 to 400 nm.

GROUND RADAR 16.
The maximum range of a ground radar is limited by?

A. Pulse width.
B. Average power.
C. Pulse recurrence rate.
D. Peak power.

GROUND RADAR 17.
A ground radar transmitting at a PRF of 1200 pulses per second will have a maximum unambiguous range of approximately?

A. 27 nm.
B. 67 nm.
C. 135 nm.
D. 270 nm.

GROUND RADAR 18.
If a radar has a beam width of 3 degrees and a pulse length of 4 microsecond, the target azimuth resolution at a range of 60 nm will be approximately?

A. 1 nm.
B. 2 nm.
C. 3 nm.

D. 4 nm.

GROUND RADAR 19.
A surveillance radar element (SRE) used to provide approach guidance?

A. Does not have a height determination capacity.
B. Can only be used to a point 3 miles from the threshold.
C. May not be used in heavy rain because of the high levels of signal loss.
D. Can be used to give guidance both horizontally and vertically.

GROUND RADAR 20
On which of the following radar displays is it possible to get an indication of the shape and to some extent the type, of the aircraft generating the returns?

A. Secondary Surveillance Radar (SSR).
B. Airborne Weather Radar (AWR).
C. Aerodrome Surface Movement Radar (ASMR).
D. Aerodrome Surveillance Approach Radar .

GROUND RADAR 21.
A surveillance radar installation will often consist of?

A. An SSR and a precision radar.
B. A primary radar and a VDF.
C. A primary radar and a secondary surveillance radar (SSR).
D. A primary radar and a precision radar.

GROUND RADAR 22.
In order to be able to penetrate cloud, a primary radar signal must have?

A. A high PRF.
B. A short wavelength.
C. A long wavelength.
D. A high frequency.

GROUND RADAR 23.
An SRA may be flown to?

A. 2 nm using QFE unless the pilot advises the controller that the approach is to be flown on QNH.
B. 0.5 nm using QNH unless the pilot advises the controller that the approach is to be flown on QFE.
C. 0.5 nm using QNH only.
D. 2 nm using QFE only.

GROUND RADAR 24.
A long range ATC surveillance radar will typically use a frequency of?

A. 600 MHz.
B. 1000 MHz.

C. 3000 MHz.
D. 10 GHz.

GROUND RADAR 25.
Complete the following statement. Aircraft Surface Movement Radar operates on frequencies in the .....(i) band employing an antenna that rotates at approximately .... (ii) revolutions per minute; it is ..... (ii) possible to determine the type of aircraft from the returns on the radar screen.

A. (i) SHF, (ii) 10, (iii) always.
B. (i) EHF, (ii) 30, (iii) never.
C. (i) SHF, (ii) 60, (iii) sometimes.
D. (i) EHF, (ii) 100, (iii) never.

AIRBORNE WEATHER RADAR 1.
Airborne weather radar systems use a wavelength of approximately 3 cm in order to:

A. Transmit at a higher pulse repetition frequency for extended range.
B. Obtain optimum use of the Cosecant squared beam.
C. Detect the smaller cloud formations as well as large.
D. Detect the larger water droplets.

AIRBORNE WEATHER RADAR 2.
The ISO-ECHO facility of an airborne weather radar is provided in order to:

A. Detect areas of possible severe turbulence in cloud.
B. Give an indication of cloud tops.
C. Inhibit unwanted ground returns.
D. Extend the mapping range.

AIRBORNE WEATHER RADAR 3.
In the MAPPING MODE the airborne weather radar utilises a:

A. Fan shaped beam effective up to a range of 150 NM.
B. Fan shaped beam effective up to a maximum of 50 NM to 60 NM range.
C. Pencil beam to a maximum range of 60 NM.
D. Pencil beam effective from zero to 150 NM.

AIRBORNE WEATHER RADAR 4.
Which of the following cloud types is most readily detected by airborne weather radar when using the 'weather beam'?

A. Cirrocumulus.
B. Cumulus.
C. Stratus.

D. Altostratus.

AIRBORNE WEATHER RADAR 5.
In which mode of operation does the aircraft weather radar use a cosecant radiation pattern?

A. CONTOUR.
B. WEATHER.
C. MAPPING.
D. MANUAL.

AIRBORNE WEATHER RADAR 6.
In an Airborne Weather Radar that has a colour cathode ray tube (CRT) the areas of greatest turbulence are indicated on the screen by:

A. Colour zones being closest together.
B. Blank iso-echo areas where there is no colour.
C. Large areas of flashing red colour.
D. Iso-echo areas, which are, coloured black.

AIRBORNE WEATHER RADAR 7.
Which of the following is a complete list of airborne weather radar antenna stabilisation axes?

A. Roll, pitch and yaw.
B. Pitch and yaw.
C. Roll and pitch.
D. Roll and yaw.

AIRBORNE WEATHER RADAR 8.
In an Airborne Weather Radar that has a colour cathode ray tube (CRT) increasing severity of rain and turbulence is generally shown by a change of colour from:

A. Green to yellow to red.
B. Yellow to amber to blue.
C. Green to red to black.
D. Yellow to orange to red.

AIRBORNE WEATHER RADAR 9.
A frequency of 10 GHz is considered to be the optimum for use in an airborne weather radar system because:

A. Greater detail can be obtained at the more distant ranges of the smaller water droplets.
B. The larger water droplets will give good echoes and the antenna can be kept relatively small.

C. Static interference is minimised
D. Less power output is required in the mapping mode

AIRBORNE WEATHER RADAR 10.
In general the operation of airborne weather radar equipment on the ground is:

A. Only permitted with certain precautions, to safeguard health of personnel and to protect equipment.
B. Permitted anywhere
C. Totally prohibited
D. Unrestrictedly permitted in aerodrome maintenance areas

AIRBORNE WEATHER RADAR 11.
The pencil shaped beam of an airborne weather radar is used in preference to the mapping mode for the determination of ground features:

A. Beyond 100 NM because insufficient antenna tilt angle is available with the Mapping mode.
B. Beyond 150 NM because the wider beam gives better definition
C. When approaching coast-lines in polar regions
D. Beyond 50 to 60 NM because more power can be concentrated in the narrower beam.

AIRBORNE WEATHER RADAR 12.
A frequency of airborne weather radar is :

A. 9375 MHz.
B. 9375 GHz.
C. 9375 kHz.
D. 93.75 MHz.

AIRBORNE WEATHER RADAR 13.
A weather radar, set to the 100 NM scale, shows a squall at 50 NM. By changing the scale to 50 NM, the return on the radar screen should:

A. Increase in area and appear nearer to the bottom of the screen.
B. Increase in area and move to the top of the screen.
C. Decrease in area but not change in position on the screen.
D. Decrease in area and move to the top of the screen.

AIRBORNE WEATHER RADAR 14.
In weather radar the use of a cosecant beam in 'Mapping' mode enables:

A. Better reception of echoes on contrasting terrain such as ground to sea.
B. A greater radar range to be achieved.

C. Higher definition echoes to be produced giving a clearer picture.
D. Scanning of a large ground zone producing echoes whose signals are practically independent of distance.

AIRBORNE WEATHER RADAR 15.
In Airborne Weather Radar (AWR), the main factors which determine whether a cloud will be detected are:

A. Size of the water drops and the wavelength/frequency used.
B. Range from cloud and the wavelength/frequency used.
C. Size of the water droplets and the diameter of the scanner.
D Rotational speed of radar scanner and the range from cloud.

AIRBORNE WEATHER RADAR 16.
In Airborne Weather Radar (AWR), the main factors which determine whether a cloud will be detected are:

A. Rotational speed of radar scanner.
B. Diameter of radar scanner.
C. Wavelength/frequency used.
D. Range from cloud.

AIRBORNE WEATHER RADAR 17.
In order to ascertain whether a cloud return on an Aircraft Weather Radar (AWR) is at or above the height of the aircraft, the tilt control should be set to?
(Assume a beam width of 5°)

A. 2.5° up.
B. 0°.
C. 2.5° down.
D. 5° up.

AIRBORNE WEATHER RADAR 18.
When switching on the weather radar, after start-up, a single very bright line appears on the screen. This means that the?

A. Transmitter is faulty.
B. Scanner is not rotating.
C. Scanning of the cathode ray tube is faulty.
D. Receiver is faulty.

AIRBORNE WEATHER RADAR 19.
Which of the following lists phenomena that CANNOT be detected by weather radar?

A. Dry hail; clear air turbulence
B. Snow; clear air turbulence

C. Clear air turbulence; turbulence in cloud with precipitation
D. Snow; turbulence in clouds with precipitation

AIRBORNE WEATHER RADAR 20.
The "gain" control knob of an AWR adjusts?

A. The power level of the transmitted energy is made dependent on the selected range.
B. The brightness of the display.
C. The automatic gain control of the AWR is activated.
D. The receiver sensitivity in order to achieve optimum target acquisition.

AIRBORNE WEATHER RADAR 21.
Airborne Weather Radars are generally based on the use of?

A. Secondary radar in the SHF band.
B. Primary radar in the UHF band.
C. Primary radar in the SHF band.
D. Secondary radar in the VHF band.

AIRBORNE WEATHER RADAR 22.
In the MAPPING MODE the airborne weather radar utilises a?

A. Fan shaped beam effective up to a range of 150 nm.
B. Fan shaped beam effective up to a maximum range of 50 nm to 60 nm.
C. Pencil beam effective from zero to 150 nm.
D. Pencil beam effective to a maximum range of 60 nm.

AIRBORNE WEATHER RADAR 23.
In Airborne Weather Radar (AWR) the main factors that determine whether or not a cloud will be detected are?

A. Range to the cloud, wavelength/frequency used.
B. Size of the water droplets and the diameter of the radar scanner.
C. Size of the water droplets, and the wavelength/frequency used.
D. Rotational speed of the radar scanner, range from cloud.

AIRBORNE WEATHER RADAR 24
In order to ascertain whether a cloud return on an Aircraft Weather Radar (AWR) is at or above the height of the aircraft, the tilt control should be set to (assume a beam width of 5 degrees)?

A. 2.5 degrees down.
B. 2.5 degrees up.
C. 5 degrees up.
D. 0 degrees.

AIRBORNE WEATHER RADAR 25.
In an Airborne Weather Radar the areas of greatest turbulence are usually indicated on the screen by?

A. Colour zones of red or magenta.
B. Blank areas where there is no colour.
C. Colour zones of green or yellow.
D. Areas which are coloured black.

AIRBORNE WEATHER RADAR 26.
To improve the detection of precipitation area(s) in e.g. Thunderstorms, in which the top of the cloud lies at or slightly above the level of flight?

A. The tilting setting should be lower when the aircraft climbs to a higher altitude.
B. The tilting setting should be higher when the aircraft climbs to a higher altitude.
C. The tilting setting should be higher when the selected range decreases.
D. The tilting setting should be lower when the selected range increases.

AIRBORNE WEATHER RADAR 27.
Which statements relating to the stabilization system of airborne weather radar antennae is true?

A. They are stabilized with respect to the pitch, roll and yaw axes.
B. They are stabilized with respect to the yaw axis, but not with respect to the pitch and roll axes.
C. They are stabilized with respect to the pitch and roll axes but not with respect to the yaw axis.
D. The pilot can choose the axes of stabilization with the system's stabilization selector switch.

AIRBORNE WEATHER RADAR 28.
Airborne Weather Radar has been primarily developed to detect?

A. Areas of wind sheer and severe aircraft icing.
B. Areas of severe clear air turbulence.
C. The kinds of precipitation, which are usually accompanied by turbulence.
D. All kinds of frozen precipitation such as hail, snow and graupel.

AIRBORNE WEATHER RADAR 29.
The antennae of modern airborne weather radars are stabilized by means of?

A. Mercury switches.
B. Inputs from the aircraft's attitude system.
C. Artificial gravity switches.
D. Feedback from the antenna accelerometers.

AIRBORNE WEATHER RADAR 30.
The heaviest turbulence is likely to be encountered?

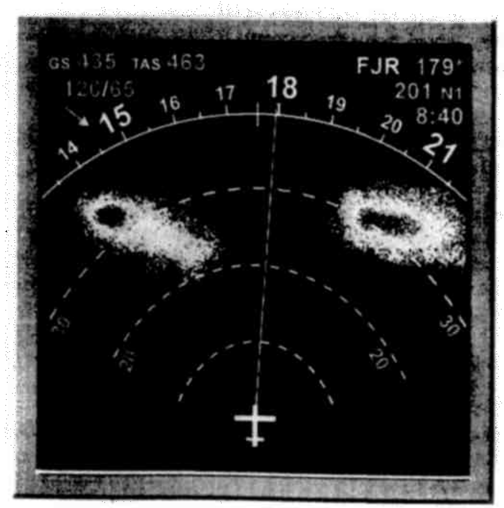
A. Where the area of heaviest precipitation is closest to the edge of the thunderstorm cell.
B. About half way between two thunderstorm cells.
C. In the very core of a thunderstorm cell.
D. In the area of heaviest precipitation.

AIRBORNE WEATHER RADAR 31.
When using airborne weather radar in the mapping mode in polar areas one runs the risk?

A. Of getting a distorted because of the ice reflections.
B. Of aurora borealis (polar light) causing false returns.
C. Of underestimating distances because the cold seawater is causing super refraction.

AIRBORNE WEATHER RADAR 32.
The pictures in the diagram are showing an aircraft's position with respect to some thunderstorm cells and the image the pilot is getting from the radar. To detect this "blind alley" the pilot should?

A. Select the cosecant square beam fro better alley detection.
B. Switch over from normal to X mode.
C. Initiate a steep climb.
D. Increase the range setting of the radar.



AIRBORNE WEATHER RADAR 33.
Is it possible for weather radar to be operated on the ground?

A. No, never.
B. Yes, always.
C. Yes, if operating within regulations and guidelines.
D. Only whilst taxiing.

AIRBORNE WEATHER RADAR 34.
In which frequency band do most Airborne Weather radars operate?

A. VHF.
B. UHF.
C. SHF.
D. EHF.

AIRBORNE WEATHER RADAR 35.
The theoretical maximum range for an airborne weather radar is determined by the?

A. Pulse length.
B. Beam width.
C. Pulse repetition frequency.
D. Carrier wave frequency.

AIRBORNE WEATHER RADAR 36.
On the airborne weather radar display in WX mode, different colours use used?

A. To display ground height differences.
B. To display echoes from other aircraft.
C. To display different intensity of precipitation.
D. To display clouds, indicating different levels of visibility.

AIRBORNE WEATHER RADAR 37.
Ground checks of AWR are?

A. Allowed under specific health and safety regulations.
B. Allowed only when the aircraft has undergone major servicing.
C. Unrestricted.
D. Prohibited at all times.

AIRBORNE WEATHER RADAR 38.
The airborne weather radar (AWR) cannot detect?

A. Snow.
B. Wet hail.
C. Dry hail.
D. Moderate rain.

AIRBORNE WEATHER RADAR 39.
Which of the following list of phenomena are least likely to be detect by airborne weather radar?

A. Clear air turbulence.
B. Precipitation.
C. Turbulence in cloud that has precipitation.
D. Wet snow and turbulence in cloud that has precipitation.

AIRBORNE WEATHER RADAR 40.
While using the AWR in the weather mode, the strongest returns on the screen indicate?

A. Areas of severe icing.
B. Areas of probable windshear.
C. Areas of high concentration of large water droplets.
D. Areas of severe turbulence.

AIRBORNE WEATHER RADAR 41.
On a colour airborne weather radar, a bright red echo indicates?

A. Strong rising air currents.
B. An area of extreme turbulence.
C. An area of strong windshear.
D. Heavy concentrations of liquid/solid water.

AIRBORNE WEATHER RADAR 42.
The ISO-ECHO feature of an airborne weather radar can be used to detect?

A. CAT.
B. Wake turbulence.
C. Turbulence in cloud.
D. Areas of possible turbulence in cloud.

AIRBORNE WEATHER RADAR 43.
On the AWR display the most severe turbulence will be shown?

A. By steep colour gradients.
B. In flashing red.
C. By a black hole.
D. Alternating red and white stripes.

AIRBORNE WEATHER RADAR 44.
Airborne weather radar uses a particularly high frequency radar signal, at 9 to 12 GHz, in order to?

A. Get good returns from droplets of water and other sorts of precipitation.
B. Get the most accurate range and bearing information.
C. Make it possible to present a colour display of the weather situation..
D. Al of the answers in this question are correct.

AIRBORNE WEATHER RADAR 45.
An airborne weather radar unit transmits a 5 degrees beam from a parabolic dish aerial reflector assembly. If the wavelength is 4 cm, the diameter of the dish is?

A. 20 cm.
B. 56 cm.
C. 87.5 cm.
D. 87.5 in.

AIRBORNE WEATHER RADAR 46.
An airborne weather radar unit transmits a 4 degrees beam from a parabolic dish aerial reflector assembly. If the wavelength is 3 cm, the diameter of the dish is?

A. 20 in.
B. 20 cm.
C. 52.5 in.
D. 52.5 cm.

AIRBORNE WEATHER RADAR 47.
An airborne weather radar, with a beam width of 4 degrees in azimuth, is being used in the mapping mode. At what maximum range will it be able to detect a 1 nm wide opening in a sea cliff?

A. 4 nm.
B. 15 nm.
C. 45 nm.
D. 60 nm.

AIRBORNE WEATHER RADAR 48.
The tilt angle on the AWR at which an active cloud just disappears from the screen is 4 degrees up. If the beam width is 5 degrees and the range to the cloud is 40 nm use the 1 in 60 rule to calculate the approximate height of the cloud relative to the aircraft?

A. 4000 ft above.
B. 4000 ft below.
C. 6000 ft above.
D. 6000 ft below.

AIRBORNE WEATHER RADAR 49.
An aircraft flying at 25 000 feet is equipped with AWR. The beam width is 5 degrees. With the radar tilted 3.5 degrees up, the radar is showing top of a cloud return at 105 nm. The approximate height of the cloud is.

A. 14 300 ft.
B. 25 600 ft.
C. 30 300 ft.
D. 35 600 ft.

AIRBORNE WEATHER RADAR 50.
In an AWR with a 5 degree beam width how do you orient the scanner to receive returns from clouds that are at or below your level?

A. 2.5 degrees down tilt.
B. 2.5 degrees up tilt.
C. 5 degrees down tilt.
D. 0 degrees tilt.

AIRBORNE WEATHER RADAR 51.
The airborne weather radar is using a 5 degree beam. The cloud is detected at a range of 60 nm. If the scanner is tilted up to 5 degrees, the cloud disappears. Using trigonometry to determine the height of the tops of the cloud, in relation to the aeroplanes cruising level, select the nearest answer from the following?

A. 15900 ft above the aircraft.
B. 15900 below the aircraft.
C. 31900 ft above the aircraft.
D. 31900 ft below the aircraft.

AIRBORNE WEATHER RADAR 52.
An airborne weather radar is using a 3 degree beam. A cloud is detected at a range of 40 nm. If the scanner is tilted up to 3 degrees the cloud disappears. The top of the cloud, in relation to the aeroplane's cruising level is approximately?

A. At the same level.
B. 6000 ft above the level.
C. 12000 ft above the level.
D. 18000 ft above the level

AIRBORNE WEATHER RADAR 53.
What frequency is typical chosen for AWR systems?

A. 9375 kHz.
B. 93.75 MHz (93 decimal 5 kHz).
C. 9.375 GHz (9 decimal 375 GHz).
D. 93.75 GHz (93 decimal 75 GHz).

AIRBORNE WEATHER RADAR 54.
The AWR can be used on the ground provided:

1. The aircraft is clear of personnel, buildings and vehicles.
2. The conical beam is selected.
3. Maximum up tilt is selected.
4. The AWR must never be operated on the ground.

A. 4.
B. 1, 2.
C. 2, 3.
D. 1, 2, 3.

AIRBORNE WEATHER RADAR 55.
The cosecant squared beam is used for mapping in the AWR because?

A. It allows cloud detection to be effected while mapping.
B. A greater range can be achieved.
C. A larger area of ground is illuminated by the beam.
D. A wider beam is produce din azimuth to give a greater coverage.

AIRBORNE WEATHER RADAR 56.
On a weather radar, the greatest turbulence is likely in an area where targets are?

A. Coloured red.
B. Coloured magenta.
C. Show a clearly defined hole.
D. Show a rapid gradient of change from magenta to yellow.

AIRBORNE WEATHER RADAR 57.
Weather radar is used by the pilot to assist in the?

A. Detection of other aircraft through clouds.
B. Detection and avoidance of potentially turbulent cloud cells.
C. Detection and avoidance of turbulence.
D. Detection and determination of a route through active cloud cell formations.

AIRBORNE WEATHER RADAR 58.
The stabilisation of the weather radar aerial is effective?

A. For up to +/- 5 degrees in pitch and roll.
B. For up to +/- 20 degrees of combined pitch and roll.
C. For up to +/- 30 degrees of combined pitch and roll.
D. For up to +/- 40 degrees of combined pitch and roll.

AIRBORNE WEATHER RADAR 59.
On an AWR the sequence of colours indicating increasing water droplet size is?

A. Blue, green, red.
B. Green. Yellow, red.
C. Black, amber, red.
D. Blue, amber, red.

AIRBORNE WEATHER RADAR 60.
The colours used on a conventional AWR to indicate increasing intensity of returns are?

A. Blue, Green, Red.
B. Green, Amber, Red.
C. Green, Yellow, Orange.
D. Blue, Amber, Red.

AIRBORNE WEATHER RADAR 61.
A height ring is used?

A. As a range marker.
B. As a zero point for range measurement.
C. To determine that the weather radar is functioning.
D. To determine the exact aeroplane height above the surface.

AIRBORNE WEATHER RADAR 62.
A side lobe from an aerial of a weather radar may produce an echo on the screen known as a "height ring". The pilot can use this?

A. As a range marker.
B. To determine the aeroplane's height above the surface.
C. As a zero point for range measurement.
D. To determine that the weather radar is functioning.

AIRBORNE WEATHER RADAR 63.
The main factors, which affect whether an AWR will detect a cloud, are?

A. The size of the water droplets and the range to the cloud.
B. The scanner rotation rate and the wavelength/frequency.
C. The size of the water droplets and the wavelength/frequency.
D. The size of the water droplets and the diameter of the antenna reflector.

AIRBORNE WEATHER RADAR 64.
The ISO-ECHO circuit is incorporated in the AWR?

A. To display areas of turbulence.
B. To allow ground mapping.
C. To alert pilots to the presence of cloud.
D. To allow simultaneous mapping and detection of clouds.

AIRBORNE WEATHER RADAR 65.
When the airborne weather radar is operating in its primary mode, to detect precipitation?

A. The radar beam is a cosecant beam.
B. The radar beam is pencil shaped.
C. Maximum tilt on the aerial will often be used.
D. The range will be limited, compared to the range obtainable in the ground mapping mode.

AIRBORNE WEATHER RADAR 66.
Airborne weather radars use a frequency of approximately 9 GHz because?

A. The frequency penetrates clouds quite easily enabling good mapping of ground feature in the mapping mode.
B. The short wavelength allows signals to be reflected from cloud water droplets of all sizes.
C. The wavelength is such that reflections are obtained only from the larger water

droplets.
D. It has a short wavelength, so producing higher frequency returns.

AIRBORNE WEATHER RADAR 67.
When using the AWR to detect long range ground features the most suitable mode of operation or beam selected would be?

A. The manual mode.
B. The mapping mode.
C. The contour mode.
D. The fan shaped beam.

AIRBORNE WEATHER RADAR 68.
Using the airborne weather radar, before take-off?

A. The gain control should be adjusted according to the light conditions expected after take-off.
B. The contrast control should be adjusted to maximum contrast.
C. The radar transmitter should not be operated when personnel are observed in the sector ahead of the aircraft.
D. The antenna tilt control should be set to maximum negative tilt.

AIRBORNE WEATHER RADAR 69.
If the AWR transmitter is to be switched on before take-off the scanner should be tilted up with?

A. The weather mode selected.
B. The mapping mode selected.
C. Either of the modes selected.
D. none of the above.

AIRBORNE WEATHER RADAR 70.
AWR in the .... Mode progressively ... . As distances .... To equalise screen brightness?

A. Weather, decreases gain, increases.
B. Weather, increases power, decreases.
C. Mapping, increase gain, decreases.
D. Mapping, decreases power, decreases.

AIRBORNE WEATHER RADAR 71.
The airborne weather radar uses the following wavelength?

A. Myriametric.
B. Metric.
C. Hectometric.
D. Centimetric.

AIRBORNE WEATHER RADAR 72.
Before commencing a flight the weather radar should?

A. Be kept at stand-by until line-up with the runway.
B. Not be switched on until clear of buildings.
C. Be switched to stand-by, but not used until airborne.
D. Be switched to a range function after push-back to make sure it is functioning.

AIRBORNE WEATHER RADAR 73.
The use of AWR on the ground is?

A. Not permitted.
B. Permitted provided reduced power is used.
C. Permitted provided special precautions, to safeguard personnel and equipment.
D. Only permitted to assist movement in low visibility conditions.

AIRBORNE WEATHER RADAR 74.
In an AWR with a colour CRT areas of greater turbulence are indicated by?

A. Iso-echo areas coloured black.
B. Large areas of flashing red.
C. Iso-echo areas with no colour.
D. Most rapid change of colour.

AIRBORNE WEATHER RADAR 75.
AWR contour mode is used for?

A. Identifying areas of maximum turbulence within a cloud.
B. Identifying rain bearing clouds.
C. Short range mapping.
D. Long range mapping.

SSR 1.
When Mode C is selected on the aircraft SSR transponder the additional information transmitted is:

A. Altitude based on regional QNH.
B. Aircraft height based on sub-scale setting.
C. Height based on QFE.
D. Flight level based on 1013.25 hPa.

SSR 2.
The ground Secondary Surveillance Radar (SSR) equipment incorporates a transmitter and receiver respectively operating in the following frequencies?

Transmitter Receiver?

A. 1090 MHz 1030 MHz.
B. 1030 MHz 1090 MHz.
C. 1090 MHz 1090 MHz.
D. 1030 MHz 1030 MHz.

SSR 3.
Why is a secondary radar display screen free of storm clutter?

A. The principle of 'echo' return is not used in secondary radar
B. The frequencies employed are too high to give returns from moisture sources.
C. A moving target indicator facility suppresses the display of static or near static returns.
D. The frequencies employed are too low to give returns from moisture sources.

SSR 4.
In order to indicate radio failure the aircraft SSR transponder should be selected to code:

A. 7700.
B. 7000.
C. 7500.
D. 7600

SSR 5.
In order to indicate unlawful interference with the planned operation of the flight, the aircraft Secondary Surveillance Radar (SSR) transponder should be selected to:

A. 7600.
B. 7500.
C. 7700.
D. 7000.

SSR 6.
When an aircraft is operating its Secondary Surveillance Radar in Mode C an air traffic controller's presentation gives information regarding the aircraft's indicated flight level that is accurate to within:

A. + or - 50 FT.
B. + or - 75 FT.
C. + or - 100 FT.
D. + or - 25 FT.

SSR 7.
The frequency of an SSR ground transmission is:

A. 1050 +/- 0.5 Mhz.
B. 1090 +/- 0.3 Mhz.
C. 1030 +/- 0.2 Mhz.
D. 1120 +/- 0.6 Mhz.

SSR 8.
The two main design functions of Secondary Surveillance Radar (SSR) Mode S are:

A. Collision avoidance using TCAS II and improved long range (HF) communication capability.
B. Continuous automatic position reporting using Global Positioning System (GPS) satellites and collision avoidance using TCAS II
C. The elimination of ground to air communications and the introduction of automatic separation between aircraft using TCAS II
D. Air to ground and ground to air data link communications and improved ATC aircraft surveillance capability

SSR 9.
The ATC transponder system, excluding Mode S, contains :

A. Four modes, each 1024 codes.
B. Two modes, each of 4096 codes.
C. Four modes, each 4096 codes.
D. Two modes, each 1024 codes.

SSR 10.
A secondary radar can provide up to 4096 different codes.
These 4096 codes can be used in?

A. All modes.
B. Mode A only.
C. Mode C only.
D. Mode S.

SSR 11.
The code transmitted by a SSR transponder consists of:

A. Pulses.
B. Phase differences.
C. Frequency differences.
D. Amplitude differences.

SSR 12.
Which of the following Secondary Surveillance Radar (SSR) codes is used to indicate transponder malfunction?

A. 7600.
B. 4096.
C. 9999.
D. 0.

SSR 13.
Which one of the following Secondary Surveillance Radar (SSR) codes should be used by aircraft entering airspace from an area where SSR operation has not been required?

A. 5000.
B. 2000.
C. 7000.
D. 0.

SSR 14.
What is the maximum number of usable Secondary Surveillance Radar (SSR) transponder codes?

A. 4096.
B. 3600.
C. 1000.
D. 760.

SSR 15.
Which of the following equipments works on the interrogator/transponder principle?

A. Global Positioning System (GPS).
B. Airborne Weather Radar (AWR).
C. Secondary Surveillance Radar (SSR).
D. Aerodrome Surface Movement Radar.

SSR 16.
In order to indicate an emergency situation, the aircraft Secondary Surveillance Radar (SSR) transponder should be set to:

A. 7600.
B. 7500.
C. 7000.
D. 7700.

SSR 17.
Which one of the following switch positions should be used when selecting a code on the Transponder?

A. IDENT (Identification).
B. NORMAL.
C. STBY (Standby).
D. OFF.

SSR 18.
The selection of code 2000 on an aircraft SSR transponder indicates:

A. Entry into airspace from an area where SSR operation has not been required.
B. Unlawful interference with the planned operation of the flight.
C. An emergency.
D. Transponder malfunction.

SSR 19.
Most aeroplanes are fitted with a transponder which is an essential aspect of .... Radar?

A. Primary.
B. Precision approach.
C. Security surveillance.
D. Secondary surveillance.

SSR 20.
Secondary surveillance radar (SSR) information is?

A. Not displayed on a screen but received by fax at the radar controller's station.
B. Displayed on the same screen as primary radar information.
C. Displayed on a screen next to the primary radar screen.
D. Not mandatory for aircraft operating in controlled airspace.

SSR 21.
The selection of code 7500 on an aircraft SSR transponder indicates:

A. Unlawful interference with the planned operation of the flight.
B. An emergency.
C. Transponder malfunction.
D. Radio communication failure.

SSR 22.
The selection of code 7600 on an aircraft SSR transponder indicates:

A. An emergency.
B. Unlawful interference with the planned operation of the flight.
C. Radio communication failure.
D. Transponder malfunction.

SSR 23.
The selection of code 7700 on an aircraft SSR transponder indicates:

A. Radio communication failure.
B. An emergency.

C. Transponder malfunction.
D. Unlawful interference with the planned operation of the flight.

SSR 24.
Mode A or C garbling may occur to?

A. Two or more aircraft in the same direction from the interrogator with a difference in slant range of less than 1.7 nm.
B. Two or more aircraft in different directions from the interrogator with a difference in slant range of less than 1.7 nm.
C. Two or more aircraft in the same direction from the ground station with a difference in slant range of less than 1.7 nm.
D. Two or more aircraft in different directions from the ground station with a difference in slant range of less than 1.7 nm.

SSR 25.
A TCAS II equipped aircraft will have mode S because?

A. The datalink is required to transmit relative position.
B. Mode S transmits a 3D position.
C. True altitude is obtained from mode S.
D. The datalink is required to co-ordinate evasive manoeuvres.

SSR 26.
How does a Mode S interrogator identify aircraft?

A. A 24 bit identifier, giving over 16 million combinations.
B. The four letter SELCAL code.
C. The P3 pulse.
D. An eight bit identifier, which gives 212 unique combinations.

SSR 27.
With Mode S, each aircraft can be uniquely interrogated and identified by using the?

A. Twelve-pulse train giving 212 possible codes.
B. 24 bits address code, giving more than 16 million possible combinations.
C. Special Position Identification (SPI) pulse.
D. Long (30.25 m/sec) P3 pulse.

SSR 28.
Which statement is correct with respect to selections on the transponder control panel?

A. With ON selected a reply in the modes A, C, and S, can be transmitted.
B. With the selector knobs the four digits of the squawk can be selected using the decimal symbols 0 through 9.
C. With ALT selected a reply in the modes A, C, and S, can be transmitted.

D. The correct ICAO 24 bits aircraft address code must be inserted on the control panel.

SSR 29.
Garbling in Mode A and C may occur?

A. Two or more aircraft in different directions from the interrogator with a difference in slant range of less than 1.7 nm.
B. Two or more aircraft in the same direction from the ground station with a difference in slant range of less than 1.7 nm.
C. Two or more aircraft in different directions from the ground station with a difference in slant range of less than 1.7 nm.
D. Two or more aircraft in the same direction from the interrogator with a difference in slant range of less than 1.7 nm.

SSR 30.
Which statement with respect to interrogation modes is correct?

A. Mode S only all-call will trigger transponder replies of all A/C/S transponders.
B. Mode S Selective will trigger replies of all mode S transponders. Mode A/C transponders are suppressed.
C. Intermode A/C/S all call and intermode A/C only all call, differ in the pulse spacing used between the P1 and P3 pulses.
D. Mode S Broadcast will transmit information to all mode S transponders.

SSR 31.
The accuracy of SSR height as displayed to the air traffic controller is

A. +/- 25 feet.
B. +/- 50 feet.
C. +/- 75 feet.
D. +/- 100 feet.

SSR 32.
Why do clouds not appear on the secondary radar screens

A. Too low a frequency.
B. Too high a frequency.
C. The transmit and receive signals are on different frequencies.
D. They do not provide an echo by returning signals.

SSR 33.
SSR is not affected by weather clutter because?

A. The frequency used penetrates clouds.
B. It uses different frequencies for transmission and reception.
C. The equipment uses a moving target indicator.
D. The wavelength is too short to be reflected from cloud droplets.

SSR 34.
What most affects the range available from secondary surveillance radar?

A. The RRP.
B. The transmission power of the aircraft interrogator.
C. The transmission power of the ground interrogator.
D. The height of the aircraft and the height of the ground interrogator.

SSR 35.
The spacing between two pulses transmitted by an SSR interrogator decides?

A. What mode is used.
B. The ATC code to be sent to the aircraft.
C. The identification of the SSR.
D. What service may be provided by the SSR.

SSR 36.
With regard to SSR?

A. The interrogator is on the ground and the transponder is on the ground.
B. The interrogator is on the ground and the transponder is in the aircraft.
C. The interrogator is in the aircraft and the transponder is on the ground.
D. The interrogator is in the aircraft and the transponder is in the aircraft.

SSR 37.
Why is the effect of returns from storms not a problem with SSR?

A. The PRF is jittered.
B. The frequency is too high.
C. SSR does not use the echo principle.
D. By the use of MTI to remove stationary and slow moving returns.

SSR 38.
SSR in ATC use?

A. Replaces primary radar.
B. Uses primary radar techniques.
C. Is complementary to primary radar.
D. Suffers from greater attenuation than primary radar, due to the higher frequencies used.

SSR 39.
When both SSR and primary radar is presented on the controller's display?

A. Altitude information is presented for all targets.
B. The SSR information is more accurate in bearing and distance.
C. The primary radar information is more accurate in bearing and distance.
D. The primary radar information is superfluous.

SSR 40.
With SSR interrogation and response signals?

A. Are separated by 63 MHz.
B. Are at variable frequencies set by the controller but are always 63 Mhz apart.
C. Must be set by the pilot but are always 63 Mhz apart.
D. Are standard frequencies separated by 60 MHz.

SSR 41.
What SSR modes are frequently used by ATC

A. Mode C and mode D.
B. Mode A and mode B.
C. Mode A and mode C.
D. Mode A, mode B and mode C.

SSR 42.
Data transmission and exchange is conducted on?
A. Mode A.
B. Mode D.
C. Mode C.
D. Mode S.

SSR 43.
A mode S transponder will?

A. Not respond to interrogations on mode A.
B. Respond normally to mode A or C interrogations.
C. Respond to mode A interrogations but not to mode C.
D. Not respond to modes A or C because it is on a different frequency.

SSR 44.
Which of the following statements regarding Mode S is most correct?

A. Mode S and Mode A/C transponders use different frequencies in operation.
B. Mode S is used to assist GPS calculations.
C. Mode S transponders are used with the radio altimeter.
D. Mode S transponders reduce R/T traffic and also provide the aircraft with a datalink facility.

SSR 45.
In SSR, the interrogations use different modes. If altitude reporting is required, the aeroplane's transponder should be set to "ALT" and will respond to?

A. Mode C interrogations only.
B. Mode A interrogations only.
C. Mode A and C interrogations.
D. Mode C and Ident interrogations.

SSR 46.
Which statement regarding Mode S transponders is most correct?

A. Mode S transponders are used with TCAS II.
B. Mode S transponders are used to assist GPS positioning.
C. Mode S and mode C transponders operate on different frequencies.
D. Mode S transponders reduce R/T traffic and provide a datalink facility.

SSR 47.
When a Mode C check is carried out, and assuming the equipment is working without error, the Mode C will report a pressure altitude of 35 064 feet as?

A. FL350.
B. FL35064.
C. FL3506.
D. FL351.

SSR 48.
When a Mode C interrogation is responded to, vertical position of the aircraft is encoded and transmitted. This vertical position is referred to?

A. 1013.2 hPa.
B. Area QNH.
C. The sub-scale setting on the altimeter.
D. Any of the above as directed by ATC.

SSR 49.
Selection of Mode C on the SSR provides ATC with information based on?

A. Aircraft height above QFE.
B. Aircraft pressure altitude.
C. Aircraft height above the surface.
D. Aircraft altitude as indicated on the captain's altimeter.

SSR 50.
The SSR code for a total radio failure is?

A. 7500.
B. 7600.
C. 7500 plus mode C.
D. 7600 plus mode C.

SSR 51.
If an aircraft is hijacked it is recommended that the pilot sets transponder code?

A. 7700.
B. 7500.
C. 7600.
D. 0000.

SSR 52.
The SSR conspicuity code is?

A. 7000.
B. 2000.
C. 0033.
D. 760.

SSR 53.
When an aircraft is operating its secondary surveillance radar SSR in Mode C an air traffic controller's presentation gives information regarding the aircraft's indicated flight level in increments of?

A. 100 ft.
B. 150 ft.
C. 200 ft.
D. 250 ft.

SSR 54.
The SSR transceiver interrogates on … and receives on …?

A. 1030 MHz 1030 MHz.
B. 1090 MHz 1090 MHz.
C. 1090 MHz 1030 MHz.
D. 1030 MHz 1090 MHz.

SSR 55.
The vertical position provided by SSR Mode C is referenced to?

A. QNH.
B. WGS 84 Datum.
C. 1013.2 hPa.
D. QNH unless QFE is in use.

SSR 56.
What are the frequencies used for interrogation and response for SSR?

A. 1090 MHz for interrogation from the ground, 1030 MHz for response from aircraft.
B. 1090 MHz for interrogation from the ground, 1090 MHz for response from aircraft.
C. 1030 MHz for interrogation from the ground, 1030 MHz for response from aircraft.
D. 1030 MHz for interrogation from the ground, 1090 MHz for response from aircraft.

SSR 57.
With normal SSR Mode A coding the aircraft replies by sending back a train of 12 pulses contained between 2 framing pulses with?

A. Up to 4096 codes in 4 boxes.
B. Up to 2048 codes in 4 boxes.
C. Up to 4096 codes in 12 boxes.
D. Up to 4096 code in 8 boxes.

SSR 58.
The transponder code set in an SSR system consists of?

A. 4 digits, forming any of 7777 different codes.
B. 4 digits, forming any of 4096 different codes.
C. 4 digits, forming any of 9999 different codes.
D. 2 digits and 2 letters, forming any of 4096 different codes.

SSR 59.
What SSR Mode A code should be selected when entering European airspace from an area where no code has been allocated?

A. 0000.
B. 2000.
C. 7000.
D. 7500.

SSR 60.
Consider the following statements on SSR Mode S?

A. Mode S will have the ability to transmit short messages from the ground to a particular aircraft.
B. A Mode S interrogator, when installed, will also collect data from old Mode A and C transponders.
C. Mode S will be able to address any particular one of some 16 million aircraft.
D. All of the statements are correct.

SSR 61.
The availability of 4096 codes in SSR is applicable to Mode?

A. A.
B. C.
C. S.
D. All of the answers are correct.

SSR 62.
A radar which employs an interrogator/transponder technique is?

A. Primary radar.
B. Doppler radar.
C. Secondary radar.
D. Continuous wave radar.

SSR 63.
What information may be displayed on an ATC radar screen connected only to a primary radar system?

A. Aircraft altitude.
B. Aircraft positions only.
C. Aircraft positions and SSR code.
D. Aircraft position, SSR code and altitude.

SSR 64.
"Fruiting" is caused by?

A. Aeroplanes in close proximity responding to the same interrogator.
B. Doppler effect on targets moving radially towards or away from the SSR.
C. An aeroplane's transponder responding to side lobes or reflections of the interrogation signal.
D. Aeroplanes at range responding to interrogations from another ATC SSR units.

SSR 65.
Garbling is caused by?

A. Aeroplanes in close proximity responding to the same interrogator.
B. Doppler effect on targets moving radially towards or away from the SSR.
C. An aeroplane's transponder responding to side lobes or reflections of the interrogation signal.
D. Aeroplanes at range responding to interrogations from another ATC SSR units.

SSR 66.
In the SSR terminology "de-fruiting" means?

A. Removing all different colours from the display, making it a mono-colour display.
B. The removal from the display of random responses.
C. Displaying only aeroplanes changing altitude.
D. Displaying only aeroplanes with a selected destination.

SSR 67.
On a typical computer generated SSR display the following data on a particular flight will be shown?

A. Squawk code, flight level, true heading, aeroplane callsign.
B. Squawk code, magnetic heading, ground speed, aeroplane callsign.
C. Squawk code, flight level, ground speed, aeroplane callsign.
D. Destination, flight level, ground speed, aeroplane callsign.

SSR 68.
In special conditions signals, to signify radio failure, which of the following codes should you select on your transponder?

A. IDENT.
B. 7500.
C. 7600.
D. 7700.

SSR 69.
When the ATC transponder "IDENT" button is pressed by the pilot?

A. Mode A will automatically be selected.
B. The controller will be urged to identify the aeroplane.
C. The aeroplane's identification will be sent to all SSR within range.
D. The aeroplane's echo on the controller's display will flash or "fill in".

SSR 70.
In the SSR response, the operation of the transponder ident button?

A. Sends out a special pulse in the X position in the pulse train.
B. Sends out a special pulse before the normal pulse train.
C. Sends out a special pulse after the normal pulse train.
D. Transmits the aeroplane's registration or flight number as a data sequence.

EFIS 1.
In an Electronic Flight Instrument System (EFIS) data relating primarily to navigation is provided by:

A. Navigation radios. Flight Management Computer. Inertial Reference Systems.
B. Inertial Reference Systems. Aircraft Mapping Radar. Navigation radios.

C. Flight Management Computer. Aircraft Mapping Radar. Navigation radios.
D. Inertial Reference Systems. Navigation radios. True airspeed and drift inputs.

EFIS 2.
How does the Electronic Flight Instrument System display of a B737-400 respond to the failure of a VHF navigation (VOR) receiver?

A. The pointer rotates around the display and a VOR 1 or 2 failure warning bar Appears.
B. It removes the associated magenta deviation bar and/or pointer from the display.
C. The deviation bar and/or pointer change colour to red and flash intermittently.
D. The pointer flashes and a VOR 1 or 2 failure warning bar appears.

EFIS 3.
Which component of the B737-400 Electronic Flight Instrument System generates the visual displays on the EADI and EHSI?

A. Symbol Generator.
B. Flight Management Computer.
C. Flight Control Computer.
D. Navigation database.

EFIS 4.
Under JAR-25 colour code rules, features displayed in red on an Electronic Flight Instrument System (EFIS), indicate:

A. Flight envelope and system limits; engaged modes.
B. Warnings; cautions and abnormal sources.
C. Cautions and abnormal sources; engaged modes.

EFIS 5.
Under JAR-25 colour code rules, features displayed in amber/yellow on an Electronic Flight Instrument System (EFIS), indicate:

A. Cautions, abnormal sources.
B. Flight envelope and system limits.
C. Warnings.
D. Engaged modes.

EFIS 6.
Under JAR-25 colour code rules, features displayed in green on an Electronic Flight Instrument System (EFIS), indicate:

A. Cautions, abnormal sources.
B. Engaged modes.

C. The earth.
D. The ILS deviation pointer.

EFIS 7.
Under JAR-25 colour code rules features displayed in cyan/blue, on an Electronic Flight Instrument Systems (EFIS), indicate:

A. Engaged modes.
B. The sky.
C. The flight director bar(s).
D. Flight envelope and system limits.

EFIS 8.
Under JAR-25 colour code rules for Electronic Flight Instrument Systems (EFIS), current data and values are coloured:

A. Cyan.
B. Red.
C. White.
D. Magenta.

EFIS 9.
Under JAR-25 colour code rules for Electronic Flight Instrument Systems (EFIS), armed modes are coloured:

A. White.
B. Green.
C. Magenta.
D. Amber/yellow.

EFIS 10.
Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in Expanded (EXP) VOR/ILS mode with an ILS frequency selected?

A. Figure 2.
B. Figure 3.
C. Figure 4.
D. Figure 1.


Figure 1


Figure 2

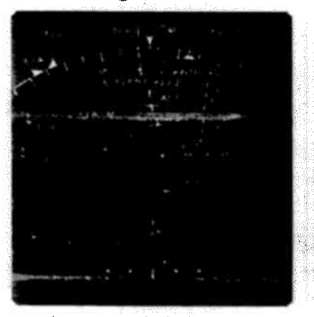


Figure 3

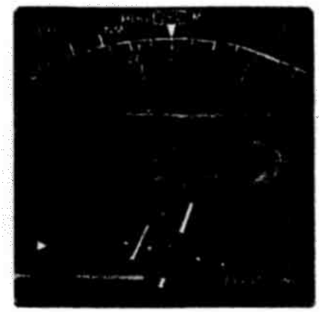


Figure 4

EFIS 11.
For this question use the diagram in question EFIS 10.

Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in Expanded (EXP) VOR/ILS mode with a VOR frequency selected?

A. Figure 1.
B. Figure 4.
C. Figure 2.
D. Figure 3.

EFIS 12.
Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in FULL VOR/ILS mode with an VOR frequency selected?

A. Figure 1.
B. Figure 2
C. Figure 3.
D. Figure 4.

Figure 1

Figure 2

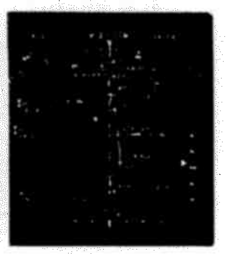


Figure 3

Figure 4

Figure 5

Figure 6

<u>EFIS 13.</u>
For this question use the diagram in question EFIS 12.

Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in PLAN mode?

A. Figure 3.
B. Figure 4.
C. Figure 2.
D. Figure 1.

<u>EFIS 14.</u>
For this question use the diagram in question EFIS 12.

Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in MAP mode?

A. Figure 3.
B. Figure 4.
C. Figure 1.
D. Figure 2.

<u>EFIS 15</u>
For this question use the diagram in question EFIS 12.

Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in Expanded (EXP) VOR/ILS mode with an VOR frequency selected?

A. Figure 1.
B. Figure 4.
C. Figure 2.
D. Figure 3.

<u>EFIS 16</u>
For this question use the diagram in question EFIS 12.

Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in Expanded (EXP) VOR/ILS mode with an ILS frequency selected?

A. Figure 5.
B. Figure 6.
C. Figure 2.
D. Figure 3.

<u>EFIS 17</u>
For this question use the diagram in question EFIS 12.

Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in FULL VOR/ILS mode with an ILS frequency selected?

A. Figure 2.
B. Figure 3.
C. Figure 5.
D. Figure 6.

<u>EFIS 18.</u>
(For this question use annex 062-9905A) use diagram 1

Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in MAP mode?

A. Figure 3.
B. Figure 4.
C. Figure 1.
D. Figure 2.

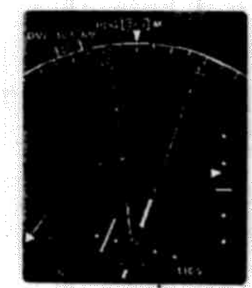


Figure 1

Figure 2

Figure 3

Figure 4

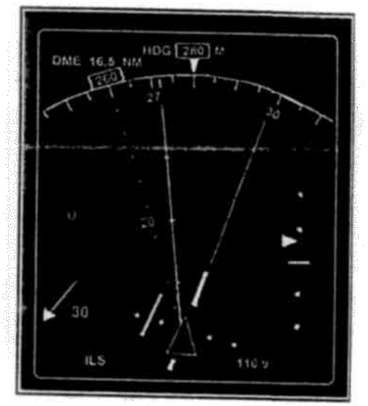
EFIS 19.
For this question use the diagram in question EFIS 10.

Which of the figures depicts an Electronic Flight Instrument System (EFIS) display in PLAN mode?

A. Figure 3.
B. Figure 4.
C. Figure 1.
D. Figure 2.

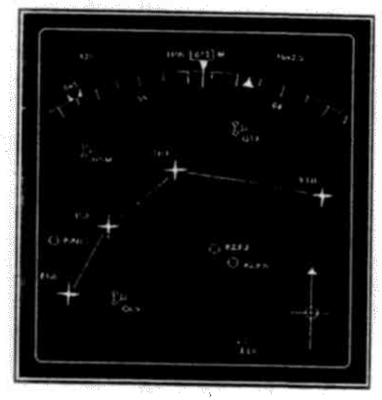
EFIS 20.
What drift is being experienced in the diagram below?

A. 20° Right.
B. 8° Left.
C. 20° Left.
D. 12° Right.



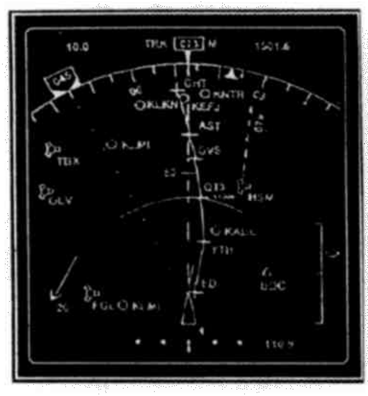
EFIS 21.
What is the value of the track from TBX to YTB in the diagram below?

A. 170°(M).
B. 097°(T).
C. 140°(M).
D. 280°(T).



EFIS 22.
What wind velocity is indicated in the diagram below?

A. 105°(M)/20KT.
B. 030°(M)/20KT.
C. 255°(M)/20KT.
D. 285°(M)/20KT.



EFIS 23.
What is the value of the selected course in the diagram below?

A. 272°(M).
B. 299°(M).
C. 260°(M).
D. 280°(M).

EFIS 24.
What is the instantaneous aircraft track in the diagram in question EFIS 23?

A. 272°(M).
B. 300°(M).

C. 260°(M).
D. 280°(M).

EFIS 25.
For this question use the diagram in question EFIS 21.

The letters QTX and adjacent symbol indicate a?

A. TACAN.
B. VOR.
C. Airport.
D. VOR/DME.

EFIS 26.
For this question use the diagram in question EFIS 22.

The 'O' followed by the letters 'KABC' indicate?

A. An off-route airport.
B. A designated alternate airport.
C. An off-route VOR/DME.
D. The destination airport.

EFIS 27.
For this question use the diagram in question EFIS 23.

What is the manually selected heading?

A. 272°(M).
B. 260°(M).
C. 280°(M).
D. 300°(M).

EFIS 28.
For this question use diagram in question EFIS 23.

The diagram indicates that the aircraft is to the?

A. Right of the localizer and below the glide path.
B. Right of the localizer and above the glide path.
C. Left of the localizer and below the glide path.
D. Left of the localizer and above the glide path.

EFIS 29.
Under JAR-25 colour code rules for Electronic Flight Instrument Systems (EFIS), selected data and values are coloured:

A. White.
B. Green.
C. Magenta.
D. Yellow.

EFIS 30.
Under JAR-25 colour code rules for Electronic Flight Instrument Systems (EFIS), a selected heading is coloured:

A. Green.
B. Magenta.
C. White.
D. Yellow.

EFIS 31.
Under JAR-25 colour code rules for Electronic Flight Instrument Systems (EFIS), the active route/flight plan is coloured:

A. Green.
B. Yellow.
C. Cyan.
D. Magenta.

EFIS 32.
Under JAR-25 colour code rules for Electronic Flight Instrument Systems (EFIS), increasing intensity of precipitation are coloured in the order:

A. Green, red, magenta, black.
B. Black, amber/yellow, magenta, red.
C. Green, amber/yellow, red, magenta.
D. Amber/yellow, magenta, black.

EFIS 33.
Under JAR-25 colour code rules for Electronic Flight Instrument Systems (EFIS), turbulence is coloured:

A. White or magenta.
B. Red.
C. Black.
D. Cyan.

FMS 1.
The Flight Management System (FMS) is organised in such a way that?

A. The pilot is able to modify the navigation database in the FMC between two updates.
B. The navigation database of the FMC is created by the pilot.
C. The navigation database of the FMC is valid for one year.
D. The navigation database is read only to the pilot.

FMS 2.
In the Flight Management Computer (FMC) of the Flight Management System (FMS), data relating to waypoints is stored in the?

A. Performance database.
B. Navigation database.
C. Auto flight database.
D. Air data computer.

FMS 3.
A FMS with only a multiple DME sensor operating shall have a position error, 95% probability, in a non-precision approach equal to or less than?

A. 0.3 nm.
B. 0.5 nm.
C. 0.06 nm.
D. 1 nm.

FMS 4.
The Flight Management System (FMS) is organised in such a way that the pilot can?

A. Insert navigation data between two database updates.
B. Read and write at any time in the database.
C. Modify the database every 14 days.
D. Modify the database between two updates.

FMS 5.
In what piece of FMS equipment will the pilot enter the waypoint information for the route?

A. The Primary Flight Display (PFD).
B. The Symbol Generator.
C. The Navigation Display (ND).
D. The Control Display Unit (CDU).

FMS 6.
Which of the following are stored in the navigation database of the Flight Management System (FMS)?

1. Waypoints.
2. Details of radio navigation aids.
3. Optimum altitudes.
4. Company routes.
5. Landing reference speeds.

A. 1, 2, 3.
B. 2, 4, 5.
C. 1, 2, 3, 4.
D. 1, 2, 4.

FMS 7.
The Control Display Unit (CDU) on an FMS is?

A. Used by the crew to input data to the FMC.
B. The autopilot control panel.
C. Used on the ground only to monitor the maintenance procedures.
D. The system used to update the navigation database.

FMS 8.
On a modern commercial aircraft, the FMS provides?

A. Lateral and vertical navigation, and guidance and performance management.
B. Traffic alert information.
C. A 3D area navigation and an air/ground datalink.
D. An air/ground datalink.

FMS 9.
The FMS navigation database usually contains:

1. Airport reference data.
2. ATC frequencies.
3. Company routes.
4. Nav aid frequencies.

The combination regrouping all of the correct statements is?

A. 1 and 3.
B. 1, 2 and 3.
C. 1, 2, 3 and 4.
D. 1, 3 and 4.

FMS 10.
What is Cross Track Distance (XTK distance) in an Area Navigation System?

A. Distance between the actual position and great circle track between active waypoints.

B. Distance between the actual position and next waypoint.
C. Distance between the air position and great circle track between active waypoints.
D. Distance between the air position and the planned track.

FMS 11.
Area Navigation is a method of navigation that permits aircraft operation on any desired flight path within the limits of the capability of self-contained systems. Which of the following systems is such a self-contained system?

A. VOR/DME system.
B. DME/DME system.
C. Global Positioning System.
D. Inertial reference system.

FMS 12.
Output from which of the following combination of navigation sources provides enough information to the RNAV equipment to calculate the wind vector?

A. Inertial reference system and the air data computer.
B. Inertial reference system and the Global Positioning System.
C. Compass system and the inertial reference system.
D. Global positioning system and the compass system.

FMS 13.
By which of the following flight deck equipment are the waypoints inserted into an FMS RNAV system by the pilot?

A. Course Deviation Indicator.
B. Control Display Unit.
C. Symbol Generator.
D. Navigation Display.

FMS 14.
On modern passenger aircraft, the navigation database usually contains?

A. Airport reference data.
B. ATC frequencies.
C. Aircraft performance data.
D. Obstacle altitudes.

FMS 15.
Which of the following data can be found in the navigation database?

1. SIDs and STARs.
2. Radio aids.
3. Optimum flight levels.

4. Company routes.
5. Cruise speeds.

A. Only 2, 3 and 4.
B. Only 2, 3 and 5.
C. Only 1, 2 and 4.
D. 1, 2, 3, 4 and 5.

FMS 16.
Which of the following data can be found in the performance database?

1. SIDs and STARs.
2. Radio aids.
3. Optimum flight levels.
4. Company routes.
5. Cruise speeds.

A. Only 2, 3 and 4.
B. Only 2, 3 and 5.
C. Only 3 and 5.
D. 1, 2, 3, 4 and 5.

RNAV 1.
Which of the following statements regarding B-RNAV is correct?

A. For 95% of the flight time, the track keeping accuracy must not exceed 5 nm.
B. B-RNAV is only applicable when flying in TMAs.
C. In case of B-RNAV, RNP1 is required.
D. B-RNAV can be used up to FL95. Above FL95 P-RNAV is required.

RNAV 2.
Which statement about RNAV is correct?

A. RNAV routes are only used in terminal areas in order to make more efficient use of the approach and landing facilities of an airport.
B. A method of navigation which permits aircraft operation on any desired flight path.
C. In general RNAV routes coincide with standard route in order to make optimum use of the available VOR/DME stations.
D. All waypoints of RNAV routes are called phantom stations.

RNAV 3.
The IRS is a self-contained system because?

A. It operates independently of navigational aids outside the aircraft.
B. It operates off its own power supply.
C. The calculation of the position does not require any software.

D. The system generates a warning in case of a failure.

RNAV 4.
One of the benefits of RNAV is?

A. RNAV allows aircraft to take a more direct flight path without requiring to fly over ground based facilities.
B. RNAV allows aircraft to fly at RNAV flight levels with a 500 ft separation.
C. RNAV allows pilots to manage horizontal and vertical separation with other aircraft without obtaining ATC clearance.
D. RNAV allows to obtain ATC clearance by HF radio without the requirement to establish any radio contact.

RNAV 5.
Which component of an Area Navigation System displays the Cross Track Distance?

A. Attitude Display.
B. DME Indicator.
C. Navigation Display.
D. Radio Magnetic Indicator.

RNAV 6.
A 3-dimensional RNAV system has capability in?

A. The horizontal plane and the cruise management system.
B. The horizontal plane and the sped management system.
C. The horizontal plane, the vertical plane, and the timing function.
D. The horizontal plane and the vertical plane.

RNAV 7.
The navigational function of the horizontal situation indicator (HSI) in relation to area navigation systems is?

A. The indication of the cross track distance (XTK).
B. The indication of the RNP.
C. The indication of the wind component.
D. The indication of the cross track angle error (TKE)

RNAV 8.
What is true about the FMC database?

A. The data can be customised for the specific airline operations.
B. The navigation database contains the company's cost index strategy.
C. The performance database contains aeronautical information for the planned area of operations of the aircraft.
D. The data includes SIDs, STARs, and runway approaches.

RNAV 9.
Concerning FMC databases?

A. The navigation database may be customised for the specific airline operations.
B. Only the performance database may be customised by the company.
C. Only the navigation database may be customised for the company's cost index strategy.
D. Company databases and FMC databases can not be used at the same time.

RNAV 10.
Which of the following gives the best information about the progress of a flight between 2 en-route waypoints from a RNAV equipment?

A. ETO.
B. ETD.
C. ATA.
D. Elapsed time on route.

RNAV 11.
The Flight Management Computer (FMC) position is:

A. The actual position of the aircraft at any point in time.
B. The computed position based on a number of sources (IRS, Radio, ILS, GPS etc)
C. The same as that given on the No. 1 IRS.
D. Another source of aircraft position; it is independent of other position sources (IRS, Radio, ILS etc).

RNAV 12.
The track-line on the Electronic Horizontal Situation Indicator (EHSI) or Navigation Display of an Electronic Flight Instrument System:

A. Corresponds to the calculated IRS TH and is correct during turns.
B. Indicates that the pilot has made a manual track selection.
C. Indicates to the pilot that a manually selected heading is being flown.
D. Represents the track of the aircraft over the ground. When it coincides with the desired track, wind influence is compensated for.

RNAV 13.
In which of the following cases would ETOs and ETA at destination calculated by the Flight Management Computer (FMC) be correct?

A. When the FMC computes each ETO and ETA using the correct GS
B. When the actual winds match the forecast winds, and the actual cruising Mach number is equal to the FMC calculated Mach number
C. When the FMC positions and GS are accurate

D. When the ETOs and ETA are based on the forecast winds calculated from the actual take-off time

RNAV 14.
Radar returns, on a B737-400, can be displayed on all Electronic Horizontal Situation Indicator (EHSI) screen modes of an Electronic Flight Instrument System (EFIS) WITH THE EXCEPTION OF:

A. FULL NAV, FULL VOR/ILS and PLAN.
B. EXP VOR/ ILS, PLAN and MAP.
C. FULL NAV, PLAN and MAP.
D. FULL VOR/ILS, EXP VOR/ILS and PLAN.

RNAV 15.
The database of an FMS (Flight Management System) is organised in such a way that the pilot can:

A. Only read the database.
B. Insert navigation data between two updates.
C. Can modify the database every 28 days.
D. Read and write at any time in database.

RNAV 16.
Which of the following combinations is likely to result in the most accurate Area Navigation (RNAV) fixes?

A. DME/DME.
B. VOR/DME.
C. NDB/VOR.
D. VOR/VOR.

RNAV 17.
ICAO Annex 11 defines Area Navigation (RNAV) as a method of navigation which permits aircraft operation on any desired flight path:

A. Within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.
B. Outside the coverage of station-referenced navigation aids provided that it is equipped with a minimum of one serviceable self-contained navigation aid.
C. Within the coverage of station-referenced navigation aids provided that it is equipped with a minimum of one serviceable self-contained navigation aid.
D. Outside the coverage of station-referenced navigation aids provided that it is equipped with a minimum of two serviceable self-contained navigation aids.

RNAV 18.
Precision RNAV (P-RNAV) requires a track-keeping accuracy of:

A. 0.25 NM standard deviation or better.
B. 1.0 NM standard deviation or better.
C. 1.5 NM standard deviation or better.
D. 0.5 NM standard deviation or better.

RNAV 19.
Basic RNAV requires a track-keeping accuracy of:

A. +/- 3NM or better for 90% of the flight time.
B. +/- 2NM or better for 75% of the flight time.
C. +/- 5NM or better for 95% of the flight time.
D. +/- 5NM or better throughout the flight.

RNAV 20.
Which one of the following inputs to an Area Navigation System (R-NAV) comes from an external, not on-board, system?

A. VOR/DME radial/distance.
B. Magnetic heading.
C. Inertial Navigation System (INS) position.
D. Pressure altitude.

RNAV 21.
Which one of the following sensors/systems is self-contained and obtains no external information?

A. Pressure altitude.
B. Inertial Navigation System (INS) position.
C. Magnetic heading.
D. VOR/DME radial/distance.

RNAV 22.
In relation to Area Navigation Systems (RNAV), which of the following is an Air Data input?

A. True airspeed.
B. Inertial Navigation System (INS) position.
C. VOR/DME radial/distance.
D. Doppler drift.

RNAV 23.
In order to enter a waypoint that is designated by a VOR into an RNAV, the VOR:

A. Does not have to be in range when entered or used.
B. Must be in range.
C. Has to be positively identified by one of the pilots.
D. Does not have to be in range when entered but must be when used.

RNAV 24.
Which of the following statements is true for a basic Area Navigation System?

A. The VHF NAV frequency is tuned and the equipment automatically selects the paired DME frequencies.
B. The VOR/DME Area Navigation System has its own VHF NAV tuner and it always tunes the DME stations closest to the aircraft.
C. The VOR/DME Area Navigation System uses whatever stations are tuned on the aircraft's normal VHF radio.
D. The pilot tunes the closest VOR/DME stations within range of the VOR/DME Area Navigation System.

RNAV 25.
When the Area Navigation system is coupled to an FMS, the VOR/DME tuner provides DME information by?

A. Tuning the VOR station selected and automatically tuning the paired DME frequency.
B. Automatically tuning to the two DME,s that are within range and that provide the best fixing geometry.
C. Automatically tuning the 2 closest DME beacons.
D. Tuning the frequencies that have previously been put into the system by the pilot during the pre flight setting up process.

RNAV 26.
Which one of the following lists information given by a basic VOR/DME-based Area Navigation System?

A. Crosstrack distance; along track distance; angular course deviation.
B. Aircraft position in latitude and longitude.
C. Wind velocity.
D. True airspeed; drift angle.

RNAV 27.
Which of the following lists information required to input a waypoint or 'Phantom Station' into a basic VOR/DME-based Area Navigation System?

A. Magnetic track and distance from the aircraft to the waypoint or 'Phantom

Station'.

B. Magnetic track and distance to a VOR/DME from the waypoint or 'Phantom Station'.

C. Radials from a minimum of two VORs to the waypoint or 'Phantom Station'.

D. Radial and distance from a VOR/DME to the waypoint or 'Phantom Station'.

RNAV 28.

Erratic indications may be experienced when flying towards a basic VOR/DME-based Area Navigation System 'Phantom Station':

A. Because, under adverse conditions (relative bearing to the Phantom Station other than 180°/360°) it takes the computer more time to calculate the necessary information.

B. When operating at low altitudes close to the limit of reception range from the reference station.

C. When in the cone of silence overhead the Phantom Station.

D. When the Phantom Station is out of range.

RNAV 29.

What is the deviation per dot on the HSI when using a 2-dot basic RNAV system in the en-route mode?

A. 5 NM.

B. 1 NM.

C. 2 NM.

D. 10 NM.

RNAV 30.

What is the deviation per dot on the HSI when using a 2-dot RNAV system in the approach mode?

A. 0.5°.

B. 10°.

C. 0.5 NM.

D. 10 NM.

RNAV 31.

Which of the following is one of the functions of the Course-Line-Computer in a basic Area Navigation (RNAV) system?

A. It checks the ground station accuracy using a built-in test programme.

B. It automatically selects the two strongest transmitters for the Area-Nav-Mode and continues working by memory in case one of the two necessary station goes off the air.

C. It calculates cross track information for NDB approaches.

D. It transfers the information given by a VOR/DME station into tracking and

distance indications to any chosen Phantom Station/waypoint.

RNAV 32.

A 3D RNAV system has capability in?

A. A horizontal plane and the vertical plane.

B. A horizontal plane and speed management system.

C. A horizontal plane and cruise management system.

D. A horizontal plane, and vertical plane and timing function.

RNAV 33.

What is the cross track deviation (XTK) indicated on an RNAV system?

A. The distance along a track between two waypoints.

B. The distance between the actual position and the great circle track between two active waypoints.

C. The distance between the air position and the planned track.

D. The distance between the air position and the great circle track between two active waypoints.

RNAV 34.

In a 2D RNAV system you have entered the DME and VOR data from two waypoints. What do you use to work out the cross track errors when an-route from one to the other?

A. Use the automatically computed values on the CDI/HSI.

B. The pilot is presented with VOR/DME information which must then be correlated to the pressure instruments to determine the effect of altitude.

C. The pilot takes VOR and DME information and computes it himself.

D. The pilot will have to calculate the wind and apply it to the VOR/DME information.

RNAV 35.

Precision RNAV (P-RNAV) requires a track-keeping accuracy of?

A. Plus or minus 5.0 nm for 95% of the flight time.

B. Plus or minus 8.0 nm for 95% of the flight time.

C. Plus or minus 10.0 nm for 95% of the flight time.

D. Plus or minus 1.0 nm for 95% of the flight time.

RNAV 36.

On what data is a VOR/DME Area Navigation System operating in the dead reckoning mode?

A. TAS from the Air Data Computer, heading from the compass.

B. TAS from the Air Data Computer, heading from the compass and the last computed W/V.

C. Radial from one VOR and distance from tow DME.
D. Radial from one VOR, distance from two DME, TAS from the air data computer, heading from the compass.

RNAV 37.
3D RNAV fixing gives you?

A. Horizontal and vertical profile guidance.
B. 2D RNAV plus time guidance.
C. Horizontal, vertical and time guidance.
D. 2D RNAV plus speed control.

RNAV 38.
When entering and using a phantom waypoint in area navigation equipment you?

A. Don't need to be within range of the referenced station to enter the waypoint but you must be to use it.
B. The referenced station must be positively identified but at least 1 pilot.
C. Don't need to be in range of the referenced station to enter or use it.
D. Must be in range of the referenced station to enter or to use it.

RNAV 39.
Which statement is true regarding a compass when directly overhead the north magnetic pole?

A. The compass tail points down.
B. The magnetic variation is 90 degrees.
C. The compass tip will point directly down.
D. The horizontal component of the earth's magnetic field is horizontal.

RNAV 40.
Which of the following gives the best information about the progress of a flight between 2 en-route waypoints from a RNAV equipment?

A. ETO.
B. ETD.
C. ATA.
D. Elapsed time en route.

RNAV 41.
The skip distance of HF-transmission will increase with?

A. Higher frequency and lower position of the reflecting ionospheric layer.
B. Lower frequency and higher position of the reflecting ionospheric layer.

C. Higher frequency and higher position of the reflecting ionospheric layer.
D. Lower frequency and lower position of the reflecting ionospheric layer.

RNAV 42.
From which of the following combination of navigation sources provide enough information to the RNAV equipment to calculate the wind vector?

A. Compass system and IRS.
B. GPS and compass output.
C. IRS and GPS.
D. IRS and air data computer.

RNAV 43.
Which one of the following sensors/systems is self-contained?

A. Inertial Navigation System.
B. Basic RNAV system.
C. VOR/DME.
D. GPS.

RNAV 44.
A pilot is flying between two waypoints defined by suitably located VOR/DMEs. Equipped with a simple 2D RNAV system, this pilot?

A. Enters relative position between his aircraft and the VOR/DMEs on the CDU to calculate the cross track error.
B. Must update any altitude change in RNAV system to have correct cross track error.
C. Reads VOR/DME bearing and distance on CDI or HSI to compute himself the cross track error.
D. Reads cross track error and the distance to go on CDI or HSI.

RNAV 45.
IRS is a self-contained system because?

A. The system has a battery back-up which guarantees the well-functioning of the system in case of power failure.
B. The system calculates the position of the aircraft without reference to externally generated (man made) signals.
C. The system has the ability to calculate the aircraft position with an accuracy comparable to the gaps position.
D. The system has the ability to calculate the position of the aircraft without reference to either man-made or natural information.

RNAV 46.
A 2-dimensional RNAV system has a capability in the?

A. Horizontal plane.
B. Vertical plane.
C. Horizontal and vertical planes.
D. Timing function.

RNAV 47.
The inputs of information used to achieve the RNAV required accuracy may be:

1. NDB.
2. IRS.
3. VOR/DME.
4. GNSS.

The combination regrouping all of the correct statements is?

A. 2 and 4.
B. 1, 2, 3 and 4.
C. 2, 3 and 4.
D. 1, 2 and 3.

RNAV 48.
Benefits of Area Navigation include:

1. Shorter flight distances.
2. Reduction in fuel and flight time.
3. No radio contact within RNAV airspace.
4. Reduction in the number of ground training facilities.
5. Pilot choice of vertical and horizontal separations.

The combination regrouping all the correct statements is?

A. 2, 4 and 5.
B. 3, 4 and 5.
C. 1, 2, 4 and 5.
D. 1, 2 and 4.

RNAV 49.
A phantom station (as used in a 2D RNAV system) is?

A. A waypoint defined by a radial and a DME distance from a VOR/DME station.
B. An existing VOR/DME station created in the memory of the navigation computer unit of the RNAV system.
C. A waypoint defined by two DME distances from two different VOR/DME stations.
D. A non-existing VOR/DME station defined by two DME distances.

RNAV 50.
Which of the following Nav Aids will provide an RNAV system with position?

A. NDB.
B. ADF.
C. VOR/DME.
D. VDF.

RNAV 51.
Kalman filtering is used within?

A. Navigation computer.
B. DME receiver.
C. Electronic Flight Instruments (EFIS).
D. VOR receiver.

RNAV 52.
Benefits of Area Navigation include:

1. Shorter flight distances.
2. Reduction in fuel and flight time.
3. No radio contact within RNAV airspace.
4. Improved safety due to more accurate navigation.
5. Pilot choice of vertical and horizontal separations.

The combination regrouping all the correct statements is?

A. 2, 4 and 5.
B. 3, 4 and 5.
C. 1, 2, 4 and 5.
D. 1, 2 and 4.

RNAV 53.
3D RNAV fixing gives you?

A. Horizontal and vertical profile guidance and time guidance.
B. 2D RNAV plus time guidance.
C. Horizontal, vertical and time guidance.
D. 2D RNAV plus speed control.

DOPPLER 1.
An apparent increase in the transmitted frequency which is proportional to the transmitter velocity will occur when:

A. The transmitter moves away from the receiver
B. The transmitter moves towards the receiver
C. The receiver moves towards the transmitter
D. Both transmitter and receiver move towards each other

DOPPLER 2.
~~The~~ Doppler Navigation System is based on:

A. Radio waves refraction in the ionosphere.
B. Doppler VOR (DVOR) Navigation System.
C. Phase comparison from ground station transmissions.
D. Based on Radar principle using this f_d. (frequency shift).

DOPPLER 3.
Due to 'Doppler' effect an apparent decrease in the transmitted frequency, which is proportional to the transmitter's velocity, will occur when:

A. The transmitter moves away from the receiver.
B. The transmitter and receiver move towards each other.
C. The transmitter moves toward the receiver.
C. Both transmitter and receiver move away from each other.

GNSS/GPS 1.
In a Satellite-Assisted Navigation system (GNSS/GPS) a position line is obtained by:

A. The aircraft's receiver measuring the phase angle of the signal received from a satellite in a known position.
B. Timing the period that is taken for a transmission from the aircraft's transmitter/receiver to reach and return from a satellite in a known position.
C. Timing the period that is taken for a satellite's transmission to reach the aircraft's receiver.
D. The aircraft's receiver measuring the time difference between signals received from a minimum number of satellites.

GNSS/GPS 2.
In which frequency band do Satellite-Assisted Navigation systems (GNSS/GPS) provide position information that is available to civil aircraft?

A. SHF.
B. UHF.
C. EHF.
D. VHF.

GNSS/GPS 3.
What is the minimum number of satellites required by a GPS in order to obtain a three dimensional fix?

A. 3.
B. 5.
C. 4.
D. 6.

GNSS/GPS 4.
What is the minimum number of satellites required for a Satellite-Assisted Navigation System (GNSS/GPS) to carry out two-dimensional operation?

A. 3.
B. 4.
C. 5.
D. 2.

GNSS/GPS 5.
Signal reception is required from a minimum number of satellites that have adequate elevation and suitable geometry in order for a Satellite-Assisted Navigation System (GNSS/GPS) to carry out independent three-dimensional operation, Receiver Autonomous Integrity Monitoring (RAIM) and to isolate any faulty satellite and remove it from contributing to the navigation solution. The number of satellites is:

A. 7.
B. 6.
C. 4.
D. 5.

GNSS/GPS 6.
Signal reception is required from a minimum number of satellites that have adequate elevation and suitable geometry in order for a Satellite-Assisted Navigation System (GPS) to carry out independent three-dimensional operation without the Receiver Autonomous Integrity Monitoring (RAIM) function. The number of satellites is:

A. 4.
B. 5.
C. 6.
D. 3.

GNSS/GPS 7.
Which of the following lists are all errors that affect the accuracy and reliability of the Satellite-Assisted Navigation system (GNSS/GPS)?

A. Satellite mutual interference; satellite ephemeris; atmospheric propagation.
B. Satellite clock; satellite ephemeris; atmospheric propagation.
C. Satellite to ground time lag; atmospheric propagation; satellite clock.
D. Satellite mutual interference; frequency drift; satellite to ground time lag.

GNSS/GPS 8.
In a Satellite-Assisted Navigation System (GNSS/GPS), a fix is obtained by:

A. Measuring the time taken for a minimum number of satellites' transmissions, in known positions, to reach the aircraft's receiver.

B. The aircraft's receiver measuring the phase angle of signals received from a number of satellites in known positions.
C. Measuring the time taken for an aircraft's transmissions to travel to a number of satellites, in known positions, and return to the aircraft's receiver.
D. Measuring the pulse lengths of signals received from a minimum number of satellites received in a specific sequential order.

GNSS/GPS 9.
GPS satellites transmit on two L-band frequencies with different types of signals.

Which of these are generally available for use by civil aviation?

A. L2-coarse acquisition (C/A).
B. L1-precise (P).
C. L1-coarse acquisition (C/A) with selected availability (S/A).
D. L2-for communications purpose.

GNSS/GPS 10.
Which of the following coordinate systems is used by the GPS receiver to determine position (Latitude, longitude and altitude)?

A. ED 87.
B. ED 50.
C. EUREF 92.
D. WGS 84.

GNSS/GPS 11.
Which of the following lists all the parameters that can be determined by a GPS receiver tracking signals from 4 different satellites?

A. Latitude and longitude.
B. Latitude, longitude and time.
C. Latitude, longitude and altitude.
D. Latitude, longitude, altitude and time.

GNSS/GPS 12.
Which of the following combinations of satellite navigation systems provide the most accurate position fixes in air navigation?

A. NAVSTAR/GPS and NNSS-Transit.
B. NAVSTAR/GPS and GLONASS.
C. NNSS-Transit and GLONASS.
D. GLONASS and COSPAS-SARSAT.

GNSS/GPS 13.
The required 24 NAVSTAR/GPS operational satellites are located on:

A. 6 orbital planes with 4 satellites in each plane.
B. 3 orbital planes with 8 satellites in each plane.
C. 4 orbital planes with 6 satellites in each plane.
D. 6 orbital planes with 3 satellites in each plane plus 6 reserve satellites positioned in a geostationary orbital plane.

GNSS/GPS 14.
Which of the following statements about the 'visibility' of NAVSTAR/GPS satellites is correct?

A. It is the same throughout the globe.
B. It is greatest at the equator.
C. It varies, depending on the time and observer's location.
D. It is greatest at the poles.

GNSS/GPS 15.
How many operational satellites are required for Full Operational Capability (FOC) of the satellite navigation system NAVSTAR/GPS?

A. 18.
B. 24.
C. 12.
D. 30.

GNSS/GPS 16.
GPS systems transmit their signals on two carrier waves 1575 MHz and 1227 MHz and supply two possible codes accessible according to user (civil or military). Commercial aviation uses?

A. Only the 1 575 MHz carrier wave and one code.
B. Only the 1 575 MHz carrier wave and two codes.
C. Only the 1 227 MHz carrier wave and one code.
D. The two carrier waves and one public code.

GNSS/GPS 17.
Which of the following satellite navigation systems has Full Operational Capability (FOC) and is approved for specified flights under IFR conditions in Europe?

A. NNSS-Transit.
B. COSPAS-SARSAT.
C. NAVSTAR/GPS.
D. GLONASS.

GNSS/GPS 18.
The basic elements of the satellite navigation system NAVSTAR/GPS are the:

A. Main control station, the monitoring station and the ground antennas.
B. Antenna, the receiver and the central control unit (CDU).
C. Atomic clock, power supply and transponder.
D. Control, space and user segments.

GNSS/GPS 19.
One of the tasks of the control segment of the satellite navigation system NAVSTAR/GPS is to:

A. Manufacture and launch the satellites.
B. Monitor the status of the satellites.
C. Manipulate the signals of selected satellites to reduce the precision of the position fix.
D. Grant and monitor user authorisations.

GNSS/GPS 20.
The main task of the user segment (receiver) of the satellite navigation system NAVSTAR/GPS is to calculate receiver position by:

A. Select appropriate satellites automatically, to track the signals and to measure the time taken by signals from the satellites to reach the receiver.
B. Transmit signals which, from the time taken, are used to determine the distance to the satellite.
C. To monitor the status of the satellites, determine their positions and to measure the time.
D. Monitor the orbital planes of the satellites.

GNSS/GPS 21.
One of the tasks of the space segment of the satellite navigation system NAVSTAR/GPS is to:

A. Transmit signals to suitable receivers and to monitor the orbital planes Autonomously.
B. Compute the user position from the received user messages and to transmit the computed position back to the user segment.
C. Monitor the satellites' orbits and status.
D. Transmit signals which can be used, by suitable receivers, to determine time, position and velocity.

GNSS/GPS 22.
The geometric shape of the reference system for the satellite navigation system NAVSTAR/GPS, defined as WGS 84, is:

A. A mathematical model that describes the exact shape of the earth.
B. A sphere.
C. An ellipsoid.
D. A geoid.

GNSS/GPS 23.
In civil aviation, the height value computed by the receiver of the satellite navigation system NAVSTAR/GPS is the:

A. Geometric height above ground.
B. Height above Mean Sea Level (MSL).
C. Height above the WGS-84 ellipsoid.
D. Flight level.

GNSS/GPS 24.
In relation to the satellite navigation system NAVSTAR/GPS, the term 'inclination' denotes the angle between the?

A. Horizontal plane at the location of the receiver and the direct line to a satellite.
B. Orbital plane and the equatorial plane.
C. Orbital plane and the earth's axis.
D. Horizontal plane at the location of the receiver and the orbital plane of a satellite.

GNSS/GPS 25.
How long does it take a NAVSTAR/GPS satellite to orbit the earth?

A. Approximately 12 hours (1/2 of a sidereal day).
B. Approximately 24 hours (one sidereal day).
C. 12 days.
D. 365 days because the satellites are located in a geostationary orbit.

GNSS/GPS 26.
At what approximate height above the WGS-84 ellipsoid are NAVSTAR/GPS satellites circling the earth?

A. 10900 km.
B. 36000 km.
C. 19500 km.
D. 20200 km.

GNSS/GPS 27.
The orbital planes of the satellite navigation system NAVSTAR/GPS are:

A. Inclined 55° to the equatorial plane.

B. Inclined 55° to the earth axis.
C. Inclined 90° to the equatorial plane.
D. Parallel to the equatorial plane.

GNSS/GPS 28.
In which frequency bands are the L1 and L2 frequencies used by the satellite navigation system NAVSTAR/GPS for transmission of the navigation message?

A. VHF.
B. EHF.
C. UHF.
D. SHF.

GNSS/GPS 29.
In relation to the satellite navigation system NAVSTAR/GPS, which of the following statements correctly describes the term 'Pseudo Random Noise (PRN)' signal?

A. PRN is the atmospheric jamming that affects the signals transmitted by the satellites.
B. PRN describes the continuous electro-magnetic background noise that exists in space.
C. PRN occurs in the receiver. It is caused by the signal from one satellite being received from different directions (multipath effect).
D. PRN is a code used for the identification of the satellites and the measurement of the time taken by the signal to reach the receiver.

GNSS/GPS 30.
Which of the following NAVSTAR/GPS satellite navigation system codes can be processed by 'unauthorised' civil aviation receivers?

A. P.
B. C/A.
C. C/A- and P.
D. P and Y.

GNSS/GPS 31.
Almanac data stored in the receiver of the satellite navigation system NAVSTAR/GPS is used for the:

A. Fast identification of received signals coming from visible satellites.
B. Recognition whether Selective Availability (SA) is operative.
C. Assignment of received PRN-codes (Pseudo Random Noise) to the appropriate satellite.
D. Correction of receiver clock error.

GNSS/GPS 32.
How does a NAVSTAR/GPS satellite navigation system receiver recognise which of the received signals belongs to which satellite?

A. The Doppler shift is unique to each satellite.
B. The receiver detects the direction from which the signals are received and compares this information with the calculated positions of the satellites.
C. Each satellite transmits its signal on a separate frequency.
D. Each satellite transmits its signal, on common frequencies, with an individual Pseudo Random Noise code.

GNSS/GPS 33.
Which of the following data, in addition to the Pseudo Random Noise (PRN) code, forms part of the so called 'Navigation Message' transmitted by NAVSTAR/GPS satellites?

A. Time; data to impair the accuracy of the position fix.
B. Almanac data; satellite status information.
C. Data to correct receiver clock error; almanac data.
D. Time; positions of the satellites.

GNSS/GPS 34.
In the NAVSTAR/GPS satellite navigation system, what is the maximum time taken to receive the complete set of almanac data from all satellites?

A. 12 hours (= period of the satellites orbit).
B. 25 seconds (= 1 second per data frame).
C. 12.5 minutes (= 30 seconds per data frame).
D. 24 seconds (= 1 second per data frame).

GNSS/GPS 35.
Which of the following statements concerning the L1 and L2 NAVSTAR/GPS transmission frequencies and codes is correct?

A. The higher frequency is used to transmit both the C/A and P codes.
B. C/A and P codes are transmitted at different times on both frequencies.
C. The higher frequency is only used to transmit the P code.
D. The lower frequency is used to transmit both the C/A and P codes.

GNSS/GPS 36.
Which one of the following errors can be compensated for by a NAVSTAR/GPS receiver comparing L1 and L2 frequencies?

A. Ionospheric.
B. Multipath.
C. Tropospheric.

D. Receiver noise.

GNSS/GPS 37.

Which of the following statements is correct concerning the principle behind the correction of one of the NAVSTAR/GPS satellite navigation system errors by the transmission of the signals on two frequencies (L1 and L2)?

A. The effect of receiver noise can be reduced due to the interference of both frequencies.
B. The effect of signal reflections (multipath effect) can be reduced due to the interference of both frequencies.
C. The path delay of the signals in the earth atmosphere is proportional to the inverse of the carrier frequency squared.
D. The influence of shadowing on the GPS signals is proportional to the inverse of the carrier frequency squared.

GNSS/GPS 38.

Concerning the NAVSTAR/GPS satellite navigation system, what is the meaning of the term 'Receiver Autonomous Integrity Monitoring' (RAIM)?

A. It is the ability of the GPS satellites to check the integrity of the data transmitted by the monitoring stations of the ground segment.
B. It is a technique by which a receiver checks the reliability of the signal it is receiving and can detect if one of the signals is incorrect.
C. It is a method whereby a receiver ensures the integrity of the Pseudo Random Noise (PRN) code transmitted by the satellites.
D. It is a technique whereby the receivers of the world-wide distributed monitor stations (ground segment) automatically determines the integrity of the navigation message.

GNSS/GPS 39.

The distance between a NAVSTAR/GPS satellite and receiver is:

A. Calculated from the Doppler shift of the known frequencies.
B. Calculated, using the WGS-84 reference system, from the known positions of the satellite and the receiver.
C. Determined by the time taken for the signal to arrive from the satellite multiplied by the speed of light.
D. Determined by the phase shift of the Pseudo Random Noise code multiplied by the speed of light.

GNSS/GPS 40.

In relation to the satellite navigation system NAVSTAR/GPS, 'All in View' is a term used when a receiver:

A. Is tracking more than the required 4 satellites and can instantly replace any lost signal with another already being monitored.

B. Is receiving the signals of all visible satellites but tracking only those of the 4 with the best geometric coverage.
C. Is receiving and tracking the signals of all 24 operational satellites Simultaneously.
D. Requires the signals of all visible satellites for navigation purposes.

GNSS/GPS 41.

The reason why the measured distance between a NAVSTAR/GPS satellite navigation system satellite and a receiver is called a 'Pseudo-Range' is because the:

A. Measured distance is based on the Pseudo Random Noise code.
B. Movement of satellite and receiver during the distance calculation is not taken into account.
C. Calculated range is based on an idealised Keplerian orbit.
D. Calculated range includes receiver clock error.

GNSS/GPS 42.

What type of satellite navigation system NAVSTAR/GPS receiver is most suitable for use on board an aircraft?

A. Sequential.
B. Multi-channel.
C. Multiplex.
D. Any hand held type.

GNSS/GPS 43.

What is the minimum number of NAVSTAR/GPS satellites required to produce an accurate independent 3-D position fix?

A. 4.
B. 5.
C. 24.
D. 3.

GNSS/GPS 44.

The receiver aerial for a NAVSTAR/GPS system should be mounted:

A. On the upper side of the fuselage in the vicinity of the centre of gravity.
B. Inside the tail fin to minimise the influence of reflections from the wing and Fuselage.
C. In the vicinity of the receiver to avoid long transmission lines.
D. Under the fuselage in order to receive correction data transmitted by D-GPS Stations.

GNSS/GPS 45.
In the NAVSTAR/GPS satellite navigation system, 'Selective Availability' (SA) gives the option to artificially degrade the accuracy by:

A. Shutting off selected satellites.
B. Using a less accurate atomic clock in a satellite for signal processing.
C. Dithering the satellite clock.
D. Offsetting satellite atomic clocks by a predetermined constant amount.

GNSS/GPS 46.
In the event of the use of Selective Availability, how does this affect, if at all, the navigation accuracy of the NAVSTAR/GPS satellite navigation system?

A. It increases because only signals from satellites in the most suitable geometric constellation are selected by the receiver.
B. It degrades position accuracy by manipulating satellite signals.
C. It has no influence because, by selecting of the most suitable signals, the computing process in the receiver is quicker.
D. It degrades accuracy by reducing the number of available satellites.

GNSS/GPS 47.
In the NAVSTAR/GPS satellite navigation system, receiver clock error:

A. Is the biggest part of the total error; it cannot be corrected.
B. Is corrected by using signals from four satellites.
C. Can be minimised by synchronisation of the receiver clock with the satellite clocks.
D. Is negligible small because of the great accuracy the atomic clocks installed in the satellites.

GNSS/GPS 48.
The influence of the ionosphere on the accuracy of the satellite navigation system NAVSTAR/GPS is:

A. Minimised by the receiver using a model of the atmosphere and comparing signals transmitted by the satellites.
B. Minimised by computing the average of all signals.
C. Only significant if the satellites are located at a small elevation angle above the horizon.
D. Negligible.

GNSS/GPS 49.
Which one of the following is an advantage of a multi-sensor system using inputs from a global navigation satellite system (GNSS) and an inertial navigational system (INS)?

A. The GNSS can be used to update a drifting INS.
B. The activation of 'Selective Availability' can be recognised by the INS.
C. The average position calculated from data provided by both systems increases overall accuracy.
D. The only advantage of coupling both systems is double redundancy.

GNSS/GPS 50.
What are the effects, if any, of shadowing by parts of the aircraft (e.g. wing) on the reception of signals from NAVSTAR/GPS satellites?

A. It causes multi-path propagation.
B. It may prevent the reception of signals.
C. The signals will be distorted, however the error can be corrected for using an algorithm and information from unaffected signals.
D. It has no influence because high frequency signals are unaffected.

GNSS/GPS 51.
Which of the following geometric satellite constellations provides the most accurate NAVSTAR/GPS position fix?

A. 3 satellites with a low elevation above the horizon and an azimuth of 120° from each other together with a fourth directly overhead.
B. 3 satellites with an azimuth of 120° from each other and an elevation of 45° above the horizon.
C. 4 satellites with an azimuth of 90° from each other and a low elevation above the horizon.
D. 4 satellites with an azimuth of 90° from each other and an elevation of 45° above the horizon.

GNSS/GPS 52.
In relation to the NAVSTAR/GPS satellite navigation system, what is involved in the differential technique (D-GPS)?

A. The difference between signals transmitted on the L1 and L2 frequencies are processed by the receiver to determine an error correction.
B. Fixed ground stations compute position errors and transmit correction data to a suitable receiver on the aircraft.
C. Receivers from various manufacturers are operated in parallel to reduce the characteristical receiver noise error.
D. Signals from satellites are received by 2 different antennas which are located a fixed distance apart. This enables a suitable receiver on the aircraft to recognise and correct for multi-path errors.

GNSS/GPS 53.

Which of the following statements about the accuracy that can be obtained with the differential technique (D-GPS) of the satellite navigation system NAVSTAR/GPS is correct?

A. The increase in accuracy of position fixes is independent of the receiver position in relation to a D-GPS ground station.

B. A D-GPS receiver can detect and correct for SA providing a more accurate position fix.

C. Only D-GPS allows position fixes accurate enough for 'Non Precision Approaches'.

D. The nearer a receiver is situated to a D-GPS ground station, the more accurate the position fix.

GNSS/GPS 54.

How does a receiver of the NAVSTAR/GPS satellite navigation system determine the elevation and azimuth data of a satellite relative to the location of the antenna?

A. It calculates it by using Almanac data transmitted by the satellites.

B. The data is stored in the receiver together with the Pseudo Random Noise (PRN) code.

C. The data is based on the direction to the satellite determined at the location of the antenna.

D. The data is determined by the satellite and transmitted together with the navigation message.

GNSS/GPS 55.

In relation to the NAVSTAR/GPS satellite navigation system, 'Search the Sky' is a:

A. Continuous process by the ground segment to monitor the GPS satellites.

B. Procedure that starts after switching on a receiver if there is no stored satellite data available.

C. Procedure performed by the receiver to recognise new satellites becoming Operational.

D. Continuous procedure performed by the receiver that searches the sky for satellites rising above the horizon.

GNSS/GPS 56.

What is the procedure to be followed if, on a flight under IFR conditions using the NAVSTAR/GPS satellite navigation system, the number of satellites required to maintain the RAIM (Receiver Autonomous Integrity Monitoring) function are not available?

A. The flight has to be continued under VFR conditions.

B. A constant heading and speed must be flown until the required number of satellites are again available.

C. The flight may be continued using other certificated navigation systems.

D. The flight may be continued as planned if at least 4 satellites are available and the pilot monitors the GPS-System manually.

GNSS/GPS 57.

Which of the following, if any, is a prerequisite if a receiver of a NAVSTAR/GPS satellite navigation system is to be used in combination with a multi sensor system?

A. The prescribed IFR-equipment must be in working correctly and the navigation information continuously displayed.

B. The prescribed IFR-equipment must be installed and operational.

C. The RAIM-function of the GPS receiver must be able to monitor all prescribed navigation systems.

D. Multi-sensor systems are not certificated for flights under IFR conditions.

GNSS/GPS 58.

Which of the following procedures must be adopted if, on a flight under IFR conditions using a NAVSTAR/GPS satellite navigation system receiver, the position fix obtained from the GPS receiver differs from the position of conventional navigation systems by an unacceptable amount?

A. It may be continued using conventional navigation systems.

B. It may be continued using NAVSTAR/GPS; prior to the next flight all systems must be checked.

C. It must be continued under VFR conditions.

D. The pilot must determine the reason for the deviation and correct the error or switch off the faulty system.

GNSS/GPS 59.

What datum is used for the Minimum Descent Altitude (MDA) on a non-precision approach when using the NAVSTAR/GPS satellite navigation system?

A. If using Differential-GPS (D-GPS) the altitude obtained from the D-GPS, otherwise barometric altitude.

B. Radar altitude.

C. GPS altitude.

D. Barometric altitude.

GNSS/GPS 60.

Which of the following is the datum for altitude information when conducting flights under IFR conditions on airways using the NAVSTAR/GPS satellite navigation system?

A. Barometric altitude.

B. The average of GPS altitude and barometric altitude.

C. GPS altitude.

D. GPS altitude if 4 or more satellites are received otherwise barometric altitude.

GNSS/GPS 61.
How many satellites form the nominal NAVSTAR GPS constellation?

A. 12.
B. 36.
C. 24.
D. 6.

GNSS/GPS 62.
How many clocks are installed in each NAVSTAR GPS satellite?

A. 1.
B. 4.
C. 2.
D. 3.

GNSS/GPS 63.
GPS satellites transmit on two L-band frequencies with different type of signal. Which of these are generally available for use by civil aviation?

A. L1 = coarse acquisition.
B. L2 - coarse acquisition (C/A).
C. L2 - precise (P).
D. L1 - precise (P).

GNSS/GPS 64.
In what type of nominal orbit are NAVSTAR GPS satellites placed.

A. Geo-stationary.
B. Elliptical.
C. Nearly Circular.
D. Pole to Pole.

GNSS/GPS 65.
In accordance with ICAO Annex 10, the NAVSTAR GPS global average 95% position accuracy in SPS should be?

A. 30 m horizontally.
B. 13 m horizontally.
C. 5 m vertically.
D. 22m is 3D.

GNSS/GPS 66.
Which of the following NAVSTAR/GPS satellite navigation system codes can be processed by "unauthorised" civil aviation receivers?

A. C/A.
B. C/A and P.
C. P and Y.
D. P.

GNSS/GPS 67.
In order to carry out an independent three-dimensional fix, Receiver Autonomous Integrity Monitoring (RAIM) and failure detection and exclusion of any faulty satellite, signal reception is required from a minimum number of how may satellites?

A. 7.
B. 6.
C. 4.
D. 5.

GNSS/GPS 68.
In the NAVSTAR/GPS satellite navigation system, re-use of Selective Availability would give the option to artificially degrade the accuracy by?

A. Shutting off selected satellites.
B. Offsetting satellite clocks by a predetermined constant amount.
C. Dithering the satellite clock.
D. Using less accurate atomic clocks in a satellite for signal processing.

GNSS/GPS 69.
In a Satellite-Assisted Navigation System (GNSS/GPS) a position line is obtained by?

A. Timing the period that is taken for the satellite's transmission to reach the aircraft receiver.
B. The aircraft receiver measuring the phase angle of the signal received from a satellite in a known position.
C. Timing the period that is taken fro a transmission from the aircraft's transmitter/receiver to reach and return from the satellite in a known position.
D. The aircraft receiver measuring the time difference between signals received from a minimum number of satellites.

GNSS/GPS 70.
What is EGNOS (European Global Navigation Overlay System)?

A. Wide Area Differential GPS (WADGPS).
B. GLONASS.

C. Local Area Augmented System (LADGPS).
D. Local Area Differential GPS (LADGPS).

GNSS/GPS 71.
The inclination to the equatorial plane of the NAVSTAR GPS orbits is?

A. 65 degrees.
B. 55 degrees.
C. 35 degrees.
D. 45 degrees.

GNSS/GPS 72.
In relation to the satellite navigation system NAVSTAR GPS, "All in View" is a term used when a receiver?

A. Is tracking all currently visible satellites above the receiver's mask angle and is using them to compute position.
B. Is receiving the signals of all visible satellites but tracking only those of the 4 with best geometric coverage.
C. Requires the signals of all visible satellites for navigation purposes.
D. Is receiving and tracking the signals of all 24 operational satellite simultaneously.

GNSS/GPS 73.
In accordance with ICAO Annex 10, the GPS NAVSTAR position accuracy in SPS should be for 95% of the time?

A. 30 metres horizontally.
B. 5 metres vertically.
C. 2 metres in 3-D.
D. 13 metres horizontally.

GNSS/GPS 74.
One of the tasks of the GPS control segment is?

A. To detect the malfunctioning of satellites.
B. To calculate and transmit differential corrections to users.
C. To calculate the accuracy of GPS.
D. To control continuously the motion of GPS satellites.

GNSS/GPS 75.
One of the tasks of the GPS control segment is?

A. To regulate the transmitted power of the satellites.
B. To calculate and transmit differential corrections to users which are able to receive Wide Area Differential GPS systems.

C. To control continuously the position and motion of GPS satellites.
D. To determine and send new ephemeris and new satellite clock errors data to the GPS satellites.

GNSS/GPS 76.
For what reason is a mask angle set-up in a GPS receiver?

A. To deny the receiver the use of GPS satellites with an elevation less than the mask angle.
B. To make the receiver select GPS satellites with a certain optimum elevation Which is about equal to the mask angle.
C. To select from the visible GPS satellites the satellite-configuration which results in the smallest GDOP.
D. To eliminate the reception of the signal from GPS satellites with an elevation of about 90 degrees.

GNSS/GPS 77.
What is the function of the control segment in GPS NAVSTAR?

A. To monitor and ensure that the transmitted signals are saved and processed to utilise WAAS.
B. To ensure that the transmitted data of the satellites is controlled and updated from time to time by ground stations.
C. It calculates the aircraft position.
D. To transmit a signal used by a suitable receiver to calculate position.

GNSS/GPS 78.
EGNOS (European Geostationary Navigation Overlay System) is a form of?

A. Wide Area Differential GPS (WADGPS).
B. Local Area Differential GPS (LADGPS).
C. Stand alone Global Navigation Satellite System (BNSS).
D. Local Area Augmentation System (LAAS).

GNSS/GPS 79.
What is the maximum latitude of a GPS satellite ground track?

A. 90 N/S.
B. 67.5 N/S.
C. 35 N/S.
D. 55 N/S.

GNSS/GPS 80.
The GPS control segment consists of?

A. A Master Control Station, Monitor Stations and Ground Antennas.

B. A Master Control Station, Monitor Stations, Ground Antennas, and geostationary satellites.
C. A Master Control Station, Monitor Stations and geostationary satellites.
D. A Master Control Station, and Monitor Stations.

GNSS/GPS 81.
The height of the NAVSTAR/GPS system above the Earth in km is?

A. 10 250 km.
B. 10 900 km.
C. 19 000 km.
D. 20 200 km.

GNSS/GPS 82.
The number of satellites required for a fully operational NACSTAR/GPS system is?

A. 12.
B. 21.
C. 24.
D. 30.

GNSS/GPS 83.
Differential GPS (D-GPS)?

A. Means to use the GPS receiver while in a known position, and register the difference.
B. Is used to differentiate between signals from different satellites.
C. Means to find the difference between a DR position and the real position and the GPS position.
D. Is used to improve the accuracy of GPS signals within an area, by using data from a receiver placed at a known position as a correction to data received in the aircraft from the satellites.

GNSS/GPS 84.
Which of the following statements concerning DGPS is true?

A. DGPS removes SV ephemeris and clock errors and propagation errors.
B. Local area DGPS gives the same improvement in accuracy regardless of the distance from the ground station .
C. DGPS can improve the accuracy of position information.
D. Wide area DGPS accuracy improves the closer the aircraft is to the ground station.

GNSS/GPS 85.
Which of the following statements about the accuracy that can be obtained with the LAAS (Local Area Augmentation System) of the satellite navigation system NAVSTAR GPS is correct?

A. The closer the receiver is to the LAAS ground reference station, the more accurate is the aircraft position fix.
B. A LAAS corrects the position of the aircraft by relaying the information via a geostationary satellite.
C. A LAAS cannot correct for satellite timing or orbital position errors.
D. The increase in accuracy of position fixes is independent of the aircraft position in relation to the LAAS ground station.

GNSS/GPS 86.
A pseudo range in GNSS is a range based on?

A. Time measurement using secondary radar principles.
B. Time measurement using UTC.
C. Time measurement using the satellite clock.
D. Time measurement using the receiver clock.

GNSS/GPS 87.
A pseudo range in GNSS is in error to the actual range because?

A. Ionospheric delays.
B. Receiver clock error.
C. Satellite clock error.
D. All of these errors.

GNSS/GPS 88.
Clock bias is a process of correcting pseudo range for?

A. Receiver clock errors.
B. UTC errors.
C. Satellite clock errors.
D. Receiver and satellite clock errors.

GNSS/GPS 89.
Using GPS, the primary position information is in the form of?

A. Spheres with the aircraft at the centres of the spheres.
B. Spheres with the satellites at the centres of the spheres .
C. Bearing and distance from the satellites.
D. Three-dimensional position, with the Earth's centre as the reference point.

GNSS/GPS 90.
What is the time taken to receive a complete navigation message (complete data set) from a satellite?

A. 12 hours (= satellite orbit time).
B. 25 seconds (= 1 second per data frame).

C. 12.5 minutes (=30 seconds per data frame).
D. 24 seconds (=1 second per data frame).

GNSS/GPS 91.
The time taken for a GNSS receiver to download the satellite almanac for NAVSTAR GPS is?

A. 12 hours.
B. 15 minutes.
C. 30 seconds.
D. 12.5 minutes.

GNSS/GPS 92.
What are the data elements transmitted by NAVSTAR GPS satellites?

1. Offset of the satellite clock from UTC
2. Ephemeris data.
3. Health data
4. Ionospheric delays.
5. Solar activity.

A. 1, 2, 3, 4, and 5.
B. 2, 3, 4 only.
C. 1, 2, and 3 only.
D. 1, 2, 3, and 4 only.

GNSS/GPS 93.
RAIM is achieved?

A. Within the receiver.
B. By ground monitoring stations determining the satellite range errors which are relayed to receivers via geostationary satellites.
C. By ground stations determining the X, Y, and Z errors and passing the corrections to receivers using pseudolites.
D. All of the above.

GNSS/GPS 94.
In NAVSTAR GPS the PRN codes are used to?

A. Remove receiver clock error.
B. Determine satellite range.
C. Reduce ionospheric and tropospheric errors.
D. Eliminate satellite clock error and ephemeris error.

GNSS/GPS 95.
In order for a GPS receiver to perform basic RAIM functions it must use a minimum of?

A. Three satellites plus a barometric unit.
B. Four satellites.
C. Five satellites.
D. Five satellites plus a barometric unit.

GNSS/GPS 96.
What is RAIM and what is its function?

A. Integrity monitoring of satellites by the receiver to ensure accurate navigation.
B. GPS integrity monitoring of master and slave stations to ensure correct alignment.
C. Resolution and intensity monitoring for increased accuracy.
D. Integrity monitoring of satellites by the master station to increase accuracy.

GNSS/GPS 97.
In NAVSTAR GPS the PRN codes are used to?

A. Differentiate between satellites.
B. Pass satellite ephemeris information.
C. Pass satellite time, ephemeris and other information.
D. Pass satellite time and ephemeris information.

GNSS/GPS 98.
The GPS system uses L1 and L2 frequency bands. Which band is used for the P code and which for the C/A code?

A. L1 is modulated with P code only.
B. L1 is modulated with P and C/A codes.
C. L2 is modulated with the C/A code only.
D. L2 is modulated with the P and C/A codes.

GNSS/GPS 99.
In GPS on which frequencies are the C/A and P codes transmitted?

A. The lower frequency.
B. The higher frequency.
C. Neither frequency.
D. Both frequencies.

GNSS/GPS 100.
Unauthorised civilian users of NAVSTAR GPS can access?

A. The C/A code.
B. The P code.
C. The P and Y codes.
D. The C/A and P codes.

GNSS/GPS 101.
Concerning NAVSTAR GPS orbits, which of the following statements is correct?

A. The orbits are geostationary to provide global coverage.
B. The inclination of the orbits is 55 degrees with an orbital period of 24 hours.
C. The inclination is 55 degrees with an orbital period of 12 hours.
D. The orbits are inclined at 65 degrees with an orbital period of 11 hours 15 minutes.

GNSS/GPS 102.
Which of the following statements is true in respect of GNSS?

A. The P code is for authorised (military) use only. It is transmitted only on L1.
B. The C/A code is for authorised (military) use only. It is transmitted both on L1 and L2.
C. The P code is the only code authorised for civilian use. It is transmitted on L.
D. The C/A code is the only code available for civilian use. It is transmitted only on L1 .

GNSS/GPS 103.
Of the types of GPS receivers available for civilian aviation, which are the most advanced type?

A. The multiplex receiver.
B. The single channel receiver.
C. The continuous tracking receiver.
D. The multiple satellite receiver.

GNSS/GPS 104.
The height derived from the NAVSTAR GPS is?

A. Pressure altitude.
B. Above mean sea level.
C. Above ground level.
D. Above the WGS84 ellipsoid.

GNSS/GPS 105.
The inclination of a satellite (SV) is?

A. 90 degrees minus the angle between the SV orbit and the Equator.
B. 90 degrees minus the angle between the SV orbit and the Polar Plane.
C. The angle between the SV orbit and the Equator.
D. The angle between the SV orbit and the Polar Plane..

GNSS/GPS 106.
Selective availability may be used to degrade the accuracy of the NAVSTAR GPS position. This is achieved by?

A. Introducing offsets in the broadcast satellites X, Y and Z co-ordinates.
B. Introducing an offset in the satellite clocks.
C. Random dithering of the broadcast satellite clock time.
D. Random dithering of the broadcast satellites X, Y and Z co-ordinates.

GNSS/GPS 107.
What type of clock is used in NAVSTAR GPS satellites?

A. Laser.
B. Quartz.
C. Mechanical.
D. Atomic.

GNSS/GPS 108.
How is the distance between the NAVSTAR GPS SV (Space Vehicle) and the receiver determined?

A. By measuring the tine from transmission to reception and multiplying this by the speed of light .
B. By reference to the SV and receiver positions to WGS84 .
C. By synchronising the receiver clock with the SV clock.
D. By measuring the time from transmission to reception and dividing by the speed of light.

GNSS/GPS 109.
The NAVSTAR GPS system transmits in the L1 and l2 frequency bands. Which bands are used for the P codes and which for the C/A codes?

A. Lower frequency for the C/A code and higher frequency for the P code.
B. Lower frequency for the P code and higher frequency for the C/A code.
C. Higher frequency for the C/A and P codes.
D. Higher frequency for the P code only.

GNSS/GPS 110.
The sky search carried out by GNSS receiver?

A. Is done prior to each fix.
B. Is the procedure carried out by the monitoring stations to check the accuracy of the satellite data.
C. Involves the receiver downloading the almanac from each satellite before determining which satellites are in view.
D. Is done when the receiver position is in error.

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SECTION 3

EXPLANATIONS

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BASIC PRINCIPLES 1. B.
Radio waves are electromagnetic waves. These are made up of an alternating electrical field set at right angles to an alternating magnetic field. Each of thee fields takes the form of a sine wave as the move forward. In each cycle the wave goes from zero to maximum positive, back through zero to maximum negative and back to zero.

The wavelength is the distance that the wave moves forward in one complete cycle. This means that the wavelength can be measured between two consecutive points at which any single value occurs. This might for example be from one crest to the next or from one trough to the next. Of the options listed in this question only "Wave crest to wave crest" is correct.

BASIC PRINCIPLES 2. D.
Under international agreement radio emissions are classified using a standard coding system. Under this system the code A3E has the following meaning:

A This means double-sideband amplitude modulation (an example of this would be an AM radio broadcast)

3 This means one channel, containing analogue information.

E This means telephony, which is voice or music intended to be listened to by human beings.

This combination of characteristics indicates that it would be used for VHF communications.

BASIC PRINCIPLES 3. C.
The propagation speed (c) is the speed at which RF energy moves through space. But this speed varies slightly depending upon the electrical properties of the material through which the energy is moving. For most practical purposes this speed can be assumed to be the speed of light, which is 300 000 000 metres per second or 162 000 nautical miles per second.

BASIC PRINCIPLES 4. B.
Radio waves are electromagnetic waves. These are made up of an alternating electrical field set at right angles to an alternating magnetic field. Each of thee fields takes the form of a sine wave as the move forward. In each cycle the wave goes from zero to maximum positive, back through zero to maximum negative and back to zero.

With regard to radio the term "Frequency" (F) means the number of complete cycles that occur in one second. Frequency is usually measured in Hertz (Hz) where 1 Hz is one cycle per second. This means that frequency is the number of complete waveforms passing a point in one second.

BASIC PRINCIPLES 5. D.
ADF employs frequencies 190 to 1750 kHz in the LF/MF bands.

Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The LF band includes frequencies from 30 to 300 kHz. Using the above equation these give wavelengths between 10 km and 1 km, so wavelengths in the LF band are kilometric.

The MF band includes frequencies from 300 kHz to 3 MHz. Using the above equation these give wavelength from 1 km to 100 m, so wavelengths in the MF band are Hectometric. (1 hectometre = 100 metres).

BASIC PRINCIPLES 6. B.
According to ICAO Annex 10, locators (which are low powered NDBs used for approach procedures) transmit on frequencies 190 to 1750 kHz in the LF/MF bands.

Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The LF band includes frequencies from 30 to 300 kHz. Using the above equation these give wavelengths between 10 km and 1 km, so wavelengths in the LF band are kilometric.

The MF band includes frequencies from 300 kHz to 3 MHz. Using the above equation these give wavelength from 1 km to 100 m, so wavelengths in the MF band are Hectometric. (1 hectometre = 100 metres).

BASIC PRINCIPLES 7. C.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The VHF band includes frequencies from 30 to 300 MHz. Using the above equation these frequencies give wavelengths from 10 metres to 1 metre, so the wavelengths for the VHF direction finder are metric.

BASIC PRINCIPLES 8. C.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The ILS uses frequencies from 108.1 to 111.95 MHz in the VHF band. Using the above equation these frequencies give wavelengths from 2.77 metres to 2.68 metres, so the wavelengths for the ILS are metric.

BASIC PRINCIPLES 9. A.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The ADF uses frequencies from 190 to 1750 kHz. Using the above equation these frequencies give wavelengths from 1579 metres to 171 metres, so the frequency band for the ADF is hectometric. (1 hectometre = 100 metres).

BASIC PRINCIPLES 10. D.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The MLS uses frequencies from 5031 to 5091 MHz. Using the above equation these frequencies give wavelengths from 5.96 centimetres to 5.89 centimetres, so the frequency band for the MLS is centimetric.

BASIC PRINCIPLES 11. B.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The ILS uses frequencies from 108.1 to 111.95 MHz. Using the above equation these frequencies give wavelengths from 2.77 metres to 2.68 metres, so the frequency band for the ILS Localiser is metric.

BASIC PRINCIPLES 12. C.
Frequency in Hz = 300 000 000 metres/sec / Wavelength in metres

So for an 18 metre wavelength

Frequency in metres = 300 000 000 metres / 18 = 16.67 MHz.

The frequency bands are as follows:

VLF	3 to 30 kHz
LF	30 to 300 kHz
MF	300 to 3000 kHz
HF	3 to 30 MHz
VHF	30 to 300 MHz
UHF	300 to 3000 MHz
SHF	3 to 30 GHz
EHF	30 to 300 GHz

So an 18 metre wavelength would occur in the HF frequency band.

BASIC PRINCIPLES 13. A.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The DME uses frequencies from 960 to 1213 MHz. Using the above equation these frequencies give wavelengths from 31.25 centimetres to 24.7 centimetres, so the frequency band for the DME is decimetric. 1 decimetre = 10 centimetres.

BASIC PRINCIPLES 14. B.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The VOR uses frequencies from 108 to 117.95 MHz. Using the above equation these frequencies give wavelengths from 2.78 metres to 2.54 metres, so the frequency band for the VOR is metric.

BASIC PRINCIPLES 15. B.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The ILS uses frequencies from 108.1 to 111.95 MHz. Using the above equation these frequencies give wavelengths from 2.77 metres to 2.68 metres, so the frequency band for the ILS localiser is metric.

BASIC PRINCIPLES 16. B.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The VOR uses frequencies from 108 to 117.95 MHz. Using the above equation these frequencies give wavelengths from 2.78 metres to 2.54 metres, so the frequency band for the VOR is metric.

BASIC PRINCIPLES 17. A.
Radio waves are electromagnetic waves. These are made up of an alternating electrical field set at right angles to an alternating magnetic field. Each of thee fields takes the form of a sine wave as the move forward. In each cycle the wave goes from zero to maximum positive, back through zero to maximum negative and back to zero.

With regard to radio the term "Frequency" (F) means the number of complete cycles that occur in one second. Frequency is usually measured in Hertz (Hz) where 1 Hz is one cycle per second. This means that frequency is the number of complete waveforms passing a point in one second. So the most accurate option in this question is "Number of complete cycles recurring in one unit of time".

BASIC PRINCIPLES 18.C.
Frequency in Hz = 300 000 000 metres/sec / Wavelength in metres

2.22 cm = 0.0222 metres.

So Frequency = 300 000 000 metres/sec / 0.0222 metres

Frequency = 13 513 513 513 Hz

Dividing by 1 000 000 converts this into 13513 MHz, or approximately 13500 MHz.

The only option that includes this frequency is "Doppler 13500 MHz".

BASIC PRINCIPLES 19. B.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The Marker Beacon carrier waves use a frequency of 75 MHz. Using the above equation these frequencies give wavelengths from 4 metres, so the frequency band for the VOR is metric.

BASIC PRINCIPLES 20. B.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The SSR uses frequencies in the UHF band. This band includes frequencies from 300 MHz to 3 GHz. Using the above equation these frequencies give wavelengths from 1 metre to 10 centimetres, so the frequency band for the VOR is decimetric. 1 decimetre = 10 centimetres.

BASIC PRINCIPLES 21. D.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The Low Altitude RADALT uses frequencies in the SHF band. This band includes frequencies from 4200 to 4400 MHz. Using the above equation these frequencies give wavelengths from 7.1 centimetres to 6.8 centimetres, so the frequency band for the VOR is centimetric.

BASIC PRINCIPLES 22. D.
A radio transmitter is made up of the following components:

An Oscillator. This produces a radio frequency signal at a frequency that is suitable for the intended use.

An Amplifier. This uses energy from the aircraft electrical system to increase the strength of the radio frequency signal, to enable it to be transmitted over the intended distances.

A Modulator. This modifies the basic radio frequency signal such that it includes some form of information. To achieve the required range the basic RF signal will of a frequency that cannot be detected by the human ear. This means that it cannot be heard. In the case of voice radio communications for example, the modulator superimposes a signal at a frequency that can be heard (an audio frequency). The modulation may be in the form of amplitude modulation or frequency modulation.

BASIC PRINCIPLES 23. C.
The Selective Calling or SELCAL system is a selective calling system that is used by the International Civil Aviation Organisation to alert flight deck crews to signals that are addressed to them while operating in trans-oceanic airspace. It uses pairs of tones that generally correspond to the Z-Chart of Motorola's (now obsolete) Quick Call II System. SELCAL is used over HF-SSB radios while operating over ICAO trans-oceanic routes.

BASIC PRINCIPLES 24. C.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

375 kHz = 375 000 Hz

So Wavelength in metres = 300 000 000 metres/sec / 375 000 Hz = 800 metres.

BASIC PRINCIPLES 25. A.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

75 MHz = 75 000 000 Hz

So Wavelength in metres = 300 000 000 metres/sec / 75 000 000 Hz = 4 metres.

BASIC PRINCIPLES 26. D.
Frequency in Hz = 300 000 000 metres/sec / Wavelength in metres

So frequency in Hz = 300 000 000 metres/sec / 8.5 metres = 35 294 117.65 Hz.

Dividing this by 1 000 000 Hz/MHZ converts it into 35.29411765 MHz.

BASIC PRINCIPLES 27. D.
The frequency bands are as follows:

VLF	3 to 30 kHz
LF	30 to 300 kHz
MF	300 to 3000 kHz
HF	3 to 30 MHz
VHF	30 to 300 MHz
UHF	300 to 3000 MHz
SHF	3 to 30 GHz
EHF	30 to 300 GHz

BASIC PRINCIPLES 28. D.
The frequency bands are listed in explanation 27 above.

BASIC PRINCIPLES 29. D.
Frequency in Hz = 300 000 000 metres/sec / Wavelength in metres

1 centimetre = 0.01 metres

So frequency in Hz = 300 000 000 metres/sec / 0.01 metres = 30 000 000 000 Hz.

Dividing this by 1 000 000 000 Hz/GHZ converts it into 30 GHz.

BASIC PRINCIPLES 30. C.
Frequency in Hz = 300 000 000 metres/sec / Wavelength in metres

1 decimetre = 0.1 metres and the Decimetric range extends for 0.1 metre to 1 metre.

So for 0.1 metre wavelength
Frequency in Hz = 300 000 000 metres/sec / 0.1 metres = 3 000 000 000 Hz.

Dividing this by 1 000 000 Hz/MHZ converts it into 30 MHz.

And for 1 metre wavelength
Frequency in Hz = 300 000 000 metres/sec / 1 metres = 300 000 000 Hz.

Dividing this by 1 000 000 Hz/MHZ converts it into 300 MHz.

So the limits are from 30 to 300 MHz.

BASIC PRINCIPLES 31. A.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

118.7 MHz = 118 700 000 Hz

Wavelength in metres = 300 000 000 metres/sec / 118 700 000 Hz = 2.527 metre.

BASIC PRINCIPLES 32. D.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

121.95 MHz = 121 950 000 Hz

Wavelength in metres = 300 000 000 metres/sec / 121 950 000 Hz = 2.46 metre.

BASIC PRINCIPLES 33. B.
Amplitude is measured vertically from the point at which the signal is zero (where it crosses the horizontal axis) to the top of the crest of the signal. From this it can be seen that the dotted signal is of a higher amplitude than the solid line signal.

The phase difference is the angular difference between the positions at which identical points in the two signals occur. If for example we select the point at which the two signals cross the zero axis in an upward direction, we can see that the solid line crosses at 000 degrees and the dotted line crosses midway between 180 degrees and 270 degrees. This midway value can be calculated using Midway = (180 + 270) / 2 = 225 degrees. So the phase difference is the difference between 000 degrees and 225 degrees. This means that the phase difference is 225 degrees.

BASIC PRINCIPLES 34. B.
Frequency in Hz = 300 000 000 metres/sec / Wavelength in metres

12 centimetres = 0.12 metres.

So Frequency in Hz = 300 000 000 metres/sec / 0.12 metres = 2 500 000 000 Hz.

Dividing this by 1 000 000 Hz /MHz converts it into 2500 MHz.

BASIC PRINCIPLES 35. D.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

20 MHz = 20 000 000 Hz

Wavelength in metres = 300 000 000 metres/sec / 20 000 000 Hz = 15 metres.

BASIC PRINCIPLES 36. C.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

375 kHz = 375 000 Hz

Wavelength in metres = 300 000 000 metres/sec / 375 000 = 800 metres.

BASIC PRINCIPLES 37. C.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

2400 kHz = 2 400 000 Hz

Wavelength in metres = 300 000 000 metres/sec / 2 400 000 Hz = 125 metres.

BASIC PRINCIPLES 38. D.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

300 kHz = 300 000 Hz

Wavelength in metres = 300 000 000 metres/sec / 300 000 Hz = 1000 metres.

BASIC PRINCIPLES 39. B.
Frequency in Hz s = 300 000 000 metres/sec / Wavelength in metres

Frequency in Hz s = 300 000 000 metres/sec / 200 metres = 1 500 000 Hz.

Dividing this by 1 000 000 Hz/MHz converts it into 1.5 MHz.

BASIC PRINCIPLES 40. B.
Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

3 GHz = 3 000 000 000 Hz

Wavelength in metres = 300 000 000 metres/sec / 3 000 000 000 Hz = 0.1 metres.

Dividing this by 100 centimetres/metre concerts it into 10 centimetres.

BASIC PRINCIPLES 41. C.
The frequency bands are as follows:

VLF	3 to 30 kHz
LF	30 to 300 kHz
MF	300 to 3000 kHz
HF	3 to 30 MHz
VHF	30 to 300 MHz
UHF	300 to 3000 MHz
SHF	3 to 30 GHz

Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

30 MHZ = 30 000 000 Hz
So at 30 MHz wavelength = 300 000 000 metres/sec / 30 000 000 Hz = 10 metres.

300 MHz = 300 000 000 Hz
So at 300 MHz wavelength = 300 000 000 metres/sec / 300 000 000 Hz = 1 metres.

So the limits of the VHF range are 10 m to 1 m.

BASIC PRINCIPLES 42. B.
The phase difference is the angular difference between the positions at which identical points in the two signals occur. If for example we select the point at which the two signals cross the zero axis in an upward direction, we can see that the solid line crosses at 000 degrees and the dotted line crosses at 180 degrees. This means that the phase difference is 180 degrees.

BASIC PRINCIPLES 43. A.
The most suitable length for a dipole aerial is ½ of the wavelength.

Wavelength in metres = 300 000 000 metres/sec / Frequency in Hz

The question specifies a frequency of 18 MHz.
18 MHz = 18 000 000 Hz.

So at 18 MHz wavelength = 300 000 000 metres/sec / 18 000 000 Hz = 16.67 metres.

½ of this wavelength = 8.33 metres.

BASIC PRINCIPLES 44. B.
As radio signals move through the atmosphere the air absorbs some of their energy. This loss of energy reduces the strength of the signal, making it more difficult to detect. This process whereby the strength of a radio signal diminishes as it moves away from the transmitter is called attenuation. The gain of an aerial is a measure of its ability to compensate for attenuation to give a stronger signal.

BASIC PRINCIPLES 45 A.
An electromagnetic wave is made up of two alternating transverse fields, which are set at right angle to each other. The first of these fields is an electrical field, which is called the E field. The second field is a magnetic field, which is called the H field.

The term "Polarisation" refers to the plane of oscillations of the E field. So a horizontally polarised wave has a horizontal E field and a vertical H field. And a vertically polarised wave has a vertical E field and a horizontal H field. For maximum efficiency the E field must be parallel to the elements of the aerial. So for example a horizontally polarised wave requires an aerial with its elements aligned horizontally.

BASIC PRINCIPLES 46. B.
An electromagnetic wave is made up of two alternating transverse fields which are set at right angle to each other. The first of these fields is an electrical field which is called the E field. The second field is a magnetic field, which is called the H field.

The term "Polarisation" refers to the plane of oscillations of the E field. So a horizontally polarised wave has a horizontal E field and a vertical H field. And a vertically polarised wave has a vertical E field and a horizontal H field.

When an aerial transmits a signal the electrical E field of the transmitted signal is parallel to the aerial. This means that the magnetic H field must be at right angle to the aerial.

BASIC PRINCIPLES 47. A.
An electromagnetic wave is made up of two alternating transverse fields, which are set at right angle to each other. The first of these fields is an electrical field, which is called the E field. The second field is a magnetic field, which is called the H field.

The term "Polarisation" refers to the plane of oscillations of the E field. So a horizontally polarised wave has a horizontal E field and a vertical H field. And a vertically polarised wave has a vertical E field and a horizontal H field.

For maximum efficiency the E field must be parallel to the elements of the aerial. So for example a wave with a horizontal magnetic component (the H field) must have a vertical electrical component (the E field). A vertical aerial will best receive this so that the E field is parallel to the aerial.

BASIC PRINCIPLES 48. D.
An electromagnetic wave is made up of two alternating transverse fields, which are set at right angle to each other. The first of these fields is an electrical field, which is called the E field. The second field is a magnetic field, which is called the H field.

BASIC PRINCIPLES 49. A.
The term "feeder lines" refers to the lines through which amplified signals are fed from the transmitter to the antenna. Slid metal conductors are used for low frequencies, but as frequency increases there is an increasing tendency for the signal to be conducted only by a thin layer of metal close to the outer skin of the conductors. This effectively reduces the cross sectional area of the conducting path, thereby increasing electrical impedance and reducing the strength of the signal that reaches the antenna. To overcome this problem three different types of feeder lines are used depending on frequency.

Twin feeder or screened pairs. These can be used for frequencies up to 10 MHz.

Co-axial cable. These are used for frequencies up to 3000 MHz.

Wave guides. These are used for frequencies above 3000 MHz.

BASIC PRINCIPLES 50. C.
The purpose of a directional radar transmitting antenna is to direct all of the radar energy forward in a specific direction to form a narrow beam. But it is not possible for any type of antenna to achieve this with 100% efficiency. In all cases some of the radar energy is transmitted radially in the form of side lobes. The proportion of energy that is wasted in the form of side lobes depends on a number of factors including the shape of the antenna. One of the advantages of flat plate antennae is that they generate less side lobes than the parabolic reflector antennae.

BASIC PRINCIPLES 51. B.
The term "Night Effect" refers to a phenomenon whereby radio waves reflected back by the ionosphere at night can cause signal strength fluctuations. In the case of NDBs thes effects can be evident 30 to 60 nautical miles (54 to 108 km) from the transmitter, especially just before sunrise and just after sunset (more common on frequencies above 350 kHz). Night effect is caused by changes in the thickness of the layers that make up the ionosphere and variations in the intensity of ionispheric ionisation between day and night. These effects are produced by changes in the direction of the plane of polarisation of radio signals due to reflections in the ionosphere.

BASIC PRINCIPLES 52. D.
Doppler shift is the process whereby the frequency of a wave changes when the distance between the transmitter and receiver is changing during the transmission. If the distance between the transmitter and receiver is increasing this has the effect of stretching out the waves, such that the wavelength increases and the frequency decreases. If the distance between the transmitter and receiver is decreasing this has the effect of compressing the waves, such that the wavelength decreases and the frequency increases.

The magnitude of the shift is proportional to the rate at which the distance between the transmitter and the receiver is changing. For any given speed of transmitter or receiver, the rate of change will be greatest when they are moving directly towards each other or directly away from each other. But even if one is moving parallel to the other there will be some rate of change and hence some Doppler Shift. This fact enables doppler radar systems to be used to detect the ground speed of the parent aircraft. So all of the options in this question are correct.

BASIC PRINCIPLES 53. C.
Doppler shift is the process whereby the frequency of a wave changes when the distance between the transmitter and receiver is changing during the transmission. If the distance between the transmitter and receiver is increasing this has the effect of stretching out the waves, such that the wavelength increases and the frequency decreases. If the distance between the transmitter and receiver is decreasing this has the effect of compressing the waves, such that the wavelength decreases and the frequency increases. So an apparent increase in frequency will occur if the transmitter is moving towards the receiver. Note that the other options in this question are all incorrect because they include movement of the receiver, but the question specifies that the shift is "proportional to the transmitter velocity". When both are moving the shift is proportional to their relative velocity.

BASIC PRINCIPLES 54. C.
The subject of Doppler Shift is discussed in explanation 52 above.

BASIC PRINCIPLES 55. D.
Doppler shift is the process whereby the frequency of a wave changes when the distance between the transmitter and receiver is changing during the transmission. If the distance between the transmitter and receiver is increasing this has the effect of stretching out the waves, such that the wavelength increases and the frequency decreases. If the distance between the transmitter and receiver is decreasing this has the effect of compressing the waves, such that the wavelength decreases and the frequency increases. So an apparent increase in frequency that is dependent on transmitter velocity will occur if the transmitter is moving towards the receiver.

BASIC PRINCIPLES 56. B.
Refraction is the process whereby electromagnetic waves are bent as they flow from one area to another of a different electrical conductivity. As the wave moves across the boundary between the two areas, the speed of the wave either increases or decreases slightly depending on the change of electrical conductivity. If the wave meets the boundary at 90 degrees all of the wave front is affected at the same time, so no bending occurs. But if the way meets the boundary at any other angle, one side of

the wave is affected before the other. This means that for a brief period one side of the wave is moving faster than the other. This causes the wave to bend as it crosses the boundary.

BASIC PRINCIPLES 57. A.

The term "attenuation" refers to the process whereby radio signal lose power as they move away from the transmitter. In the ionosphere radio signals lose power due to the absorption of energy in the electrically charged ionised layers. The rate of energy absorption is inversely proportional to the frequency, so lower frequencies suffer higher attenuation. In the lower atmosphere the attenuation rate depends upon the surface material such that attenuation of water is less than over land.

Refraction is the process whereby the paths of radio signals are bent as they pass through the ionosphere. The degree of bending is inversely proportional to frequency, so the lower frequency waves are reflected back to Earth, while the higher frequency waves (VHF and above) pass out into space.

BASIC PRINCIPLES 58. A.

The term "attenuation" refers to the process whereby radio signal lose power as they move away from the transmitter. In the ionosphere radio signals lose power due to the absorption of energy in the electrically charged ionised layers. The rate of energy absorption is inversely proportional to the frequency, so lower frequencies suffer higher attenuation. In the lower atmosphere the attenuation rate depends upon the surface material such that attenuation of water is less than over land.

BASIC PRINCIPLES 59. D.

Doppler shift is the process whereby the frequency of a wave changes when the distance between the transmitter and receiver is changing during the transmission. If the distance between the transmitter and receiver is increasing this has the effect of stretching out the waves, such that the wavelength increases and the frequency decreases. If the distance between the transmitter and receiver is decreasing this has the effect of compressing the waves, such that the wavelength decreases and the frequency increases. So the term Doppler shift refers to the change in frequency measured at the receiver.

BASIC PRINCIPLES 60. C.

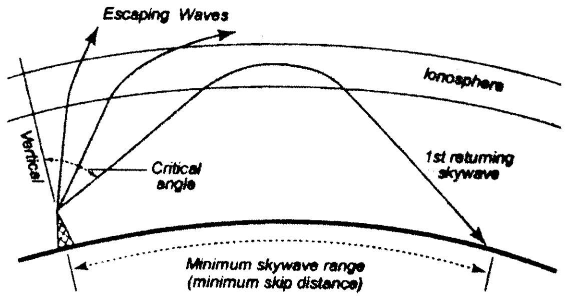
The term "attenuation" refers to the process whereby radio signal lose power as they move away from the transmitter. In the lower atmosphere attenuation occurs because the radio wave induces electrical currents in the surface of the earth. This process draws energy out of the radio wave. Materials that are good electrical conductors such as water return most of this energy back to the wave. But poor conductors such as hot dry desert sand simply absorb the lost energy. So the attenuation rate is greater over land than over water. Attenuation rate is also affected by frequency but radio waves of all frequencies gradually slow down and become weaker due to attenuation as they move over the surface of the Earth.

BASIC PRINCIPLES 61. A.

HF radio wave propagation is mainly by Sky Waves. Sky Waves are produced when radio waves striking the D layer, E layer and F layer of the ionosphere are refracted and reflected back to the surface of the Earth. The skip distance is the distance

between the transmitter and the point at which the first returning sky wave strikes the surface. The size of skip distance is determined by the angle at which the waves strike the ionospheric layers, the height of the ionospheric layers and the frequency of the wave. For maximum communication efficiency the range to the receiving station must be equal to or very slightly greater than the skip distance.

Increasing the height of the ionospheric layers or increasing the frequency of the waves will increase the skip distance. In daytime the lowest layer of the ionosphere is the D layer. This reflects HF waves and produces strong sky waves, which, for a given frequency strike the Earth at a certain skip distance. At night the D layer is dissipated due to the lack of sunlight, so the waves must go higher until they strike the E layer. This reflects HF waves and produces strong sky waves, but because the E layer is higher than the D layer, the skip distance is longer at night. To reduce the skip distance to its daytime value it is necessary to reduce the frequency. So to establish and maintain effective HF communication the frequency used at a given range should be decreased at night.



BASIC PRINCIPLES 62. C.

HF radio wave propagation is mainly by Sky Waves. Sky Waves are produced when radio waves striking the D layer, E layer and F layer of the ionosphere are refracted and reflected back to the surface of the Earth. The skip distance is the distance between the transmitter and the point at which the first returning sky wave strikes the surface.

BASIC PRINCIPLES 63. D.

Diffraction is the phenomenon whereby electromagnetic waves tend to bend around objects over which they pass. The degree of bending is greatest when the object dimensions are close to the wavelength of the electromagnetic wave.

BASIC PRINCIPLES 64. A.

The term "fading" refers to the phenomenon whereby the strength of LF, MF and HF radio waves varies in an apparently random manner. This is cause by radio waves reaching the receiver by two paths simultaneously, effectively producing two copies of the same radio wave. The two paths are usually sky waves reflected from the ionosphere, and ground waves. Because the lengths of these two paths are not identical and are not integer multiples of the wavelength, this causes the radio waves to be out of phase when they arrive at the receiver. This in turn causes the two signals to interfere with each other thereby reducing overall signal strength.

Three types of fading occur:

Interference Fading. When several different signals arrive at the receiver by different paths with varying phase differences.

Polarisation Fading. Caused by changes in the polarisation of the sky wave signals as they are reflected from the layers of the ionosphere.

Absorption Fading. Caused by attenuation of the signals.

Although the D layer exists during daytime, it is not sufficiently ionised to reflect MF waves. But as they pass through it they are absorbed. This means that no significant MF sky waves are produced during daytime. At night the D layer dissipates due to the absence of sunlight, so LF and MF waves are able to reach the higher E and F layers, which reflect them back to Earth as sky waves. These returning sky waves are more likely to be affected by a phase shift, so fading is more likely at night.

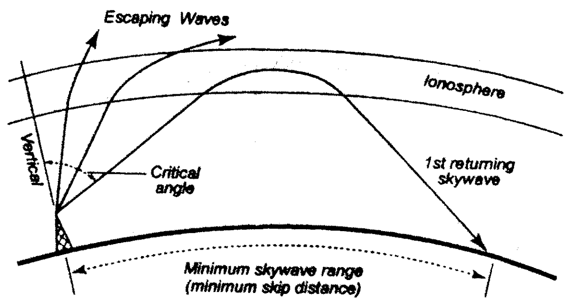
BASIC PRINCIPLES 65. B.
MF waves are propagated primarily as ground waves. Although surface attenuation reduces signal strength, sufficient energy remains to give usable ground waves. But at night changes in the layers of the ionosphere permit some sky waves to return to the Earth. These tend to interfere with the ground waves thereby causing fading. Due to the different attenuation rates, MF ground wave range is typically limited to 1 200 km over the sea and 500 to 700 km over land.

VHF waves are propagated by direct waves only, so they are limited to line of sight. They pass straight through the ionosphere so they do not form sky waves.

Taking the above factors into account it can be seen that the correct answer to this question is, "MF radio signals have a greater range by ground wave over sea than over land."

BASIC PRINCIPLES 66. A.
VLF waves are reflected from the surface of the Earth and also from the lowest layer of the ionosphere. They are also experience very low levels of attenuation in the atmosphere. This produces an effect similar to ducting whereby the waves travel great distances, giving usable ranges of up to 11 000 nautical miles. LF, MF and HF waves are absorbed and/or reflected by the ionosphere to varying degrees depending on the time of day or night. These variations can cause fading, which reduces usable range. So it can be said that the frequency at which sky waves should least affect reception is VLF.

BASIC PRINCIPLES 67. C.
HF radio wave propagation is mainly by Sky Waves. Sky Waves are produced when radio waves striking the D layer, E layer and F layer of the ionosphere are refracted and reflected back to the surface of the Earth. The skip distance is the distance between the transmitter and the point at which the first returning sky wave strikes the surface. The size of skip distance is determined by the angle at which the waves strike the ionospheric layers, the height of the ionospheric layers and the frequency of the wave. Increasing the height of the reflecting ionospheric layers or increasing the frequency of the waves will increase the skip distance.



BASIC PRINCIPLES 68. D.
The term "attenuation" refers to the process whereby radio signal lose power as they move away from the transmitter. In the lower atmosphere attenuation occurs because the radio wave induces electrical currents in the surface of the earth. This process draws energy out of the radio wave. Materials that are good electrical conductors such as water return most of this energy back to the wave. But poor conductors such as hot dry desert sand simply absorb the lost energy. So the attenuation rate is greater over land than over water. Attenuation rate is also affected by frequency but radio waves of all frequencies gradually slow down and become weaker due to attenuation as they move over the surface of the Earth.

BASIC PRINCIPLES 69. B.
When ultraviolet light from the sun strikes the upper atmosphere it causes the air to break down into positively charged and negatively charged ions. The degree of ionisation depends upon the intensity of the ultraviolet light, so ionisation is greatest at the top of the atmosphere and gradually reduces with reducing altitude. Significant ionisation occurs only in a thin band of the upper atmosphere called the ionosphere. The ionosphere is made up of a number of distinct layers, each with a different degree of ionisation.

When radio waves strike the lower layers of the ionosphere, the charged particles tend to deflect them in a process called refraction. The degree of refraction depends upon the degree of ionisation and the frequency of the radio waves. HF radio waves are refracted to such an extent that they return to the Earth in the form of sky waves by day and by night. VHF and UHF waves pass straight through the ionosphere with very little refraction, so they do not produce sky waves. VLF waves are propagated primarily in the form of ground waves.

BASIC PRINCIPLES 70. D.

The term "fading" refers to the phenomenon whereby the strength of LF, MF and HF radio waves varies in an apparently random manner. This is cause by radio waves reaching the receiver by two paths simultaneously, effectively producing two copies of the same radio wave. The two paths are usually sky waves reflected from the ionosphere, and ground waves. Because the lengths of these two paths are not identical and are not integer multiples of the wavelength, this causes the radio waves to be out of phase when they arrive at the receiver. This in turn causes the two signals to interfere with each other thereby reducing overall signal strength.

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Absorption Fading. Caused by attenuation of the signals.

Although the D layer exists during daytime, it is not sufficiently ionised to reflect MF waves. But as they pass through it they are absorbed. This means that no significant MF sky waves are produced during daytime. At night the D layer dissipates due to the absence of sunlight, so LF and MF waves are able to reach the higher E and F layers, which reflect them back to Earth as sky waves. These returning sky waves are more likely to be affected by a phase shift, so fading is more likely at night.

BASIC PRINCIPLES 71. B.

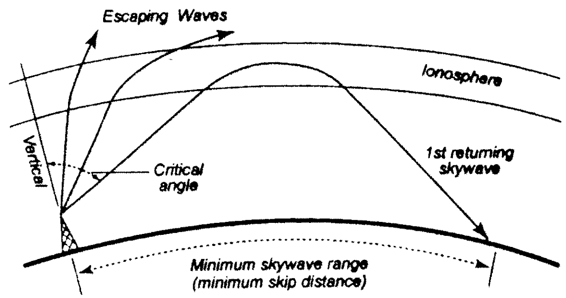
The term "attenuation" refers to the process whereby radio signal lose power as they move away from the transmitter. This limits the maximum range at which ground waves are strong enough to be usable. In the lower atmosphere attenuation occurs because the radio wave induces electrical currents in the surface of the earth. This process draws energy out of the radio wave. Materials that are good electrical conductors such as water return most of this energy back to the wave. But poor conductors such as hot dry desert sand simply absorb the lost energy. So the attenuation rate is greater over land than over water. Attenuation rate is also affected by frequency, such that the rate of attenuation, and hence the range decreases with increasing frequency. So as the frequency of a transmitter is increased, the range of the ground waves will decrease.

BASIC PRINCIPLES 72. D.

HF radio wave propagation is mainly by Sky Waves. Sky Waves are produced when radio waves striking the D layer, E layer and F layer of the ionosphere are refracted and reflected back to the surface of the Earth. The skip distance is the distance between the transmitter and the point at which the first returning sky wave strikes the surface. The size of skip distance is determined by the angle at which the waves strike the ionospheric

layers, the height of the ionospheric layers and the frequency of the wave. Increasing any of these factors will increase the skip distance.

Increasing the height of the ionospheric layers or increasing the frequency of the waves will increase the skip distance. In daytime the lowest layer of the ionosphere is the D layer. This reflects HF waves and produces strong sky waves, which, for a given frequency strike the Earth at a certain skip distance. At night the D layer is dissipated due to the lack of sunlight, so the waves must go higher until they strike the E layer. This reflects HF waves and produces strong sky waves, but because the E layer is higher than the D layer, the skip distance is longer at night. So skip distance is longest by night and with a high frequency.



BASIC PRINCIPLES 73. A.

The term "attenuation" refers to the process whereby radio signal lose power as they move away from the transmitter. This limits the maximum range at which ground waves are strong enough to be usable.

One cause of attenuation in the lower atmosphere is the fact that the radio wave induces electrical currents in the surface of the earth. This process draws energy out of the radio wave. Materials that are good electrical conductors such as water return most of this energy back to the wave. But poor conductors such as hot dry desert sand simply absorb the lost energy.

Another cause of attenuation is the scattering of the waves due to reflection from objects and particles in the air. A third cause is the fact that as radio waves move away from the transmitter they are spread out over a wider area. This causes the power of the wave to decrease in proportion to the square of the distance from the transmitter. So it can be said that attenuation of a radio wave is the reduction of its power by absorption, scattering and spreading.

BASIC PRINCIPLES 74. C.

The term "attenuation" refers to the process whereby radio signal lose power as they move away from the transmitter. This limits the maximum range at which ground waves are strong enough to be usable.

One cause of attenuation in the lower atmosphere is the fact that the radio wave induces electrical currents in the surface of the earth. This process draws energy out of the radio wave. Materials that are good electrical conductors such as water return most of this energy back to the wave. But poor conductors such as hot dry desert sand simply absorb the lost energy.

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BASIC PRINCIPLES 75. D.
The term "fading" refers to the phenomenon whereby the strength of LF, MF and HF radio waves varies in an apparently random manner. This is cause by radio waves reaching the receiver by two paths simultaneously, effectively producing two copies of the same radio wave. The two paths are usually sky waves reflected from the ionosphere, and ground waves. Because the lengths of these two paths are not identical and are not integer multiples of the wavelength, this causes the radio waves to be out of phase when they arrive at the receiver. .This in turn causes the two signals to interfere with each other thereby reducing overall signal strength.

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BASIC PRINCIPLES 76. B.
The subject of fading is discussed in explanation BASIC PRINCIPLES 74.

Taking the above facts into account it can be seen that the most accurate option in this question is, "fading occurs at night when ground waves and sky waves interfere with each other".

BASIC PRINCIPLES 77. B.
In radio communications the term "bandwidth" means the range of frequencies that is occupied by a modulated carrier wave. An Ampliude Moduluted (AM) signal is one in

which the information is added to the carrier wave in the form af maodulation of its amplitude. So an AM signal occupies only one frequency. A frequency modulated signal is one in which the information is added to the carrier wave in the from of modualtion of the frequencies. This means that an FM signal occupies more than one single frequency, so it nadwidth is greater than that of an Amplitude Modulated (AM) signal.

If a signal has avery large bandwidth, there is a risk that the frequencies used will encroach on those being used by other signls. This will cause noise on both signals. There is a limited number of frequencies available in each frequency band. This means that the bandwidth of each signal must be minimised in order to permit a large number of signals to be transmitted simultaneously without excessive noise. So whenever possible the bandwidth of a signal must be reduced in order to reduce noise.

BASIC PRINCIPLES 78. C.
Under normal circumstance electromagnetic waves travel in straight lines. Refraction is the process whereby electromagnetic waves are bent as they flow from one area to another of a different electrical conductivity. As the wave moves across the boundary between the two areas, the speed of the wave either increases or decreases slightly depending on the change of electrical conductivity. If the wave meets the boundary at 90 degrees all of the wave front is affected at the same time, so no bending occurs. But if the way meets the boundary at any other angle, one side of the wave is affected before the other. This means that for a brief period one side of the wave is moving faster than the other. This causes the wave to bend as it crosses the boundary. This enables radio waves to travel over and around objects in their paths.

It should be noted that the option "A direct wave is bent around the form of the Earth" is incorrect, because direct waves do not bend. They follow direct line-of-sight paths. It is the Surface Waves that are refracted around the form of the Earth.

BASIC PRINCIPLES 79. B.
Static interference consists of naturally occurring electromagnetic waves. The most common cause of static is lightning discharges. Static occurs at frequencies from a few hundred hertz to several thousand kilohertz. It is most common at the lower end of the frequency range and becomes less and less common as frequency increases. The lowest frequency at which freedom from static can be guaranteed is approximately 30 MHz.

BASIC PRINCIPLES 80. D.
The average heights of the ionospheric layers are as follows:

D Layer	75 km
E Layer	125 km
F Layer	225 km

Maximum skip distance can be calculated using the following equation.

Maximum skip distance in nm = 143 x √(height of reflecting layer in km)

So for a wave reflected from the E Layer.