

PRACTICE TEST 9: INSTRUMENTS, COMMUNICATION, AND NAVIGATION

Instructions: Select the best answer for each question. Each question is based on the Airframe Mechanic Certification Standards

1. The pitot-static system provides data for:
 - A. Engine instruments only
 - B. Gyroscopic instruments
 - C. Airspeed, altimeter, and vertical speed indicators
 - D. Magnetic compass
2. The pitot tube senses:
 - A. Static pressure only
 - B. Temperature
 - C. Altitude
 - D. Ram air pressure (dynamic pressure)
3. Static ports sense:
 - A. Atmospheric pressure undisturbed by aircraft motion
 - B. Ram air pressure
 - C. Engine pressure
 - D. Cabin pressure
4. Alternate static source when selected typically:
 - A. Reduces all readings
 - B. Has no effect
 - C. Causes slightly higher altimeter and airspeed readings
 - D. Stops all instruments
5. Pitot heat prevents:
 - A. Overheating
 - B. Ice blockage in pitot tube
 - C. Static port freezing
 - D. Instrument damage
6. Airspeed indicator measures:
 - A. Difference between ram air and static pressure
 - B. Static pressure only

- C. Temperature
 - D. Altitude
7. Altimeter measures altitude based on:
- A. Temperature
 - B. Airspeed
 - C. GPS signals
 - D. Atmospheric pressure changes
8. Altimeter setting adjusts:
- A. Temperature compensation
 - B. Barometric scale to local pressure
 - C. Airspeed
 - D. Vertical speed
9. Vertical speed indicator shows:
- A. Rate of altitude change (climb/descent)
 - B. Airspeed changes
 - C. Temperature
 - D. Heading
10. Blockage of the pitot tube with drain hole open causes:
- A. All instruments to fail
 - B. Airspeed indicator to read zero
 - C. Altimeter to fail
 - D. VSI to malfunction
11. Blocked static port causes:
- A. Only airspeed to fail
 - B. Engine instruments to fail
 - C. No problems
 - D. Altimeter, airspeed, and VSI to malfunction
12. Gyroscopic instruments operate on principles of:
- A. Magnetic fields
 - B. Atmospheric pressure
 - C. Rigidity in space and precession
 - D. Temperature sensing
13. The attitude indicator is powered by:
- A. Static pressure
 - B. Vacuum or electrical system
 - C. Pitot pressure
 - D. Battery only

14. The heading indicator uses:
- A. Gyroscope for directional reference
 - B. Magnetic compass directly
 - C. GPS signals
 - D. Static pressure
15. The turn coordinator shows:
- A. Heading only
 - B. Altitude
 - C. Rate of turn and roll coordination
 - D. Airspeed
16. Vacuum system provides suction for:
- A. Engine cooling
 - B. Pitot heat
 - C. Fuel pumps
 - D. Gyroscopic instruments (attitude and heading indicators)
17. Typical vacuum system operates at:
- A. 4.5–5.5 inches of mercury
 - B. 10 psi
 - C. 20 psi
 - D. 30 inches of mercury
18. Vacuum system failure causes:
- A. Airspeed failure
 - B. Attitude and heading indicator failure
 - C. Altimeter failure
 - D. Magnetic compass failure
19. Electric gyroscopic instruments use:
- A. Vacuum only
 - B. Pressure only
 - C. Electric motors spinning gyros
 - D. Magnetic fields only
20. Rigidity in space means:
- A. Gyro falls down
 - B. Gyro changes direction
 - C. Gyro stops
 - D. Gyro maintains orientation in space
21. Precession is:
- A. Immediate response

- B. Tilting reaction 90 degrees from applied force
- C. Gyro stopping
- D. No reaction

22. Magnetic compass operates using:

- A. Gyroscopes
- B. Pressure
- C. Earth's magnetic field
- D. GPS

23. Magnetic variation is:

- A. Difference between true and magnetic north
- B. Compass error
- C. Deviation
- D. Dip error

24. Magnetic deviation is:

- A. True north error
- B. Variation error
- C. GPS error
- D. Compass error from aircraft magnetic fields

25. Compass turning errors occur due to:

- A. Vacuum failure
- B. Static pressure
- C. Magnetic dip causing lead/lag in turns
- D. Pitot blockage

26. Acceleration errors affect compass:

- A. In turns only
- B. On east/west headings during speed changes
- C. Never
- D. In climbs only

27. Engine tachometer measures:

- A. Oil pressure
- B. Fuel flow
- C. Temperature
- D. Engine RPM

28. Manifold pressure gauge indicates:

- A. Intake manifold absolute pressure
- B. Oil pressure

- C. Fuel pressure
- D. Exhaust pressure

29. Oil pressure gauge measures:

- A. Fuel pressure
- B. Lubricating oil pressure
- C. Hydraulic pressure
- D. Manifold pressure

30. Oil temperature gauge monitors:

- A. Exhaust temperature
- B. Cylinder head temperature
- C. Engine lubricating oil temperature
- D. Fuel temperature

31. Cylinder head temperature gauge measures:

- A. Oil temperature
- B. Exhaust temperature
- C. Manifold pressure
- D. Hottest cylinder temperature

32. Exhaust gas temperature (EGT) gauge monitors:

- A. Exhaust gas temperature for mixture leaning
- B. Oil temperature
- C. Cylinder head temperature
- D. Carburetor temperature

33. Fuel quantity gauges may use:

- A. Pressure sensors
- B. Thermocouples
- C. Float-type or capacitance-type sensors
- D. Gyroscopes

34. Fuel flow indicators measure:

- A. Tank quantity
- B. Rate of fuel consumption
- C. Fuel pressure
- D. Fuel temperature

35. Fuel pressure gauge indicates:

- A. Pressure of fuel delivered to engine
- B. Tank quantity
- C. Flow rate
- D. Temperature

36. Thermocouple sensors produce:
- A. Pressure signals
 - B. Mechanical motion
 - C. Magnetic fields
 - D. Voltage from temperature difference
37. Bourdon tube instruments measure:
- A. Temperature
 - B. Voltage
 - C. Pressure through curved tube deflection
 - D. Resistance
38. Bimetallic temperature sensors work by:
- A. Two metals with different expansion rates bending
 - B. Thermocouple action
 - C. Pressure changes
 - D. Magnetic fields
39. VHF communication radios operate in frequency range:
- A. 30–300 MHz
 - B. 118–137 MHz
 - C. 200–400 MHz
 - D. 1–30 MHz
40. VHF transmission is generally:
- A. Worldwide range
 - B. Ground wave propagation
 - C. Skywave propagation
 - D. Line-of-sight limited
41. AM (Amplitude Modulation) varies:
- A. Signal strength to carry voice information
 - B. Frequency only
 - C. Phase only
 - D. Wavelength
42. Squelch control on radios:
- A. Changes frequency
 - B. Adjusts power
 - C. Silences receiver when no signal present
 - D. Modulates transmission
43. Audio panel allows:
- A. Engine control

- B. Selection of communication and navigation audio sources
 - C. Autopilot control
 - D. Fuel management
44. Intercom system provides:
- A. Radio communication only
 - B. Navigation signals
 - C. Flight control
 - D. Crew communication without radio transmission
45. HF (High Frequency) radio provides:
- A. Short range only
 - B. Line-of-sight range
 - C. Long-range communication via skywave
 - D. No range
46. Emergency Locator Transmitter (ELT) transmits on:
- A. 121.5 and 243.0 MHz
 - B. 118.0 MHz
 - C. 135.5 MHz
 - D. 300.0 MHz
47. ELT is activated by:
- A. Pilot switch only
 - B. GPS signal
 - C. Altitude
 - D. Impact forces or manual activation
48. Transponder provides:
- A. Communication capability
 - B. Aircraft identification and altitude to ATC radar
 - C. Navigation guidance
 - D. Weather information
49. Transponder Mode C transmits:
- A. Identification only
 - B. Heading
 - C. Altitude information with identification
 - D. Speed
50. Transponder code 7700 indicates:
- A. Emergency
 - B. Lost communication

- C. Hijacking
- D. VFR flight

51. VOR (VHF Omnidirectional Range) provides:

- A. Distance information
- B. Altitude
- C. Weather
- D. Magnetic bearing information from station

52. VOR operates in frequency range:

- A. 118–137 MHz
- B. 108–118 MHz
- C. 200–400 MHz
- D. 1–30 MHz

53. VOR radial is:

- A. Magnetic course FROM the station
- B. Distance from station
- C. Altitude at station
- D. True course TO station

54. TO/FROM indicator shows:

- A. Distance
- B. Altitude
- C. Whether flying TO or FROM station
- D. Wind direction

55. DME (Distance Measuring Equipment) provides:

- A. Bearing to station
- B. Altitude
- C. Heading
- D. Slant range distance to station

56. ILS (Instrument Landing System) provides:

- A. Enroute navigation only
- B. Precision approach guidance with localizer and glideslope
- C. Communication
- D. Weather only

57. Localizer provides:

- A. Vertical guidance
- B. Distance information
- C. Horizontal (left/right) guidance to runway centerline
- D. Weather information

58. Glideslope provides:
- A. Vertical (up/down) guidance for descent angle
 - B. Horizontal guidance
 - C. Distance
 - D. Heading
59. Marker beacons transmit at:
- A. 118 MHz
 - B. 108 MHz
 - C. 243 MHz
 - D. 75 MHz
60. Outer marker indicates approximately:
- A. Runway threshold
 - B. 4–7 miles from runway
 - C. 10 miles out
 - D. Decision height
61. GPS (Global Positioning System) determines position using:
- A. Satellite ranging signals
 - B. Ground-based transmitters
 - C. Magnetic fields
 - D. Radar
62. GPS requires reception from minimum:
- A. 1 satellite
 - B. 2 satellites
 - C. 4 satellites for 3D position
 - D. 10 satellites
63. WAAS (Wide Area Augmentation System):
- A. Replaces GPS
 - B. Provides communication
 - C. Blocks signals
 - D. Improves GPS accuracy for precision approaches
64. RAIM (Receiver Autonomous Integrity Monitoring):
- A. Controls radar
 - B. Monitors GPS signal integrity
 - C. Provides communication
 - D. Measures fuel
65. ADF (Automatic Direction Finder) receives:
- A. VHF signals

- B. GPS signals
- C. Non-directional beacon (NDB) signals in LF/MF bands
- D. ILS signals

66. ADF pointer indicates:
- A. Relative bearing to station
 - B. Magnetic bearing FROM station
 - C. Distance to station
 - D. Altitude
67. NDB operates in frequency range:
- A. 118–137 MHz
 - B. 190–1750 kHz
 - C. 108–118 MHz
 - D. 2–30 MHz
68. Weather radar detects:
- A. Other aircraft only
 - B. Terrain only
 - C. Airports
 - D. Precipitation and weather cells
69. Radar altimeter measures:
- A. Height above ground by radio waves
 - B. Barometric altitude
 - C. Airspeed
 - D. Temperature
70. TCAS (Traffic Collision Avoidance System) provides:
- A. Weather information
 - B. Navigation guidance
 - C. Traffic alerts and resolution advisories
 - D. Communication
71. Mode S transponder enables:
- A. Communication only
 - B. Weather display
 - C. Fuel management
 - D. Data link and selective interrogation
72. ADSB (Automatic Dependent Surveillance-Broadcast):
- A. Replaces radar
 - B. Broadcasts position, velocity, and identification

- C. Provides ILS guidance
- D. Measures fuel

73. Antenna installation requires:

- A. Proper location, grounding, and matching to equipment
- B. Any location
- C. No grounding
- D. Random orientation

74. Coaxial cable for antennas provides:

- A. Power only
- B. No shielding
- C. Shielded transmission preventing signal loss and EMI
- D. Structural support

75. Standing wave ratio (SWR) indicates:

- A. Altitude
- B. Speed
- C. Heading
- D. Antenna impedance match quality

76. Poor antenna grounding causes:

- A. Improved performance
- B. Reduced range and potential interference
- C. No effect
- D. Increased power

77. VOR antenna typically located:

- A. On fuselage top
- B. On landing gear
- C. On vertical stabilizer
- D. On wing tips

78. GPS antenna requires:

- A. Clear view of sky for satellite reception
- B. Fuselage bottom mounting
- C. Metal shielding
- D. Wing tip location

79. Avionics cooling is important because:

- A. Cold improves signal
- B. Heat has no effect
- C. Equipment looks better cold
- D. Excessive heat causes component failure

80. Avionics master switch:
- A. Controls engine
 - B. Controls avionics bus power
 - C. Adjusts instruments
 - D. Changes frequencies
81. Static discharge on radio causes:
- A. Noise and interference in communications
 - B. Improved reception
 - C. No effect
 - D. Better signal
82. Shielded wiring in avionics prevents:
- A. Current flow
 - B. Proper operation
 - C. Electromagnetic interference
 - D. All signals
83. Bonding avionics equipment provides:
- A. Insulation
 - B. Color coding
 - C. Weight reduction
 - D. EMI protection and proper grounding
84. Installation of avionics requires:
- A. Random placement
 - B. Following manufacturer instructions and regulations
 - C. No documentation
 - D. Any mounting method
85. Avionics weight and balance considerations:
- A. Are ignored
 - B. Don't matter
 - C. Must be calculated and recorded
 - D. Only apply to large aircraft
86. Troubleshooting avionics starts with:
- A. Checking power, circuit breakers, and antenna connections
 - B. Replacing everything
 - C. Ignoring the problem
 - D. Random testing
87. Intermittent avionics problems often caused by:
- A. Perfect installation

- B. New equipment
- C. Proper maintenance
- D. Loose connections, corrosion, or thermal cycling

88. Built-in test equipment (BITE) provides:

- A. Physical damage
- B. Self-diagnostic capabilities in modern avionics
- C. External power
- D. Fuel indication

89. Avionics connector inspection checks for:

- A. Corrosion, bent pins, and proper seating
- B. Color only
- C. Weight
- D. Age

90. Ramp testing avionics verifies:

- A. Engine performance
- B. Fuel quantity
- C. Proper operation before flight
- D. Oil pressure

91. IFR certification requires:

- A. VFR equipment only
- B. Communication only
- C. No special equipment
- D. Specific navigation and communication equipment

92. Pitot-static system certification includes:

- A. Visual inspection only
- B. Leak test and accuracy verification every 24 months
- C. No testing required
- D. Annual visual only

93. Transponder certification requires:

- A. No testing
- B. Visual inspection only
- C. Performance verification every 24 months
- D. Owner certification

94. Altimeter certification involves:

- A. Testing to ensure accuracy every 24 months for IFR
- B. No testing

- C. Visual check only
- D. 100-hour inspection

95. VOR accuracy check required:

- A. Never
- B. Every flight
- C. Monthly
- D. Every 30 days for IFR

96. ELT inspection required:

- A. Never
- B. Annually, plus battery replacement per schedule
- C. Every 10 years
- D. When it activates

97. ADSB Out equipment must transmit:

- A. Position, velocity, time, and identification
- B. Communication only
- C. Navigation only
- D. Weather

98. Glass cockpit displays integrate:

- A. Single instrument only
- B. Engine instruments only
- C. Multiple flight instruments on electronic screens
- D. No information

99. EFIS (Electronic Flight Instrument System) replaces:

- A. Engine only
- B. Radio only
- C. Fuel system
- D. Traditional analog flight instruments with displays

100. Primary Flight Display (PFD) shows:

- A. Engine parameters only
- B. Navigation map only
- C. Critical flight instruments (attitude, airspeed, altitude, heading)
- D. Fuel quantity only

Answer Explanations

- 1. C. Airspeed, altimeter, and vertical speed indicators** Pitot-static system provides pressure data for three primary instruments: airspeed indicator (ram and static pressure), altimeter (static pressure), and vertical speed indicator (static pressure rate of change).
- 2. D. Ram air pressure (dynamic pressure)** Pitot tube senses ram air pressure (impact pressure) from forward aircraft motion. Combined with static pressure, this creates differential pressure measured by airspeed indicator.
- 3. A. Atmospheric pressure undisturbed by aircraft motion** Static ports sense ambient atmospheric pressure undisturbed by aircraft movement, typically flush-mounted on fuselage sides where airflow least affected. Essential for accurate altitude and airspeed indications.
- 4. C. Causes slightly higher altimeter and airspeed readings** Alternate static source draws from cabin where pressure typically slightly lower than outside static pressure, causing altimeter to read slightly high and airspeed to read slightly fast.
- 5. B. Ice blockage in pitot tube** Pitot heat prevents ice formation blocking pitot tube in visible moisture and freezing temperatures. Blocked pitot causes airspeed indicator failure while other instruments remain functional.
- 6. A. Difference between ram air and static pressure** Airspeed indicator measures differential pressure between ram air (pitot) and static pressure. Greater speed difference creates higher indicated airspeed through calibrated aneroid mechanism.
- 7. D. Atmospheric pressure changes** Altimeter measures altitude by sensing atmospheric pressure changes with altitude. Pressure decreases approximately 1 inch Hg per 1,000 feet, measured by sensitive aneroid wafers expanding/contracting.
- 8. B. Barometric scale to local pressure** Altimeter setting (Kollsman window) adjusts barometric scale to local atmospheric pressure correcting for pressure variations from standard, providing accurate altitude relative to sea level.
- 9. A. Rate of altitude change (climb/descent)** Vertical speed indicator (VSI) shows rate of altitude change in feet per minute by measuring rate of static pressure change through calibrated leak.
- 10. B. Airspeed indicator to read zero** Blocked pitot tube with drain hole open allows ram air to escape, equalizing pitot and static pressure, causing airspeed indicator to read zero. Altimeter and VSI remain functional using static ports.
- 11. D. Altimeter, airspeed, and VSI to malfunction** Blocked static port prevents pressure sensing for all three pitot-static instruments. Airspeed indicator, altimeter, and VSI freeze at blockage altitude/airspeed or show erroneous readings.

12. C. Rigidity in space and precession Gyroscopic instruments utilize two fundamental properties: rigidity in space (gyro maintains orientation) and precession (tilting reaction 90 degrees from applied force in rotation direction).

13. B. Vacuum or electrical system Attitude indicator powered by vacuum system (engine-driven or electric pump) spinning gyro, or electric motor in electrically-powered instruments. Gyro maintains level reference for pitch and roll.

14. A. Gyroscope for directional reference Heading indicator uses gyroscope maintaining directional reference, must be periodically aligned with magnetic compass. Provides stable heading reference without magnetic compass errors.

15. C. Rate of turn and roll coordination Turn coordinator shows rate of turn (gyro-driven needle) and coordination (inclinometer ball). Indicates whether turn coordinated (ball centered) and turn rate (standard rate = 3° per second).

16. D. Gyroscopic instruments (attitude and heading indicators) Vacuum system provides suction spinning gyros in attitude indicator and heading indicator (directional gyro). Engine-driven vacuum pump or electric pump creates airflow through instruments.

17. A. 4.5-5.5 inches of mercury Typical vacuum system operates at 4.5-5.5 inches of mercury suction, monitored by vacuum gauge. Insufficient vacuum causes sluggish or erratic gyro operation; excessive vacuum causes premature bearing wear.

18. B. Attitude and heading indicator failure Vacuum system failure causes attitude indicator and heading indicator (directional gyro) to become unreliable as gyros slow down. Turn coordinator typically electrically powered remains functional.

19. C. Electric motors spinning gyros Electric gyroscopic instruments use electric motors directly spinning gyroscope instead of air-driven gyros. More reliable, no vacuum system required, common in modern aircraft.

20. D. Gyro maintains orientation in space Rigidity in space means spinning gyroscope resists changes to axis of rotation, maintaining fixed orientation in space. Higher spin rate provides greater rigidity for stable reference.

21. B. Tilting reaction 90 degrees from applied force Precession is gyroscopic property where applied force causes tilting reaction 90 degrees ahead in rotation direction. Used intentionally in some instruments for specific indications.

22. C. Earth's magnetic field Magnetic compass operates using magnetized needles aligning with Earth's magnetic field, pointing toward magnetic north. Simple, reliable, requires no electrical power, primary backup to heading indicator.

23. A. Difference between true and magnetic north Magnetic variation is angular difference between true north (geographic) and magnetic north, varies by location. Shown on charts with isogonic lines, must be applied for true course calculations.

24. D. Compass error from aircraft magnetic fields Magnetic deviation is compass error caused by aircraft magnetic fields from electrical systems, metal structures, and equipment. Varies with heading, corrected using compass correction card.

25. C. Magnetic dip causing lead/lag in turns Compass turning errors result from magnetic dip (vertical component of Earth's field). Compass leads actual heading when turning north, lags when turning south in Northern Hemisphere.

26. B. On east/west headings during speed changes Acceleration errors affect compass on east/west headings. Accelerating on east heading causes north indication; decelerating causes south indication. Acronym ANDS: Accelerate North, Decelerate South.

27. D. Engine RPM Engine tachometer measures and displays engine rotational speed in revolutions per minute (RPM). Mechanical, electric, or electronic sensing from crankshaft or accessory drive.

28. A. Intake manifold absolute pressure Manifold pressure gauge indicates absolute pressure in intake manifold in inches of mercury, reflecting engine power output. Higher MP indicates more power; controlled by throttle.

29. B. Lubricating oil pressure Oil pressure gauge measures engine lubricating oil pressure typically 30-60 psi normal operation, ensuring adequate lubrication. Low pressure indicates potential lubrication failure requiring immediate attention.

30. C. Engine lubricating oil temperature Oil temperature gauge monitors engine oil temperature typically 180-220°F normal range. High oil temperature indicates inadequate cooling, excessive bearing clearances, or insufficient oil quantity.

31. D. Hottest cylinder temperature Cylinder head temperature (CHT) gauge measures temperature of hottest cylinder (or multiple cylinders), typically 300-450°F normal range. Indicates engine cooling effectiveness and power settings.

32. A. Exhaust gas temperature for mixture leaning Exhaust gas temperature (EGT) gauge monitors exhaust temperature for mixture leaning procedures. Peak EGT indicates stoichiometric mixture; leaning past peak reduces fuel consumption.

33. C. Float-type or capacitance-type sensors Fuel quantity gauges use float-type sensors (float-operated variable resistor) or capacitance-type sensors (capacitance changes with fuel level). Capacitance systems more accurate, compensate for fuel density.

34. B. Rate of fuel consumption Fuel flow indicators measure and display rate of fuel consumption typically in gallons per hour or pounds per hour, allowing pilots to monitor consumption and calculate endurance.

35. A. Pressure of fuel delivered to engine Fuel pressure gauge indicates pressure of fuel delivered to carburetor or fuel injection system, typically 2-8 psi carbureted engines, higher for fuel-injected. Ensures adequate fuel delivery.

36. D. Voltage from temperature difference Thermocouple sensors generate small voltage from temperature difference between hot junction (sensing point) and cold junction (reference). Used for EGT, turbine temperature measurements.

37. C. Pressure through curved tube deflection Bourdon tube instruments measure pressure using curved metal tube straightening under pressure, mechanical linkage moves pointer. Used for oil pressure, manifold pressure, fuel pressure gauges.

38. A. Two metals with different expansion rates bending Bimetallic temperature sensors use two metals with different thermal expansion coefficients bonded together. Temperature changes cause bending, mechanical linkage moves pointer indicating temperature.

39. B. 118-137 MHz VHF communication radios operate in 118-137 MHz frequency band allocated for aeronautical communication. Channels spaced 25 kHz (older) or 8.33 kHz (newer) apart.

40. D. Line-of-sight limited VHF transmission is generally line-of-sight limited, range increases with altitude. Typical range 25-50 miles at low altitude, over 100 miles at high altitude.

41. A. Signal strength to carry voice information AM (Amplitude Modulation) varies signal amplitude (strength) while maintaining constant frequency, encoding voice information in amplitude variations. Standard for aviation VHF communication.

42. C. Silences receiver when no signal present Squelch control automatically silences receiver when no signal present, eliminating static noise. Adjusted to threshold where weak signals break squelch while blocking noise.

43. B. Selection of communication and navigation audio sources Audio panel allows selecting which communication and navigation radios are heard, controlling speaker/headset routing, intercom, and marker beacon audio for crew stations.

44. D. Crew communication without radio transmission Intercom system provides internal communication between crew and passengers without transmitting externally. Allows crew coordination, passenger announcements, and communication during radio silence.

45. C. Long-range communication via skywave HF (High Frequency) radio provides long-range communication (hundreds to thousands of miles) through ionospheric skywave propagation. Essential for oceanic and remote area operations.

46. A. 121.5 and 243.0 MHz Emergency Locator Transmitter (ELT) transmits on 121.5 MHz (civil emergency) and 243.0 MHz (military emergency). Newer 406 MHz ELTs provide GPS position data to satellite system.

47. D. Impact forces or manual activation ELT activated automatically by impact forces exceeding design threshold (typically 5g) during crash, or manually using cockpit switch or switch on ELT unit.

48. B. Aircraft identification and altitude to ATC radar Transponder replies to ATC radar interrogation transmitting four-digit identification code and (Mode C) pressure altitude, allowing controllers to identify and track aircraft.

49. C. Altitude information with identification Transponder Mode C transmits pressure altitude information along with identification code in reply to radar interrogation, displayed on controller's screen showing altitude automatically.

50. A. Emergency Transponder code 7700 indicates emergency, immediately alerting controllers. Other emergency codes: 7600 (lost communication), 7500 (hijacking). Code 1200 standard VFR.

51. D. Magnetic bearing information from station VOR (VHF Omnidirectional Range) provides magnetic bearing (radial) information from ground station. Aircraft receiver determines which radial aircraft is on, enabling navigation TO or FROM station.

52. B. 108-118 MHz VOR operates in 108-118 MHz frequency band (VHF), shared with ILS localizer frequencies. VOR frequencies are even-tenths (e.g., 113.0, 113.2); odd-tenths reserved for ILS.

53. A. Magnetic course FROM the station VOR radial is magnetic course FROM station. Radial 090 means magnetic course 090° FROM station (or 270° TO station). 360 radials emanate from each VOR.

54. C. Whether flying TO or FROM station TO/FROM indicator shows whether selected course will take aircraft TO or FROM station. Ambiguity (OFF flag) shown when abeam station or more than 90° from selected course.

55. D. Slant range distance to station DME (Distance Measuring Equipment) provides slant range distance in nautical miles to ground station by measuring time delay of interrogation/reply signals. Accuracy ± 0.5 nm or 3%, whichever greater.

56. B. Precision approach guidance with localizer and glideslope ILS (Instrument Landing System) provides precision approach guidance using localizer (lateral guidance to runway centerline) and glideslope (vertical guidance, typically 3° descent angle).

57. C. Horizontal (left/right) guidance to runway centerline Localizer provides horizontal guidance aligning aircraft with runway centerline within $\pm 35^\circ$ from centerline, transmitted from antenna beyond far end of runway.

58. A. Vertical (up/down) guidance for descent angle Glideslope provides vertical guidance maintaining proper descent angle (typically 3°) from intercept altitude to decision height. Transmitter located beside runway threshold.

59. D. 75 MHz Marker beacons transmit vertically at 75 MHz providing position fixes along ILS approach: outer marker (blue, 4-7nm), middle marker (amber, ~3,500ft), inner marker (white, decision height).

60. B. 4-7 miles from runway Outer marker indicates position approximately 4-7 miles from runway threshold where aircraft typically intercepts glideslope, identified by blue light and low-tone audio (dashes).

61. A. Satellite ranging signals GPS determines position by measuring precise distances to multiple satellites using timing of radio signals traveling at speed of light, triangulating position through satellite geometry.

62. C. 4 satellites for 3D position GPS requires minimum 4 satellites for 3D position (latitude, longitude, altitude) plus time. Three satellites provide 2D position; additional satellites improve accuracy.

63. D. Improves GPS accuracy for precision approaches WAAS (Wide Area Augmentation System) improves GPS accuracy to approximately 1-2 meters enabling precision approach capability. Ground stations monitor GPS, broadcast corrections via geostationary satellites.

64. B. Monitors GPS signal integrity RAIM (Receiver Autonomous Integrity Monitoring) monitors GPS signal integrity using redundant satellite signals detecting failures or excessive errors, alerting pilot when accuracy insufficient.

65. C. Non-directional beacon (NDB) signals in LF/MF bands ADF (Automatic Direction Finder) receives non-directional beacon (NDB) signals in low/medium frequency bands (190-1750 kHz), determining relative bearing to station.

66. A. Relative bearing to station ADF pointer indicates relative bearing to station (angle from nose to station). Adding relative bearing to magnetic heading gives magnetic bearing TO station.

67. B. 190-1750 kHz NDB (Non-Directional Beacon) operates in low/medium frequency range 190-1750 kHz. Lower frequencies provide longer range but more susceptible to atmospheric interference and night effect.

68. D. Precipitation and weather cells Weather radar detects precipitation (rain, snow, hail) and weather cells by measuring radar reflections from water droplets. Intensity displayed in colors helping pilots avoid severe weather.

69. A. Height above ground by radio waves Radar altimeter measures height above ground (AGL) by transmitting radio waves downward, measuring time for reflection return. Accurate to few feet, essential for low-altitude operations.

70. C. Traffic alerts and resolution advisories TCAS (Traffic Collision Avoidance System) provides traffic alerts (TA) warning of nearby aircraft and resolution advisories (RA) commanding climb/descent maneuvers avoiding collision.

71. D. Data link and selective interrogation Mode S transponder enables data link communication between aircraft and ground, selective interrogation reducing frequency congestion, and enhanced surveillance capabilities beyond basic Mode C.

72. B. Broadcasts position, velocity, and identification ADSB (Automatic Dependent Surveillance-Broadcast) continuously broadcasts aircraft position (GPS-derived), velocity, identification, and altitude enabling surveillance without radar and traffic awareness.

73. A. Proper location, grounding, and matching to equipment Antenna installation requires proper location for signal coverage, good electrical grounding, impedance matching to transmitter/receiver, and minimum interference from structure and other antennas.

74. C. Shielded transmission preventing signal loss and EMI Coaxial cable provides shielded transmission path between antenna and radio preventing signal loss, maintaining constant impedance, and preventing electromagnetic interference.

75. D. Antenna impedance match quality Standing Wave Ratio (SWR) indicates antenna impedance match quality; ratio of maximum to minimum voltage along transmission line. SWR of 1:1 perfect; higher SWR indicates mismatch causing power loss.

76. B. Reduced range and potential interference Poor antenna grounding causes reduced transmission/reception range, potential interference, noise in receivers, and inefficient radiation pattern. Good ground plane essential for proper antenna operation.

77. C. On vertical stabilizer VOR antenna typically located on vertical stabilizer providing omnidirectional reception pattern, minimum interference from fuselage/wings, and away from propeller arc.

78. A. Clear view of sky for satellite reception GPS antenna requires clear view of sky (typically top of fuselage) for unobstructed satellite reception. Composite aircraft may require external antenna due to carbon fiber shielding.

79. D. Excessive heat causes component failure Avionics cooling essential because excessive heat causes semiconductor component failure, reduced reliability, shortened lifespan, and intermittent operation. Adequate ventilation and cooling critical.

80. B. Controls avionics bus power Avionics master switch controls power to avionics bus isolating sensitive equipment. Turned off before engine start preventing voltage spikes, turned on after alternator online.

81. A. Noise and interference in communications Static discharge on radio causes noise, crackling, and interference in communications from precipitation static (P-static) buildup during flight. Static wicks dissipate charges reducing interference.

82. C. Electromagnetic interference Shielded wiring in avionics prevents electromagnetic interference between equipment and systems. Shield intercepts radiated interference preventing coupling into signal wires.

83. D. EMI protection and proper grounding Bonding avionics equipment provides EMI protection through common ground reference, static discharge path, lightning protection, and minimizes ground loops causing interference.

84. B. Following manufacturer instructions and regulations Avionics installation requires following manufacturer installation manual, FAA regulations (14 CFR Part 43), applicable technical standard orders (TSO), and proper documentation.

85. C. Must be calculated and recorded Avionics weight and balance must be calculated and recorded. Equipment changes affect useful load and CG requiring updated weight and balance documentation.

86. A. Checking power, circuit breakers, and antenna connections Troubleshooting avionics starts with basics: verify power applied, check circuit breakers/fuses, inspect antenna connections, verify proper operation mode selected before complex troubleshooting.

87. D. Loose connections, corrosion, or thermal cycling Intermittent avionics problems often caused by loose connections from vibration, corrosion on contacts, cracked solder joints from thermal cycling, or damaged connectors.

88. B. Self-diagnostic capabilities in modern avionics Built-In Test Equipment (BITE) provides self-diagnostic capabilities in modern avionics, running internal tests, identifying failures, storing fault codes simplifying troubleshooting.

89. A. Corrosion, bent pins, and proper seating Avionics connector inspection checks for corrosion on pins/sockets, bent or damaged pins, proper mating and locking, cracked insulators, and secure backshell attachment.

90. C. Proper operation before flight Ramp testing avionics verifies proper operation before flight, testing all modes, checking reception, verifying displays, ensuring proper interaction between systems.

91. D. Specific navigation and communication equipment IFR certification requires specific equipment: two-way radio, navigation suitable for route, transponder with Mode C, gyroscopic rate-of-turn indicator, slip-skid indicator, sensitive altimeter, clock.

92. B. Leak test and accuracy verification every 24 months Pitot-static system certification requires leak test and accuracy verification every 24 calendar months per 14 CFR 91.411 for IFR operations.

93. C. Performance verification every 24 months Transponder certification requires performance verification and inspection every 24 calendar months per 14 CFR 91.413 ensuring proper operation and accuracy.

94. A. Testing to ensure accuracy every 24 months for IFR Altimeter certification involves testing accuracy every 24 calendar months per 14 CFR 91.411 for IFR operations, verifying proper operation throughout altitude range.

95. D. Every 30 days for IFR VOR accuracy check required every 30 days for IFR operations using VOT facility ($\pm 4^\circ$), ground checkpoint ($\pm 4^\circ$), airborne checkpoint ($\pm 6^\circ$), or dual VOR cross-check ($\pm 4^\circ$ between).

96. B. Annually, plus battery replacement per schedule ELT inspection required annually checking operation, crash sensor, antenna, mounting, and connections. Battery replaced when 50% service life expired or after 1 cumulative hour use.

97. A. Position, velocity, time, and identification ADSB Out equipment must transmit position (GPS-derived latitude/longitude/altitude), velocity (ground speed and track), time (GPS time), aircraft identification, and emergency status.

98. C. Multiple flight instruments on electronic screens Glass cockpit displays integrate multiple flight instruments (airspeed, altitude, attitude, heading, navigation) on electronic screens replacing individual analog instruments improving situational awareness.

99. D. Traditional analog flight instruments with displays EFIS (Electronic Flight Instrument System) replaces traditional analog flight instruments with electronic displays showing same information digitally with enhanced presentation and integration.

100. C. Critical flight instruments (attitude, airspeed, altitude, heading) Primary Flight Display (PFD) shows critical flight instruments including attitude indicator, airspeed, altitude, heading, vertical speed, and navigation information in integrated presentation.