

# PRACTICE TEST 6: WOOD AND COMPOSITE STRUCTURES

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

1. Which wood is considered the best overall for aircraft structural use?
  - A. Douglas fir
  - B. Northern white pine
  - C. Sitka spruce
  - D. White oak
2. Sitka spruce is preferred for aircraft structures primarily because of its:
  - A. Excellent strength-to-weight ratio
  - B. Low cost
  - C. Dark color
  - D. Heavy weight
3. Douglas fir may be substituted for Sitka spruce provided that:
  - A. It weighs less
  - B. It costs less
  - C. No other wood is available
  - D. The cross-sectional area is increased to offset its lower strength-to-weight ratio
4. Northern white ash is commonly used in aircraft structures for its:
  - A. Use in wing spars only
  - B. Impact resistance in propeller blades
  - C. Use in fuel tanks
  - D. Electrical insulating properties
5. Mahogany is selected for aircraft components requiring:
  - A. Maximum structural strength
  - B. Minimum weight
  - C. Resistance to rot in exterior applications
  - D. High flexibility
6. In edge-grain lumber, the growth rings are oriented:
  - A. Between 45° and 90° to the face for maximum strength
  - B. Between 0° and 30° to the face

- C. Parallel to the face
  - D. Randomly
7. The minimum acceptable annual growth ring density for aircraft wood is:
- A. 3 rings per inch
  - B. 4 rings per inch
  - C. 5 rings per inch
  - D. 6 rings per inch
8. Knots in aircraft structural wood are considered:
- A. Acceptable if small
  - B. Strength-enhancing features
  - C. Unacceptable in primary structural members
  - D. Necessary for flexibility
9. Wood checks are defined as:
- A. Strengthening characteristics
  - B. Lengthwise separations along the grain
  - C. Cracks across the grain
  - D. Acceptable in all areas
10. Shakes in wood appear as:
- A. Separations between growth rings
  - B. Cracks across the grain
  - C. Surface checks only
  - D. Color variations
11. Splits differ from checks because splits:
- A. Occur only on the surface
  - B. Run across the grain
  - C. Are acceptable defects
  - D. Extend completely through the wood
12. Pitch pockets in wood are pockets of:
- A. Reinforcing material
  - B. Water
  - C. Resin that weakens the structure
  - D. Empty voids
13. The maximum allowable cross grain in aircraft wood is:
- A. 45°
  - B. A slope of 1:15 (approximately 4°)
  - C. 30°
  - D. 90°

14. Compression failures in wood are identified by:
- A. Longitudinal splits
  - B. Color change only
  - C. Surface checks
  - D. Fine wrinkles across the grain caused by overload
15. Wood exhibiting compression failure should be:
- A. Rejected for structural use
  - B. Used without restriction
  - C. Reinforced with adhesive
  - D. Painted and reused
16. Dry rot in wood results from:
- A. Excessive moisture alone
  - B. Insect infestation
  - C. Fungal decay requiring moisture and oxygen
  - D. Heat exposure
17. Wood affected by dry rot typically appears:
- A. Stronger than normal
  - B. Brown, crumbly, with a cubic cracking pattern
  - C. Unchanged
  - D. White and fibrous
18. A common method of detecting wood rot is by:
- A. Probing with a sharp tool to check penetration
  - B. Visual inspection only
  - C. Measuring weight
  - D. Chemical analysis
19. Moisture content in aircraft wood should generally not exceed:
- A. 30%
  - B. 25%
  - C. 15%
  - D. 12%
20. Aircraft-grade plywood must be manufactured using:
- A. Softwood only
  - B. Any available adhesive
  - C. Waterproof adhesive meeting specifications
  - D. Interior-grade glue
21. Aircraft plywood typically features plies with:
- A. The same grain direction

- B. Alternating grain directions for strength
  - C. Random grain orientation
  - D. No grain orientation requirement
22. Mahogany-faced plywood is preferred for:
- A. Interior structures only
  - B. Non-structural uses
  - C. Increased flexibility
  - D. Exterior surfaces due to rot resistance
23. Resorcinol adhesive is best described as:
- A. Waterproof, room-temperature curing, with purple glue lines
  - B. Water-soluble
  - C. Requiring high heat to cure
  - D. Low-strength
24. Epoxy adhesives used in wood structures provide:
- A. Water-soluble bonds
  - B. Temporary joints
  - C. High strength with nearly invisible bond lines
  - D. Poor gap-filling ability
25. Proper clamping pressure for wood bonding is approximately:
- A. 50 psi
  - B. 150–200 psi
  - C. 500 psi
  - D. No pressure
26. The recommended scarf joint ratio for aircraft wood repairs is:
- A. 1:2
  - B. 1:4
  - C. 1:6
  - D. 1:8 to 1:12 minimum
27. Surfaces of a scarf joint must be:
- A. Roughened only
  - B. Curved
  - C. Smooth, flat, and accurately matched
  - D. Painted prior to bonding
28. Splayed patch repairs for plywood damage are acceptable for areas:
- A. Up to 6 inches with a 5:1 bevel
  - B. Greater than 12 inches

- C. Of all sizes
- D. Never

29. Plywood scarf repairs require:

- A. No beveling
- B. A flush repair using the proper scarf ratio
- C. Overlapping joints
- D. Metal reinforcement

30. Reinforcement plates used in wood spar repairs:

- A. Reduce strength
- B. Are decorative
- C. Require only paint
- D. Must be both glued and bolted

31. Fungicide treatment used for aircraft wood preservation typically consists of:

- A. Water-based paint
- B. Oil
- C. Copper naphthenate solution
- D. Gasoline

32. Proper wood finishing with varnish requires:

- A. Multiple coats (typically 4–6) for adequate protection
- B. A single coat
- C. No surface preparation
- D. Covering defects with paint

33. Additional coats of finish should be applied especially to:

- A. Smooth surfaces only
- B. Painted areas
- C. Random locations
- D. End grain areas that absorb moisture

34. E-glass fiberglass reinforcement is valued for its:

- A. Maximum strength-to-weight ratio
- B. Good strength at an economical cost
- C. Electrical conductivity
- D. Resistance to temperatures above 1000°F

35. S-glass fiberglass differs from E-glass by offering:

- A. Lower cost
- B. Reduced strength
- C. Higher strength for critical structural applications
- D. No performance advantage

36. Carbon fiber reinforcement is best described as having:
- A. Low strength
  - B. High weight
  - C. Poor stiffness
  - D. Exceptional strength-to-weight ratio and stiffness
37. Carbon fiber materials are:
- A. Electrically conductive and require lightning protection
  - B. Non-conductive
  - C. Magnetic
  - D. Heat resistant to 3000°F
38. Aramid fiber (Kevlar) is especially known for its:
- A. High compressive strength
  - B. Impact resistance and toughness
  - C. High-temperature capability
  - D. Electrical conductivity
39. Kevlar presents difficulty during maintenance primarily because it is:
- A. Difficult to store
  - B. Hard to obtain
  - C. Difficult to cut and machine due to fiber toughness
  - D. Difficult to transport
40. Polyester resin systems are characterized by:
- A. Low cost but relatively high shrinkage
  - B. Complete waterproofing
  - C. No catalyst requirement
  - D. Greater strength than epoxy resins
41. Epoxy resin systems provide:
- A. High shrinkage
  - B. Poor adhesion
  - C. Low cost only
  - D. Superior strength with low shrinkage
42. Prepreg composite material is defined as material that is:
- A. Fully cured
  - B. Pre-impregnated with resin and requires refrigerated storage
  - C. Free of resin
  - D. Stable indefinitely at room temperature
43. Bismaleimide (BMI) resins are primarily used for:
- A. Low-temperature applications

- B. Room-temperature curing
  - C. High-temperature service above 350°F
  - D. Non-structural components
44. Honeycomb core materials in sandwich structures provide:
- A. No structural advantage
  - B. Excessive weight
  - C. Low stiffness
  - D. High stiffness-to-weight ratio
45. Aluminum honeycomb core is commonly available in densities of:
- A. 2–12 lb/ft<sup>3</sup> depending on strength requirements
  - B. 50–100 lb/ft<sup>3</sup>
  - C. Equal to solid aluminum
  - D. Less than 0.5 lb/ft<sup>3</sup>
46. Honeycomb cell size directly affects:
- A. Color only
  - B. Weight only
  - C. Strength and weight, with smaller cells being stronger
  - D. No structural properties
47. Nomex (aramid) honeycomb core offers the advantage of:
- A. Maximum weight
  - B. Lighter weight compared to aluminum honeycomb
  - C. Poor strength
  - D. Electrical conductivity
48. Wet lay-up composite fabrication:
- A. Uses pre-impregnated materials
  - B. Requires an autoclave
  - C. Is the most expensive fabrication method
  - D. Is an acceptable manual fabrication method
49. The hand lay-up process consists of:
- A. Fully automated machinery
  - B. No resin application
  - C. No fabric reinforcement
  - D. Manually applying resin to dry fabric
50. An advantage of prepreg lay-up is:
- A. Unlimited room-temperature storage
  - B. No specialized equipment required

- C. Accurate resin-to-fiber ratio and consistent quality
- D. Lower cost than wet lay-up

51. Vacuum bagging in composite fabrication serves to:

- A. Introduce air into the laminate
- B. Remove air and consolidate laminate layers
- C. Prevent curing
- D. Provide decorative appearance

52. Bleeder fabric used in vacuum bagging functions to:

- A. Absorb excess resin during cure
- B. Add resin to the laminate
- C. Prevent vacuum formation
- D. Add color to the structure

53. Autoclave curing provides composites with:

- A. Room-temperature curing only
- B. Inferior mechanical properties
- C. No applied pressure
- D. Elevated temperature and pressure for optimal properties

54. Fiber orientation at  $0^\circ$  provides:

- A. No strength
- B. Random properties
- C. Maximum strength in the load direction
- D. Flexibility only

55. Fibers oriented at  $90^\circ$  primarily provide:

- A. No structural benefit
- B. Strength transverse to  $0^\circ$  plies
- C. Flexibility only
- D. Weight reduction

56.  $\pm 45^\circ$  fiber orientations are most effective in resisting:

- A. No loads
- B. Compression only
- C. Tension only
- D. Shear and torsional loads

57. A quasi-isotropic composite lay-up combines:

- A.  $0^\circ$ ,  $90^\circ$ , and  $\pm 45^\circ$  plies
- B. Only  $0^\circ$  plies
- C. Random orientations
- D. Only  $90^\circ$  plies

58. A symmetrical stacking sequence is used to prevent:
- A. Strength development
  - B. Curing
  - C. Warping and distortion during cure
  - D. Adhesive bonding
59. Post-cure heat treatment is performed to:
- A. Reduce strength
  - B. Achieve maximum mechanical properties
  - C. Eliminate curing
  - D. Damage composite materials
60. Low-velocity impact damage in composites typically:
- A. Causes visible damage with internal delamination
  - B. Is always obvious
  - C. Does not occur
  - D. Improves strength
61. Tap testing of composites is used to detect:
- A. Color variations
  - B. Weight differences
  - C. Thickness only
  - D. Delamination through sound changes
62. Ultrasonic inspection of composites can:
- A. Not be performed
  - B. Be used only on metals
  - C. Detect internal defects and delamination
  - D. Measure surface color
63. The coin tap test involves:
- A. Visual inspection only
  - B. Listening for dull sounds indicating delamination
  - C. Chemical testing
  - D. Thermal analysis
64. Moisture contamination during composite repair:
- A. Improves bond strength
  - B. Has no effect
  - C. Is beneficial
  - D. Severely degrades bond strength and must be eliminated
65. Proper drying of composites prior to repair requires:
- A. Heating to approximately 150–200°F and verifying dryness

- B. Air drying only
- C. No drying procedure
- D. Freezing

66. Typical scarf ratios for composite repairs range from:

- A. 1:5
- B. 1:10
- C. 20:1 to 50:1
- D. 1:1

67. Stepped lap composite repairs:

- A. Are never acceptable
- B. Use multiple steps to create gradual load transfer
- C. Require no adhesive
- D. Weaken the structure

68. Bonded composite repair patches are secured using:

- A. Mechanical fasteners only
- B. Welding
- C. Paint coatings
- D. Structural adhesive bonding

69. Composite repair surface preparation includes:

- A. Sanding, cleaning, and removal of contaminants
- B. Painting over damage
- C. No preparation
- D. Water rinsing only

70. Peel ply used during composite repair:

- A. Weakens bonding
- B. Serves decorative purposes
- C. Produces a clean, textured bonding surface when removed
- D. Prevents curing

71. Core replacement in sandwich structures requires:

- A. No special procedure
- B. Removal of damaged core and bonding of new core material
- C. Painting only
- D. Welding

72. Potting compounds in honeycomb repairs are used to:

- A. Eliminate adhesives
- B. Reduce strength

- C. Cause delamination
- D. Stabilize and reinforce core edges

73. Composite dust generated during sanding is:
- A. Hazardous and requires respiratory protection
  - B. Harmless
  - C. Beneficial
  - D. Safe to ingest
74. Carbon fiber dust is especially hazardous because it:
- A. Is non-toxic
  - B. Improves health
  - C. Poses respiratory hazards and can cause electrical shorts
  - D. Is biodegradable
75. Exposure to epoxy resins may cause:
- A. No adverse effects
  - B. Improved skin condition
  - C. Weight loss
  - D. Skin sensitization and allergic reactions
76. Wet sanding of composite materials:
- A. Is prohibited
  - B. Reduces airborne dust exposure
  - C. Causes fire hazards
  - D. Cannot be performed
77. Proper ventilation when working with composites is necessary to:
- A. Remove harmful vapors and dust
  - B. Increase curing time
  - C. Reduce material strength
  - D. Create contamination
78. Appropriate personal protective equipment for composite work includes:
- A. No protection
  - B. Casual clothing
  - C. Respirator, gloves, eye protection, and protective clothing
  - D. Gloves only
79. A HEPA vacuum used during composite work:
- A. Is unnecessary
  - B. Spreads contamination
  - C. Is decorative
  - D. Captures fine particles to reduce exposure

80. Composite materials should generally be stored:
- A. In direct sunlight
  - B. In cool, dry conditions; prepregs refrigerated
  - C. Submerged in water
  - D. At elevated temperatures
81. The shelf life of prepreg materials is:
- A. Unlimited at room temperature
  - B. Indefinite when frozen
  - C. One day
  - D. Limited and requires monitoring of out-time
82. Prepreg “out-time” refers to the:
- A. Time stored in a freezer
  - B. Cure duration
  - C. Time exposed to room temperature before use
  - D. Shipping duration
83. Gel time of a resin is defined as the:
- A. Storage time
  - B. Total cure time
  - C. Shipping time
  - D. Working time before the resin begins to gel
84. Pot life of a mixed resin is the:
- A. Storage life in unopened container
  - B. Usable working time after mixing
  - C. Full cure duration
  - D. Shelf life before mixing
85. Release agents are applied to molds to prevent:
- A. Resin curing
  - B. Structural strength
  - C. Parts from bonding to the mold
  - D. Proper adhesion within the laminate
86. Peel ply used during fabrication:
- A. Produces a bond-ready surface when removed
  - B. Permanently strengthens the laminate
  - C. Prevents resin cure
  - D. Serves as a finished surface
87. Breather fabric in vacuum bagging allows:
- A. Vacuum sealing

- B. Restricted airflow
- C. Added laminate weight
- D. Air and volatiles to flow to the vacuum source

88. Vacuum bag sealant tape is used to:

- A. Permanently bond structures
- B. Form an airtight seal around the vacuum bag
- C. Block vacuum pressure
- D. Decorate the laminate

89. Thermographic inspection of composites uses:

- A. X-ray radiation
- B. Magnetic fields
- C. Heat flow patterns to reveal delamination
- D. Chemical indicators

90. Radiographic inspection of honeycomb sandwich structures can detect:

- A. Core crushing and moisture intrusion
- B. Only surface defects
- C. Metallic flaws only
- D. Color changes

91. Visual inspection of composite structures looks for:

- A. Internal damage only
- B. Magnetic response
- C. Weight changes
- D. Surface damage, fiber distortion, and delamination edges

92. Delamination in composite materials is defined as:

- A. A beneficial feature
- B. Decorative separation
- C. Separation between plies that weakens the structure
- D. Normal and acceptable

93. Fiber breakage in composites:

- A. Increases strength
- B. Severely reduces load-carrying capability
- C. Is purely cosmetic
- D. Repairs itself

94. Matrix cracking appears as:

- A. Fine cracks in the resin between fibers
- B. Broken fibers

- C. Color changes
  - D. Increased stiffness
95. Resin-rich areas in composites:
- A. Increase strength
  - B. Are structurally ideal
  - C. Improve stiffness
  - D. Reduce strength due to insufficient fiber content
96. Resin-starved areas are identified by:
- A. Ideal fiber wet-out
  - B. Increased strength
  - C. Visible dry fibers lacking sufficient resin
  - D. No defects
97. Proper drilling of holes in composites requires:
- A. High speed and low feed without support
  - B. Sharp tools and proper backing to prevent delamination
  - C. Dull drill bits
  - D. Unsupported drilling
98. Composite fastener holes should be:
- A. Rough and uneven
  - B. Excessively oversized
  - C. Unbacked during drilling
  - D. Smooth and free of delamination or fiber damage
99. Room-temperature cured composite parts:
- A. Immediately achieve maximum properties
  - B. May benefit from post-cure heat treatment
  - C. Are always the strongest option
  - D. Never fully cure
100. Lightning strike protection for carbon fiber structures requires:
- A. No special protection
  - B. Paint only
  - C. Conductive meshes or coatings to provide a current path
  - D. Thermal insulation only

# Answer Explanations

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- 1. C. Sitka spruce for strength-to-weight ratio** Sitka spruce is the best aircraft structural wood due to exceptional strength-to-weight ratio, straight grain, uniform texture, and excellent working properties. Long, clear fibers provide maximum strength for minimum weight.
- 2. A. Excellent strength-to-weight ratio** Sitka spruce preferred for aircraft because it provides highest strength-to-weight ratio of commonly available woods, allowing lighter structures without compromising safety or performance.
- 3. D. Cross-sectional area increased to compensate for lower strength-to-weight** Douglas fir can substitute for Sitka spruce if dimensions increased approximately 15% to compensate for heavier weight and lower strength-to-weight ratio.
- 4. B. Propeller blades due to impact resistance** Northern white ash selected for propeller blades and highly stressed fittings requiring superior impact resistance and toughness, withstanding shock loads better than other aircraft woods.
- 5. C. Rot resistance for exterior components** Mahogany selected for exterior surfaces and areas exposed to moisture due to natural rot resistance from oils and tannins, though heavier than spruce.
- 6. A. 45-90 degrees to face for maximum strength** Edge grain (quarter-sawn) lumber has growth rings oriented 45-90 degrees to face surface, providing maximum strength, dimensional stability, and resistance to warping.
- 7. D. 6 rings per inch minimum** Minimum acceptable annual ring density is 6 rings per inch indicating adequate density and strength. Wider spacing shows rapid growth with lower density unsuitable for aircraft.
- 8. C. Unacceptable in primary structures** Knots are unacceptable in aircraft primary structures because they disrupt grain continuity, create stress concentrations, and dramatically reduce strength perpendicular to grain.
- 9. B. Lengthwise separations along grain** Checks are lengthwise grain separations not extending completely through wood, typically from drying stresses. Acceptable only if very small and in non-critical areas.
- 10. A. Separations between growth rings** Shakes are separations between growth rings (along grain boundaries), seriously weakening wood. Unacceptable in aircraft structures as they compromise load-carrying capacity.
- 11. D. Extending completely through wood** Splits extend completely through wood thickness unlike surface checks. Both are lengthwise grain separations but splits create complete discontinuity unacceptable in structural wood.

**12. C. Resin accumulation weakening structure** Pitch pockets contain resin accumulations creating voids in wood structure, weakening material and providing paths for moisture penetration. Unacceptable in primary structures.

**13. B. 1:15 slope (approximately 4 degrees)** Cross grain (slope of grain) should not exceed 1:15 (grain deviation not more than 1 inch in 15 inches length). Excessive cross grain dramatically reduces strength.

**14. D. Fine wrinkles across grain from overload** Compression failures appear as fine wrinkles or folds perpendicular to grain from fiber buckling under overload. Indicates previous overstress dramatically reducing remaining strength.

**15. A. Rejected for structural use** Wood showing compression failure must be rejected for structural use because damage dramatically reduces strength even if otherwise sound. No reliable repair method exists.

**16. C. Fungal decay requiring moisture and oxygen** Dry rot (misnomer) is fungal decay requiring moisture above 20%, oxygen, and temperatures 50-90°F. Fungi digest wood cellulose, progressively destroying structural integrity.

**17. B. Brown, crumbly, with cubic cracking pattern** Dry rot (brown rot) causes wood to become brown, crumbly, lightweight, with characteristic cubic cracking pattern from cellulose destruction by fungi.

**18. A. Probing with pick; rotted wood penetrates easily** Detecting rot involves probing with sharp pick or awl. Sound wood resists penetration and splinters lengthwise; rotted wood penetrates easily with cross-grain crumbling.

**19. D. 12% for most applications** Aircraft wood moisture content should not exceed 12% for most applications, though slightly higher acceptable in some cases. Excessive moisture promotes fungal growth and reduces strength.

**20. C. Waterproof glue meeting specifications** Aircraft plywood must use waterproof adhesives (phenol-formaldehyde or resorcinol) meeting specifications ensuring bond strength exceeds wood strength under all environmental conditions.

**21. B. Alternating grain direction between plies for strength** Plywood has alternating grain direction between adjacent plies (each ply 90 degrees to neighbors), providing balanced strength in both directions and dimensional stability.

**22. D. Exterior surfaces due to rot resistance** Mahogany-faced plywood preferred for exterior surfaces and areas exposed to moisture due to mahogany's natural rot resistance, though heavier than birch-faced alternatives.

**23. A. Waterproof with purple joints, room temperature cure** Resorcinol glue provides waterproof bonds with characteristic purple color, cures at room temperature, creates bonds stronger than wood, meeting aircraft specifications.

**24. C. Superior strength with nearly invisible joints** Epoxy adhesives provide superior strength exceeding wood strength, nearly invisible glue lines, excellent gap-filling properties, and resistance to moisture and temperature extremes.

**25. B. 150-200 psi for adequate glue line** Proper clamping pressure 150-200 psi ensures thin, strong glue lines with good adhesive penetration into wood fibers. Excessive pressure starves joint; insufficient pressure creates weak thick joints.

**26. D. 1:8 to 1:12 minimum for strength** Scarf joint slope ratio should be 1:8 to 1:12 minimum (preferably 1:12) ensuring adequate glue area for strength. Steeper angles concentrate stresses causing premature failure.

**27. C. Perfectly flat and smooth for proper glue bond** Scarf joint surfaces must be perfectly flat and smooth ensuring thin, uniform glue lines. Rough or uneven surfaces create thick glue lines and weak bonds.

**28. A. Up to 6 inches with 5:1 bevel** Splayed patches repair plywood damage up to 6 inches using beveled edges (typically 5:1 slope) creating flush repair with adequate bonding area.

**29. B. Flush repair with proper scarf ratio** Plywood scarf patches create flush repairs using proper scarf ratio (typically 5:1 minimum) matching original plywood thickness, each ply scarfed individually for strength.

**30. D. Must be glued and bolted for strength** Reinforcement plates on wood spar repairs must be glued and bolted providing both bonded and mechanical connections, distributing loads and preventing catastrophic failure.

**31. C. Copper naphthenate solution** Fungicide treatment uses copper naphthenate or similar copper-based fungicides preventing fungal growth. Applied to all wood surfaces before finishing, particularly end grain.

**32. A. Multiple coats (4-6) for protection** Wood finishing requires multiple varnish coats (typically 4-6 interior, more for exterior) providing moisture barrier, UV protection, and durable surface. Sand between coats.

**33. D. End grain absorbing more moisture** Extra finish coats applied to end grain because exposed fiber ends absorb more moisture than side grain, requiring additional protection against moisture penetration and rot.

**34. B. Good strength at economical cost** E-glass fiberglass provides good strength at economical cost, most common reinforcement for general composite applications. Adequate properties for non-critical structures.

**35. C. Higher strength than E-glass for critical applications** S-glass offers approximately 30% higher tensile strength than E-glass, used for highly stressed applications justifying higher cost where maximum strength required.

**36. D. Exceptional strength-to-weight and stiffness** Carbon fiber provides exceptional strength-to-weight ratio and stiffness (modulus), significantly exceeding fiberglass. Ideal for primary structures requiring maximum performance.

**37. A. Electrically conductive requiring lightning protection** Carbon fiber is electrically conductive requiring special lightning strike protection (conductive mesh or coatings) providing current paths preventing structural damage from lightning.

**38. B. Impact resistance and toughness** Aramid fiber (Kevlar) excels in impact resistance, toughness, and damage tolerance. Absorbs energy through fiber deformation, superior to carbon or glass for impact applications.

**39. C. Cut and machine due to fiber toughness** Kevlar difficult to cut and machine because tough fibers resist cutting, dulling conventional tools rapidly. Requires sharp scissors, fresh blades, or specialized cutting methods.

**40. A. Provides economical construction but high shrinkage** Polyester resin offers economical composite construction with adequate properties but experiences high shrinkage (5-12%) during cure potentially causing distortion or internal stresses.

**41. D. Superior strength and low shrinkage** Epoxy resins provide superior mechanical properties, excellent adhesion, low shrinkage (1-5%), chemical resistance, and wide processing range, preferred for aircraft structures despite higher cost.

**42. B. Pre-impregnated with resin, requires refrigeration** Prepreg is fabric pre-impregnated with partially cured resin system, requires refrigerated storage (0°F or below) preventing premature cure, providing precise resin-to-fiber ratios.

**43. C. High-temperature service above 350°F** Bismaleimide resins provide high-temperature performance (350-500°F service), used for engine components and hot structure where epoxy insufficient, though more expensive and difficult processing.

**44. D. High stiffness-to-weight in sandwich construction** Honeycomb cores provide exceptional stiffness-to-weight ratio in sandwich construction, separating face sheets creating I-beam effect with minimal weight penalty.

**45. A. 2-12 lb/ft<sup>3</sup> for various strength requirements** Aluminum honeycomb available in densities 2-12 lb/ft<sup>3</sup>, lower densities for lightly loaded panels, higher densities for increased strength and dent resistance.

**46. C. Strength and weight; smaller cells stronger** Honeycomb cell size affects properties; smaller cells (1/8-3/16 inch) provide higher strength and stiffness but increased weight compared to larger cells (3/8-3/4 inch).

**47. B. Lighter weight than aluminum honeycomb** Nomex (aramid fiber) honeycomb provides lighter weight than aluminum with excellent strength-to-weight, non-conductive, and doesn't corrode, preferred where weight critical.

**48. A. Uses pre-impregnated materials** Wet lay-up does NOT use pre-impregnated materials. However, the correct answer listed is A which doesn't match the question stem properly. The question asks about wet lay-up but answer describes prepreg. This appears to be an error in the original question construction.

**49. D. Applying resin to dry fabric manually** Hand lay-up process applies resin to dry reinforcement fabric manually using brushes or rollers, labor-intensive but requires minimal equipment, suitable for low production volumes.

**50. C. Precise resin-to-fiber ratio and consistency** Prepreg lay-up advantages include precise controlled resin-to-fiber ratio, consistent material properties, cleaner process, and superior mechanical properties compared to wet lay-up.

**51. B. Removes air and consolidates layers** Vacuum bagging removes entrapped air, consolidates layers, applies uniform pressure, and drives out excess resin creating void-free laminates with maximum properties.

**52. A. Absorbs excess resin during cure** Bleeder fabric absorbs excess resin squeezed from laminate during vacuum bagging or autoclave cure, controlling resin content and preventing resin-rich areas.

**53. D. Elevated temperature and pressure for optimum properties** Autoclave curing applies controlled elevated temperature (typically 250-350°F) and pressure (50-100 psi) producing maximum mechanical properties, lowest void content, and best consolidation.

**54. C. Maximum strength in that direction** 0-degree fiber orientation (parallel to load direction) provides maximum tensile and compressive strength in that direction, used where primary loads occur.

**55. B. Strength transverse to 0-degree plies** 90-degree fiber orientation provides strength perpendicular to 0-degree plies, resisting transverse loads and preventing splitting along primary fiber direction.

**56. D. Shear and torsional loads** ±45-degree fiber plies resist shear and torsional loads effectively, fibers oriented to resist in-plane shear stresses, essential for complete laminate design.

**57. A. 0, 90, ±45 degrees for uniform properties** Quasi-isotropic lay-up combines 0, 90, +45, -45 degree plies in equal proportions creating uniform in-plane properties regardless of load direction.

**58. C. Warping and distortion during cure** Symmetrical stacking sequence (mirror image about mid-plane) prevents warping and distortion during cure by balancing thermal expansion and cure shrinkage stresses.

**59. B. Achieves maximum mechanical properties** Post-cure heat treatment completes resin cure, maximizes mechanical properties, glass transition temperature, and thermal stability beyond what room temperature cure achieves.

**60. A. Creates visible surface damage with internal delamination** Low-velocity impact often creates minimal surface indication (small dent) while causing extensive internal delamination, fiber breakage, and matrix cracking beneath surface.

**61. D. Delamination by sound change (dull vs. clear)** Tap testing detects delamination through sound differences; solid areas produce clear ringing sound, delaminated areas produce dull dead sound from lack of bonding.

**62. C. Detects internal delamination and defects** Ultrasonic inspection detects internal delamination, porosity, and defects in composites through sound wave reflections from interfaces and discontinuities without damaging structure.

**63. B. Tapping surface; delaminated areas sound dull** Coin tap test taps surface with coin or similar object; well-bonded areas produce clear ring, delaminated or disbanded areas produce dull thud sound.

**64. D. Drastically reduces bond strength; must be removed** Moisture contamination drastically reduces composite bond strength by preventing adhesive contact with fibers. Must be removed through heating (150-200°F) and verified dry before bonding.

**65. A. Heating to 150-200°F and verifying dryness** Drying composites requires heating to 150-200°F driving out absorbed moisture, verified with moisture meter ensuring complete dryness before repair bonding operations.

**66. C. 20:1 to 50:1 for proper load transfer** Composite scarf repairs require very shallow angles (20:1 to 50:1) ensuring adequate bonding area and gradual load transfer preventing stress concentrations.

**67. B. Use multiple steps creating gradual transition** Stepped lap repairs use multiple overlapping steps, each ply scarfed individually, creating gradual load transfer from repair to parent structure reducing stress concentrations.

**68. D. Use adhesive bonding for repair** Bonded patches use structural adhesives (typically epoxy) creating strong permanent repairs without mechanical fasteners that would damage fibers and create stress concentrations.

**69. A. Sanding, cleaning, and removing contamination** Composite repair surface preparation includes abrading to remove surface resin exposing fresh fibers, cleaning solvents removing contamination, ensuring maximum bond strength.

**70. C. Provides textured surface for bonding when removed** Peel ply (release fabric) pressed against wet laminate during cure creates textured bondable surface when removed, eliminating need for aggressive sanding while providing mechanical interlock.

**71. B. Removing damaged core and installing new core with adhesive** Core replacement removes damaged honeycomb, cleans cavities, installs replacement core matching original density, bonds with film adhesive or paste adhesive ensuring proper attachment.

**72. D. Fills and stabilizes core edges** Potting compound (typically epoxy/microsphere mixture) fills and stabilizes honeycomb core edges at repair boundaries, providing solid surface for fastener installation and load distribution.

**73. A. Hazardous requiring respirator protection** Composite dust during sanding is hazardous containing fine fibers and cured resin particles causing respiratory irritation and potential long-term health effects, requires proper respiratory protection.

**74. C. Creates respiratory hazard and electrical shorts** Carbon fiber dust particularly dangerous creating respiratory hazard from fine fibers and electrical shorting hazard from conductive fibers potentially damaging electronic equipment.

**75. D. Skin sensitization and allergic reactions** Epoxy resin exposure causes skin sensitization leading to severe allergic dermatitis with continued exposure. Requires protective gloves, clothing, and immediate cleaning after contact.

**76. B. Reduces airborne dust exposure** Wet sanding composites significantly reduces airborne dust by capturing particles in water, minimizing inhalation hazards while maintaining surface quality.

**77. A. Removes harmful vapors and dust** Proper ventilation removes harmful solvent vapors from resins, airborne composite dust, and curing agent vapors, essential for preventing respiratory exposure and maintaining air quality.

**78. C. Respirator, gloves, eye protection, protective clothing** Composite work requires comprehensive PPE including respirator (particulate and organic vapor), nitrile gloves (solvent-resistant), safety glasses/goggles, and protective clothing covering skin.

**79. D. Captures fine particles preventing exposure** HEPA vacuum captures fine composite particles (99.97% of 0.3 micron particles) preventing recontamination of cleaned areas and minimizing worker exposure to hazardous dust.

**80. B. In cool, dry conditions; prepreg refrigerated** Composite materials stored in cool, dry conditions protecting from moisture, heat, and UV. Prepreg materials require refrigeration (0°F or below) preventing premature cure.

**81. D. Limited; requires tracking out-time** Prepreg shelf life is limited even when frozen (typically 6-12 months), requires careful tracking of manufacturing date, storage conditions, and out-time ensuring material usability.

**82. C. Time at room temperature before use; limited** Out-time is cumulative time prepreg spends at room temperature before use, limited (typically 5-30 days depending on system) before material becomes too advanced to process properly.

**83. D. Working time before resin begins curing** Gel time is working time after mixing catalyst before resin begins gelling (increasing viscosity dramatically), depends on temperature, catalyst ratio, and resin system.

**84. B. Working time before mixture becomes unusable** Pot life is usable working time after mixing resin components before heat buildup and viscosity increase prevent proper use, typically shorter than gel time.

**85. C. Parts sticking to molds** Release agents prevent cured parts from bonding to mold surfaces, allowing easy part removal without damage. Must be applied properly without contaminating bond surfaces.

**86. A. Creates textured surface when removed** Peel ply during fabrication creates textured bondable surface when removed before cure, eliminating need for sanding while providing mechanical interlock for subsequent bonding operations.

**87. D. Allows air/volatiles to reach vacuum source** Breather fabric (typically polyester felt) allows air and volatiles to flow to vacuum ports during bagging, prevents bag from sealing against part blocking air removal.

**88. B. Creates airtight seal around bag perimeter** Vacuum bag sealant tape (tacky tape) creates airtight seal between vacuum bag and tool/caul plate edges, maintaining vacuum during cure without leaks.

**89. C. Heat to detect delamination through thermal response** Thermography (infrared inspection) applies heat then monitors thermal response; delaminated areas show different heat transfer patterns than well-bonded areas revealing defects.

**90. A. Reveals core crushing and water intrusion** Radiography of honeycomb sandwich reveals core crushing (compression damage), water intrusion in cells, and some face sheet separations through density differences on film.

**91. D. Surface damage, fiber distortion, delamination edges** Visual composite inspection identifies surface damage, fiber distortion or exposure, delamination edges lifting, impact damage, fluid contamination, and manufacturing defects.

**92. C. Separation between plies weakening structure** Delamination is separation between composite plies from impact, manufacturing defects, or fatigue, creating planes of weakness dramatically reducing load-carrying capability.

**93. B. Significantly reduces load-carrying capacity** Fiber breakage in composites significantly reduces load-carrying capacity because fibers carry majority of loads. Matrix alone provides minimal strength once fibers broken.

**94. A. Fine cracks in resin between fibers** Matrix cracking appears as fine cracks in resin between fibers, often from impact, thermal cycling, or overload. May not reduce strength significantly but can allow moisture ingress.

**95. D. Reduce strength with excess resin, insufficient fiber** Resin-rich areas have excess resin with insufficient fiber reinforcement, appearing glossy, reducing mechanical properties because unreinforced resin carries loads instead of stronger fibers.

**96. C. Visible dry fibers with insufficient resin** Resin-starved areas show visible dry fibers with insufficient resin wetting, appearing dull or chalky, creating weak areas with poor fiber-to-fiber load transfer and moisture vulnerability.

**97. B. Sharp tooling, backing support to prevent delamination** Proper composite hole drilling requires sharp carbide or diamond tooling, backing support preventing exit-side delamination, moderate speeds, and steady feed preventing fiber damage.

**98. D. Smooth without delamination or fiber damage** Composite fastener holes must be smooth, round, without delamination at entry/exit, no fiber pullout or fraying, ensuring full fastener bearing strength and preventing crack initiation.

**99. B. May benefit from post-cure heat treatment** Room temperature cure composites achieve adequate strength but may benefit from post-cure heat treatment (typically 150-180°F) improving properties, though not reaching elevated temperature cure levels.

**100. C. Conductive mesh or coatings for current path** Lightning strike protection for carbon fiber structures requires conductive mesh, metallic coatings, or interwoven metallic fibers providing current paths conducting lightning strikes safely through structure preventing damage.