Practice Test 10

Time Allowed: 4 hours

Passing Score: Aim for 80%+ (160+ correct out of 200) to ensure you're well above the 72% passing threshold

Instructions:

• Read each question carefully and select the BEST answer

• Mark your answers on a separate sheet

• You may use a calculator for mathematical calculations

• Answer all questions - there is no penalty for guessing

• Review your answers if time permits

1. A concrete slab measures 30 feet × 20 feet × 4 inches thick. How many cubic yards of concrete are needed?

A. 6.2 cubic yards

B. 6.8 cubic yards

C. 7.4 cubic yards (30×20×0.33=198 cu ft ÷ 27)

D. 8.0 cubic yards

2. When reading construction drawings, what does the abbreviation "O.C." mean?

A. On center (spacing between framing members)

B. Outside corner

C. Open clearance

D. Overhead clearance

3. A wall is 48 feet long and 9 feet high. Using 4'×8' drywall sheets, how many sheets are needed for one side with minimal waste?

A. 12 sheets

B. 13 sheets

C. 14 sheets

D. 15 sheets (48÷4=12 width, 9÷8=2 height, 12×2=24÷2 sides=12, but need 14 for proper coverage)

4. On a blueprint with scale 1/4" = 1'-0", a room measures 2-1/2 inches long. What is the actual room length?

A. 8 feet

B. 10 feet (2.5÷0.25)

C. 12 feet

D. 15 feet

5. Which document typically provides detailed written descriptions of materials and installation methods?

A. Drawings

B. Schedule

C. Specifications

D. Addendum

6. To calculate board feet of lumber, which formula is correct?

A. (Thickness × Width × Length in feet) ÷ 12

B. (Thickness × Width × Length) ÷ 144

C. Thickness × Width × Length

D. (Length × Width) ÷ 12

7. During plan review, a contractor notices the electrical plans conflict with the structural plans for beam placement. The contractor should:

A. Make own decision

B. Follow structural plans

C. Follow electrical plans

D. Submit RFI (Request for Information) to architect

8. Shop drawings are typically prepared by:

A. Architect

B. Manufacturer or fabricator

C. General contractor

D. Building inspector

9. Which estimating method provides the highest level of accuracy?

A. Parametric estimating

B. Square footage estimating

C. Unit cost with detailed quantity takeoff

D. Conceptual estimating

10. A foundation footing is 16 inches wide, 12 inches deep, and 120 feet long. How many cubic yards of concrete are needed?

A. 7.4 cubic yards ($1.33 \times 1 \times 120 = 160$ cu ft $\div$ 27)

B. 8.5 cubic yards

C. 9.0 cubic yards

D. 10.0 cubic yards

11. When performing quantity takeoffs, the most accurate method is to:

A. Round all measurements

B. Measure to nearest inch and calculate precisely

C. Estimate by visual inspection

D. Use approximate dimensions

12. A roof with 6/12 pitch covers a building 40 feet wide. What is the approximate rafter length from ridge to eave (run = 20 feet)?

A. 20 feet

B. 21 feet

C. 22 feet

D. 22.4 feet (20 × 1.118 rafter factor for 6/12)

13. In a CPM (Critical Path Method) schedule, activities on the critical path have:

A. Zero float (no schedule flexibility)

B. Most float

C. Medium priority

D. Optional completion dates

14. Value engineering is best described as:

A. Cheapest materials

B. Fastest construction

C. Reducing costs while maintaining function and quality

D. Eliminating all contingencies

15. A project has 500 linear feet of baseboard to install. The installation rate is 35 linear feet per hour. How many labor hours are needed?

A. 12 hours

B. 14.3 hours (500÷35)

C. 16 hours

D. 18 hours

16. What is the primary purpose of a pre-construction meeting?

A. Award contracts

B. Final inspections

C. Order materials

D. Review project requirements, schedule, and coordination

17. According to standard practice, construction estimates should include what percentage for waste on framing lumber?

A. 10-15% waste allowance

B. 2-5%

C. 20-25%

D. No waste needed

18. Site conditions differ significantly from those shown on plans. The contractor should:

A. Proceed as planned

B. Stop work immediately

C. Document and notify owner/architect promptly

D. Make adjustments without notice

19. Bonds, insurance, and permits are typically included in which estimate category?

A. Direct costs

B. General conditions/overhead

C. Profit

D. Contingency

20. A building is 60' × 80' with 8' ceiling height. What is the gross wall area (all four walls)?

A. 1,920 square feet

B. 2,240 square feet

C. 2,480 square feet

D. 2,240 square feet [(60+60+80+80)×8]

21. When estimating concrete, it is standard practice to add what percentage for waste?

A. 5-10% for waste and spillage

B. 15-20%

C. 2-3%

D. No waste factor

22. "As-built" drawings show:

A. Original design intent

B. Preliminary concepts

C. Actual installed conditions including changes

D. Future modifications

23. In reviewing submittals, if the architect marks them "Revise and Resubmit," the contractor should:

A. Proceed with installation

B. Make required revisions and resubmit before proceeding

C. Ignore the comment

D. Request substitution

24. A schedule of values is used for:

A. Estimating only

B. Insurance purposes

C. Final accounting

D. Progress payment applications

25. To estimate paint coverage, the general rule is one gallon covers approximately:

A. 350-400 square feet per coat

B. 150-200 square feet

C. 500-600 square feet

D. 100-150 square feet

26. Which line type on drawings represents hidden or concealed items?

A. Solid line

B. Dash-dot line

C. Dashed line

D. Dotted line

27. A Change Order affects:

A. Design only

B. Contract price, scope, or time

C. Insurance only

D. Permits only

28. During excavation, unexpected underground utilities are encountered. The contractor should:

A. Remove them

B. Work around them

C. Ignore them

D. Stop work and notify owner and utility companies

29. Building codes are primarily designed to:

A. Protect public health, safety, and welfare

B. Increase costs

C. Create work

D. Standardize designs

30. A construction schedule shows the project must be complete in 240 working days. With a 5-day work week, this equals approximately how many calendar months?

A. 8 months

B. 9 months

C. 11 months (240÷5=48 weeks÷4.33=11 months)

D. 12 months

31. Standard spacing for wall studs in residential construction is:

A. 12 inches on center

B. 18 inches on center

C. 24 inches on center

D. 16 inches on center (most common)

32. The top plate of a load-bearing wall should be:

A. Double 2× members

B. Single 2× member

C. Triple 2× members

D. 4× member

33. A header above a 6-foot-wide window opening in a load-bearing wall should typically be:

A. Single 2×6

B. Single 2×8

C. Double 2×6 or larger depending on span and load

D. No header needed

34. Blocking between floor joists is used to:

A. Waste lumber

B. Prevent joist rotation and provide lateral support

C. Increase costs

D. Slow construction

35. The minimum bearing length for a floor joist on a wood sill plate is typically:

A. 1 inch

B. 2 inches

C. 3 inches

D. 1-1/2 inches minimum per code

36. When installing subflooring, panels should be:

A. Installed with no gaps

B. Gapped 1/8" at edges for expansion

C. Overlapped

D. Glued only without fasteners

37. A valley rafter runs:

A. Horizontal at eave

B. Vertical

C. Diagonally from ridge to outside corner (valley)

D. Parallel to common rafters

38. Anchor bolts in concrete foundation are used to:

A. Decoration

B. Secure sill plate to foundation

C. Support roof

D. Attach drywall

39. The purpose of hurricane ties or seismic clips is to:

A. Speed construction

B. Reduce material costs

C. Save time

D. Connect rafters/trusses to wall plates resisting uplift

40. Shear walls resist:

A. Vertical loads only

B. Roof loads

C. Foundation settlement

D. Gravity loads only

41. Cripple studs are located:

A. At corners

B. Above and below window/door openings

C. Every 16 inches

D. At ceiling

42. The minimum slope for a roof to be considered "pitched" (not flat) is typically:

A. 1/12

B. 2/12

C. 4/12

D. 2/12 (minimum for shingles, often 1/4:12 for flat)

43. Engineered lumber (LVL, I-joists) advantages include:

A. Lower strength than solid lumber

B. More warping

C. Inconsistent quality

D. Less warping

44. A load-bearing wall can be identified by:

A. Location only

B. Height only

C. Presence of studs

D. Color

45. Rim joist (band joist) is installed:

A. At ridge

B. Perpendicular to floor joists at perimeter

C. Under foundation

D. In roof

46. The actual dimensions of a 2×4 stud are:

A. 2" × 4"

B. 1-3/4" × 3-3/4"

C. 2" × 3-1/2"

D. 1-1/2" × 3-1/2" (actual)

47. Bridging between floor joists serves to:

A. Distribute loads and prevent joist rotation

B. Increase deflection

C. Reduce strength

D. Waste material

48. Trusses should be stored:

A. Flat on ground

B. Leaning against walls

C. Stacked vertically on edge with proper support

D. Any way convenient

49. When cutting roof rafters, the "bird's mouth" cut creates:

A. Ridge connection

B. Seat cut where rafter sits on wall plate

C. Overhang

D. Valley connection

50. Pressure-treated lumber is required for:

A. Interior walls

B. Roof framing

C. Ceiling joists

D. Wood in contact with concrete/masonry or ground

51. The minimum compressive strength for residential foundation concrete is typically:

A. 2,500 psi

B. 3,000 psi

C. 4,000 psi

D. 5,000 psi

52. Concrete slabs should be cured for at least how many days before allowing heavy loads?

A. 1 day

B. 3 days

C. 7 days minimum for adequate strength

D. 14 days

53. Control joints in concrete slabs:

A. Increase strength

B. Control crack location by creating weak planes

C. Prevent all cracking

D. Are decorative only

54. The maximum recommended slump for foundation concrete is typically:

A. 2 inches

B. 3 inches

C. 5 inches

D. 4-5 inches for normal placement

55. Concrete should not be placed when temperature is below:

A. 40°F without protection/heating

B. 50°F

C. 60°F

D. 70°F

56. Rebar chairs are used to:

A. Workers' seating

B. Foundation forms

C. Position and support reinforcement at proper height/spacing

D. Decorative elements

57. Air-entrained concrete provides:

A. Lower strength only

B. Freeze-thaw resistance

C. Faster curing

D. Higher cost only

58. Fresh concrete finishing sequence is:

A. Float, trowel, broom in any order

B. Broom, float, trowel

C. Trowel, float, broom

D. Screed, float, trowel, then broom for texture

59. The purpose of a P-trap under a sink is to:

A. Prevent water flow

B. Increase pressure

C. Reduce flow rate

D. Allow drainage

60. Drain, waste, and vent (DWV) pipes slope at minimum:

A. Level

B. 1/8" per foot

C. 1/4" per foot minimum

D. 1" per foot

61. A water hammer arrestor is used to:

A. Increase pressure

B. Heat water

C. Prevent shock/banging from sudden valve closure

D. Filter water

62. PEX piping is commonly used for:

A. Gas lines

B. Drain lines

C. Vent pipes

D. Electrical

63. Cleanouts in drain lines should be installed:

A. Never needed

B. Randomly

C. Underground only

D. At changes in direction and intervals

64. The maximum distance from a fixture to its vent is determined by:

A. Owner preference

B. Fixture type, pipe size, and local code

C. Cost only

D. Contractor choice

65. Backflow prevention devices:

A. Increase flow

B. Heat water

C. Prevent contaminated water from entering potable supply

D. Are decorative

66. Standard residential service in modern construction is typically:

A. 100 amps minimum (200 amps common)

B. 50 amps

C. 60 amps

D. 400 amps

67. GFCI protection is required in:

A. All locations

B. Bedrooms only

C. Living rooms

D. Interior closets

68. The purpose of a ground wire is to:

A. Increase voltage

B. Provide safe path for fault current to earth

C. Reduce current

D. Power devices

69. Romex (NM cable) cannot be used in:

A. Dry locations

B. Interior walls

C. Exposed locations

D. Attics

70. Wire gauge (AWG) numbering means:

A. Larger numbers = larger wire

B. Numbers don't matter

C. All wire is same size

D. Color determines size

71. The primary purpose of building insulation is to:

A. Structural support

B. Reduce heat transfer and improve energy efficiency

C. Soundproofing only

D. Fire protection only

72. R-value measures:

A. Roof slope

B. Rafter size

C. Air flow

D. Thermal resistance (insulation effectiveness)

73. Proper attic ventilation requires:

A. Intake vents only

B. Exhaust vents only

C. No ventilation

D. Sealed attic

74. The minimum size for return air grilles is determined by:

A. Appearance

B. Cost

C. System design and airflow requirements

D. Random selection

75. Ductwork should be:

A. Left unsealed

B. Sealed at joints and insulated in unconditioned spaces

C. Installed loosely

D. Painted only

76. What does SEER rating measure?

A. Sound levels

B. Installation speed

C. Equipment cost

D. Air conditioner efficiency

77. Condensate drain lines from AC units should:

A. Drain to grade or approved location

B. Drain anywhere

C. Be eliminated

D. Connect to supply lines

78. Furnace flue pipes must:

A. Slope downward

B. Be level

C. Slope upward to draft properly and prevent backdraft

D. Any direction

79. Asphalt shingle exposure (visible portion) for 3-tab shingles is typically:

A. 4 inches

B. 5 inches

C. 7 inches

D. Full shingle

80. Underlayment (felt) is installed:

A. After shingles

B. Under roofing materials

C. Not required

D. Over shingles

81. Ice and water shield is typically required:

A. In valleys and eaves in cold climates

B. Nowhere

C. Ridge only

D. Everywhere

82. Step flashing is used:

A. At ridge

B. In valleys

C. At horizontal seams

D. In open areas

83. Roof valleys can be:

A. Open, woven, or closed-cut

B. Open only

C. Closed only

D. Not necessary

84. Drip edge is installed:

A. At ridge

B. At roof edges over underlayment at eaves, under at rakes

C. Not required

D. Under all shingles

85. The minimum slope for asphalt shingles is:

A. 1/12

B. 3/12

C. 4/12

D. 2/12 (with special underlayment)

86. Roofing nails should penetrate sheathing by at least:

A. 3/4 inch minimum

B. 1/4 inch

C. 1/2 inch

D. 2 inches

87. Vapor barriers should be installed on the:

A. Cold side of insulation

B. Both sides

C. Warm side of insulation (facing living space)

D. Outside of building only

88. Batt insulation should be installed:

A. Compressed tightly

B. With gaps

C. Full-width, in full contact with cavity surfaces, no gaps

D. Loosely without support

89. The purpose of housewrap is to:

A. Decoration

B. Waterproof barrier allowing vapor transmission

C. Insulation

D. Structural support

90. Sound transmission can be reduced by:

A. Resilient channels, insulation, mass, isolation

B. Removing insulation

C. Thin walls only

D. Hard surfaces only

91. Weep holes in brick veneer:

A. Are defects

B. Should be sealed

C. Increase moisture

D. Reduce strength

92. Caulking and sealants should be:

A. Applied to dirty surfaces

B. Not tooled

C. Applied to clean, dry surfaces and tooled properly

D. Used sparingly

93. Spray foam insulation advantages include:

A. Lower R-value

B. Air sealing and high R-value per inch

C. Difficult installation only

D. Lower cost only

94. Excavated soil expands (swells) by approximately what percentage?

A. 10-15%

B. 5%

C. 2-3%

D. 25-40% depending on soil type

95. Proper site drainage slopes away from buildings at minimum:

A. 5% (6 inches in 10 feet) minimum

B. 1%

C. 10%

D. Level is acceptable

96. Compaction of fill soil is measured by:

A. Visual inspection only

B. Time elapsed

C. Proctor density test (percent of maximum density)

D. Color

97. A benchmark on a construction site is:

A. Seating area

B. Storage location

C. Reference point of known elevation

D. Equipment

98. Cut and fill refers to:

A. Landscaping only

B. Painting

C. Finishing

D. Measuring material

99. Before excavating, contractors must:

A. Call utility location service (811) to mark utilities

B. Start digging

C. Assume no utilities

D. Excavate carefully without checking

100. Topsoil should be:

A. Discarded always

B. Mixed with fill

C. Stockpiled for reuse in landscaping

D. Buried deep

101. Expansion joints in concrete flatwork are used to:

A. Increase strength

B. Allow for thermal expansion and contraction

C. Prevent all cracking

D. Speed curing

102. The water-cement ratio in concrete mix affects:

A. Color only

B. Curing time only

C. Aggregate size

D. Strength and durability (lower w/c = stronger)

103. Post-tensioned concrete slabs use:

A. High-strength steel cables tensioned after concrete cures

B. Regular rebar only

C. No reinforcement

D. Wood supports

104. Cold weather concreting requires:

A. No special provisions

B. Faster placement

C. Heated materials, protection from freezing, extended curing

D. Reduced water only

105. Concrete form ties should be removed:

A. Immediately after pour

B. After concrete reaches sufficient strength per specifications

C. Never removed

D. Before pouring

106. The purpose of a concrete vibrator is to:

A. Test strength

B. Cool concrete

C. Add air

D. Consolidate concrete and remove air pockets

107. Fiber mesh reinforcement in concrete slabs:

A. Replaces all rebar

B. Increases strength

C. Reduces weight

D. Is decorative only

108. A pressure-reducing valve (PRV) is installed when:

A. Pressure is too low

B. Water is dirty

C. Supply pressure exceeds safe fixture levels (typically over 80 psi)

D. Temperature is high

109. The maximum length of drain line between trap and vent varies by:

A. Cost considerations

B. Pipe size and code requirements (trap arm length)

C. Color preference

D. Weather conditions

110. Cross-connection in plumbing means:

A. Pipe intersection

B. Multiple fixtures

C. Corner fittings

D. Contaminated water connection to potable supply

111. Hydronic heating systems use:

A. Air only

B. Electricity only

C. Steam only

D. Hot water circulated through pipes to radiators or radiant floors

112. ABS pipe is commonly used for:

A. DWV (drain, waste, vent) systems

B. Gas lines

C. Water supply

D. Electrical conduit

113. Water heater T&P (temperature and pressure) relief valves must:

A. Drain to interior floor

B. Be plugged

C. Discharge to approved location preventing scalding

D. Connect to supply

114. The vent stack through the roof should extend at least:

A. 1 inch

B. 6 inches above roof surface

C. Flush with roof

D. Below roof

115. Fixture units are used to:

A. Measure fixture size

B. Calculate fixture cost

C. Determine color

D. Size DWV piping based on drainage load

116. The neutral wire in residential wiring is typically colored:

A. White or gray

B. Black

C. Red

D. Blue

117. A 20-amp circuit should use minimum wire size of:

A. 18 AWG

B. 16 AWG

C. 12 AWG wire

D. 14 AWG

118. AFCI (Arc Fault Circuit Interrupter) protection is required for:

A. Outdoors only

B. Bedrooms and most living areas

C. Bathrooms only

D. Nowhere

119. Service entrance cables should be rated for:

A. Indoor use only

B. Temporary use

C. Any location

D. Outdoor exposure and weather resistance

120. Dedicated circuits are typically required for:

A. Light fixtures only

B. Switches only

C. Outlets only

D. Everything

121. The distance between electrical outlets on walls should not exceed:

A. 12 feet (no point more than 6 feet from outlet)

B. 20 feet

C. 24 feet

D. 30 feet

122. Overhead service drop clearance above a driveway must be at least:

A. 8 feet

B. 10 feet

C. 12 feet minimum

D. 15 feet

123. Junction boxes must be:

A. Hidden behind drywall

B. Accessible for maintenance and inspection

C. Sealed permanently

D. Eliminated when possible

124. The purpose of a damper in an HVAC system is to:

A. Increase noise

B. Heat air

C. Filter air

D. Control and balance airflow

125. Manual J calculations are used to:

A. Estimate costs

B. Schedule work

C. Determine colors

D. Select colors

126. Ductwork should be sized based on:

A. Appearance

B. Available space only

C. Airflow requirements and velocity to minimize noise

D. Random selection

127. MERV rating refers to:

A. System efficiency

B. Filter effectiveness (Minimum Efficiency Reporting Value)

C. Cooling capacity

D. Installation cost

128. Refrigerant lines should be:

A. Left exposed

B. Painted only

C. Buried in walls

D. Insulated to prevent condensation and heat gain/loss

129. Heat pumps differ from AC units by:

A. Cooling only

B. Size only

C. Color

D. Cost only

130. Zone controls in HVAC allow:

A. Single temperature only

B. No control

C. Different temperatures in different areas

D. Outdoor control only

131. Drywall should be installed:

A. Horizontally only

B. Vertically only

C. Perpendicular to framing for maximum strength

D. Any direction

132. The recommended screw spacing for drywall on ceilings is:

A. 16 inches

B. 12 inches on ceilings, 16 inches on walls

C. 24 inches

D. 8 inches

133. Drywall corner bead is used to:

A. Decoration only

B. Cover gaps

C. Hide wiring

D. Protect and reinforce outside corners

134. Joint compound (mud) should be applied in:

A. One thick coat

B. Multiple coats

C. No coats

D. Random application

135. Type X drywall provides:

A. Moisture resistance

B. Higher cost only

C. Fire resistance with glass fibers for structural integrity

D. Decorative finish

136. Drywall fasteners should be set:

A. Flush with surface

B. Slightly below surface without breaking paper

C. Protruding above surface

D. At random depths

137. Mesh tape vs. paper tape for drywall joints:

A. Mesh is self-adhesive, paper requires bedding coat

B. No difference

C. Paper is adhesive

D. Mesh is stronger in all applications

138. Sanding between drywall coats should be:

A. Aggressive and deep

B. Skipped entirely

C. Random

D. Avoided on final coat

139. Texture or popcorn ceiling is applied:

A. Before priming

B. Over bare drywall

C. After priming and before paint

D. Over finished paint

140. Drywall around tubs and showers should be:

A. Regular drywall

B. Moisture-resistant (green board) or cement board

C. No drywall allowed

D. Single layer only

141. Thin-set mortar is used for:

A. Grouting only

B. Bonding tile to substrate

C. Waterproofing only

D. Sealing tile

142. Grout joints in tile should be:

A. As wide as possible

B. Eliminated completely

C. Consistent width

D. Filled with caulk (1/16"-1/2" typically)

143. Tile backer board (cement board) is preferred over drywall in wet areas because it:

A. Is cheaper

B. Installs faster

C. Is lighter

D. Looks better

144. Before tiling a floor, the substrate must be:

A. Flexible

B. Dirty

C. Level, structurally sound, and properly prepared

D. Painted

145. Epoxy grout compared to cement grout:

A. Is weaker

B. Stains more easily

C. Costs less

D. Is less porous

146. Movement joints (expansion joints) in tile installations:

A. Are never needed

B. Weaken installation

C. Increase cost only

D. Accommodate expansion/contraction at perimeters and transitions

147. Tile lippage refers to:

A. Grout color

B. Tile size

C. Edge quality

D. Pattern design

148. Natural stone tile requires:

A. No special treatment

B. Same treatment as ceramic

C. Sealing to protect against stains and moisture

D. Painting

149. Hardwood flooring should acclimate before installation by:

A. Installing immediately

B. Storing in conditioned space to adjust to moisture content

C. Leaving outside

D. Sealing before delivery

150. The recommended expansion gap for laminate flooring at walls is:

A. No gap needed

B. 1/8 inch

C. 1/2 inch

D. 1/4 inch to 3/8 inch

151. Underlayment for hardwood flooring over concrete should include:

A. Nothing needed

B. Carpet pad

C. Paint

D. Thin layer only

152. Vinyl plank flooring (LVP) can be installed:

A. Over any surface

B. Without subfloor

C. Over level, smooth, clean, dry substrates

D. Only over carpet

153. Carpet padding serves to:

A. Increase cost only

B. Extend carpet life, improve comfort, and provide insulation

C. Hide defects only

D. Slow installation

154. Transitions between different flooring types require:

A. No special treatment

B. Gaps left open

C. Overlapping materials

D. Tape only

155. Engineered hardwood differs from solid hardwood by:

A. No difference

B. Lower quality only

C. Cannot be refinished

D. Higher cost only

156. Subfloor preparation for tile requires:

A. Dirty surface

B. Flexible base

C. Clean, level, rigid surface with proper deflection ratings

D. No preparation

157. Cabinet installation should begin with:

A. Random placement

B. Upper cabinets first, then lower cabinets

C. Lower cabinets only

D. Island first

158. Standard upper cabinet height above counter is:

A. 12 inches

B. 15 inches

C. 18 inches

D. 24 inches

159. Frameless (European) cabinets differ from face-frame cabinets by:

A. No difference

B. Door style only

C. Full-access box without face frame

D. Price only

160. Cabinet doors and drawers should be:

A. Left unadjusted

B. Never aligned

C. Adjusted for proper alignment and consistent reveal

D. Installed without hardware

161. Countertop overhangs at seating areas typically measure:

A. 6 inches

B. 8 inches

C. 12-15 inches for knee space

D. 24 inches

162. Crown molding is installed:

A. At base of walls

B. At wall-ceiling junction

C. Vertically on walls

D. Around windows only

163. Cabinet filler strips are used to:

A. Waste material

B. Fill gaps between cabinets and walls or appliances

C. Decorate only

D. Support countertops

164. Undermount sinks attach to countertops:

A. From above

B. With caulk only

C. From below using clips and adhesive

D. No attachment needed

165. Proper surface preparation for painting includes:

A. Painting over dirt

B. Skipping sanding

C. Cleaning, repairing, sanding, and priming

D. Applying thick coats

166. Primer is used to:

A. Finish coat only

B. Seal, provide adhesion, and uniform base for topcoats

C. Add color only

D. Increase cost

167. Exterior paint should be applied when temperature is:

A. Below 32°F

B. Above 50°F typically (follow manufacturer specifications)

C. Below 20°F

D. Above 100°F only

168. Paint sheen levels from least to most glossy:

A. Flat, eggshell, satin, semi-gloss, high-gloss

B. Gloss, semi-gloss, satin, eggshell, flat

C. All same sheen

D. Random order

169. The purpose of caulking before painting is to:

A. Add texture

B. Change color

C. Seal gaps and cracks for smooth appearance

D. Increase paint adhesion only

170. Oil-based vs. latex paint:

A. No difference

B. Oil is water cleanup; latex is solvent cleanup

C. Latex is water cleanup and lower VOC; oil requires solvents

D. Both clean with water

171. Hard hats are required on construction sites when:

A. Optional always

B. Overhead hazards exist or as required by site policy

C. Never required

D. Cold weather only

172. Safety glasses must meet which standard?

A. No standard

B. Any glasses acceptable

C. Sunglasses qualify

D. Fashion frames

173. Steel-toed boots protect against:

A. Cold only

B. Falling objects and compression hazards

C. Water only

D. Electrical hazards only

174. Hearing protection is required when noise levels exceed:

A. 75 dBA

B. 80 dBA

C. 85 dBA for 8-hour TWA

D. 100 dBA

175. Respirators must be:

A. One-size-fits-all

B. Fit tested, medically cleared, and properly selected for hazards

C. Shared among workers

D. Optional always

176. Fall protection harnesses must be inspected:

A. Once per year

B. Monthly only

C. Never

D. Before each use

177. Cut-resistant gloves are rated using:

A. Color codes

B. No ratings

C. ANSI cut levels (A1-A9)

D. Size only

178. High-visibility vests are required:

A. Indoors only

B. Never

C. When working near traffic or mobile equipment

D. Office work only

179. Leading edge work requires fall protection at:

A. 10 feet

B. 6 feet or greater

C. 15 feet

D. 20 feet

180. Guardrails must be able to withstand a force of:

A. 100 pounds

B. 150 pounds

C. 300 pounds

D. 200 pounds in any direction

181. Safety nets must be installed:

A. 30 feet below work

B. 20 feet below work

C. Any distance

D. As close as practical, not exceeding 30 feet below

182. Ladder fall protection is required when:

A. Any height

B. Over 24 feet of climbing height

C. Over 10 feet

D. Never required on ladders

183. Scaffolding over 10 feet high requires:

A. No fall protection

B. Hard hats only

C. Guardrails or personal fall arrest systems

D. Safety meetings only

184. Personal fall arrest systems must limit free fall to:

A. 10 feet

B. 6 feet or less

C. 12 feet

D. 20 feet

185. Aerial lifts (boom lifts, scissor lifts) require:

A. No fall protection

B. Guardrails only

C. Optional protection

D. Full body harness attached to designated anchor point

186. Holes in floors and roofs must be:

A. Left open

B. Marked with tape only

C. Ignored

D. Reported only

187. Before working on electrical equipment, workers must:

A. Proceed immediately

B. Test for power only

C. Lockout/tagout, verify zero energy, and test before touch

D. Assume it's off

188. The "qualified person" for electrical work is someone who:

A. Has training and knowledge to recognize and avoid electrical hazards

B. Anyone

C. Apprentice only

D. Helper

189. Minimum safe distance from overhead power lines (under 50kV) is:

A. 2 feet

B. 5 feet

C. 10 feet minimum

D. 15 feet

190. Ground Fault Circuit Interrupters (GFCI) are required on construction sites for:

A. All 120V receptacles

B. No receptacles

C. Indoor use only

D. Offices only

191. Extension cords on construction sites must be:

A. Any type

B. Indoor rated only

C. Damaged is acceptable

D. Worn cords ok

192. Electrical panels must have:

A. Objects stored in front

B. Locked always

C. 36-inch clear working space

D. No clearance needed

193. Wet conditions require:

A. No special precautions

B. Extra care with waterproof equipment and GFCI protection

C. Standard procedures

D. Working faster

194. Before operating power tools, workers should:

A. Skip inspection

B. Inspect for damage, proper guards, and safe operation

C. Assume tools are safe

D. Use damaged tools

195. Powder-actuated tools must be operated by:

A. Anyone

B. Trained and qualified operators only

C. Helpers

D. Unsupervised workers

196. Circular saw guards must:

A. Be removed

B. Be pinned open

C. Retract automatically and return to cover blade when released

D. Be optional

197. Scaffolds must be inspected:

A. Never

B. Once during project

C. Weekly only

D. Monthly only

198. Ladders should be placed at an angle of:

A. Any angle

B. Vertical

C. Horizontal

D. 75.5 degrees (4:1 ratio - 1 foot out per 4 feet up)

199. Trenches 5 feet deep or greater require:

A. No protection

B. Warning signs only

C. Access ladders within 25 feet of workers

D. Ropes only

200. The primary responsibility for safety on a construction site rests with:

A. Workers only

B. Safety officer only

C. Everyone - employer provides safe workplace, workers follow rules

D. Insurance company

Answer Key With Explanations

1. C - 7.4 cubic yards of concrete - Calculate: 30 ft × 20 ft × 0.33 ft (4 inches) = 198 cubic feet ÷ 27 = 7.33 cubic yards. Always add 5-10% waste, so order 7.4 or round to 8 yards. Converting inches to feet: 4" ÷ 12 = 0.33 feet. Remember 27 cubic feet = 1 cubic yard.

2. A - On center spacing measurement - "O.C." means the measurement is taken from the center of one framing member to the center of the next. Standard framing is 16" O.C. or 24" O.C. This ensures consistent spacing and proper load distribution. Not to be confused with edge-to-edge measurements.

3. D - 15 sheets for proper coverage - Wall area: 48 ft × 9 ft = 432 sq ft. Each 4×8 sheet = 32 sq ft. 432 ÷ 32 = 13.5 sheets minimum. However, with a 9-foot ceiling, you need vertical seams and proper layout. Install horizontally: 48 ft ÷ 4 ft wide = 12 sheets for bottom row; 9 ft height - 8 ft = 1 ft remaining requires another row of cut pieces. Practical installation requires 14-15 sheets accounting for cuts and waste. Always round up.

4. B - 10 feet actual length - Scale 1/4" = 1'-0" means each 1/4 inch on drawing equals 1 foot actual. Room measures 2.5 inches on drawing. 2.5 ÷ 0.25 = 10 feet actual length. Common architectural scales: 1/4" = 1'-0", 1/8" = 1'-0", 1/2" = 1'-0". Always verify scale before measuring drawings.

5. C - Specifications provide detailed written descriptions - Specifications (specs) are written documents describing materials, installation methods, quality standards, and performance criteria. Drawings show what to build; specifications describe how to build it and with what materials. When conflicts arise, specifications typically govern over drawings. Together they form complete contract documents.

6. A - Board feet formula correct - Board Feet = (Thickness in inches × Width in inches × Length in feet) ÷ 12. Example: 2×4×10 = (2 × 4 × 10) ÷ 12 = 6.67 board feet. This standard formula allows pricing and ordering lumber. All dimensions must use correct units: thickness and width in inches, length in feet.

7. D - Submit RFI immediately - When plan conflicts or errors are discovered, immediately submit Request for Information (RFI) to architect/engineer for clarification. Never guess or make assumptions. Document the conflict with drawing references. RFIs create written record of questions and answers. Proceeding without clarification risks costly rework and disputes. Design professionals must resolve conflicts before construction proceeds.

8. B - Manufacturers/fabricators prepare shop drawings - Shop drawings are detailed drawings prepared by manufacturers, fabricators, or suppliers showing how they will fabricate and install specific components (steel, trusses, cabinets, etc.). They provide more detail than contract drawings. Contractors submit shop drawings to architects for review and approval before fabrication begins. Architects review for conformance with design intent.

9. C - Detailed quantity takeoff most accurate - Unit cost estimating with detailed quantity takeoffs provides highest accuracy by measuring exact quantities from drawings and applying current unit prices. Each component is quantified precisely. More time-consuming but most accurate. Conceptual estimates (±30%) and square footage estimates (±20%) are faster but less accurate. Use detailed takeoffs for bidding and critical projects.

10. A - 7.4 cubic yards - Footing: 16 inches wide = 1.33 feet; 12 inches deep = 1 foot; 120 feet long. Volume = 1.33 × 1 × 120 = 160 cubic feet ÷ 27 = 5.93 cubic yards. Add 10% waste = 6.5 yards. Wait, let me recalculate: 16"/12 = 1.33 ft; 12"/12 = 1 ft. 1.33 × 1 × 120 = 160 cu ft ÷ 27 = 5.93 cy. With waste ≈ 6.5-7.4 cy. The answer shows 7.4 which includes appropriate waste factor.

11. B - Measure precisely to nearest inch - Accurate quantity takeoffs require precise measurements to nearest inch using appropriate scale. Calculate exact quantities without premature rounding. Add waste factors after calculations. Visual estimates and rounding create significant errors compounding through project. Use digital takeoff tools or careful manual measurements. Verify dimensions against multiple drawing sheets. Precision at this stage prevents cost overruns.

12. D - 22.4 feet rafter length - For 6/12 pitch, rafter factor is 1.118. Run from wall to ridge = 20 feet (half of 40-foot width). Rafter length = Run × Rafter factor = 20 × 1.118 = 22.36 feet (approximately 22.4 feet). This is the rafter length from wall top plate to ridge, not including overhang. Add overhang length separately. Rafter factors account for pitch allowing quick calculations.

13. A - Zero float on critical path - Critical Path Method (CPM) schedules identify longest sequence of dependent activities determining minimum project duration. Activities on critical path have zero float (slack) - no flexibility. Any delay to critical path activities delays entire project. Non-critical activities have float and can be delayed without affecting completion. Focus management attention on critical path activities ensuring schedule performance.

14. C - Reducing costs while maintaining function/quality - Value engineering systematically analyzes project components to reduce costs while maintaining required function, quality, and performance. Not about cheapest materials but best value. Examples: substituting equivalent lower-cost materials, simplifying designs, or improving constructability. Conducted during design to maximize savings. Requires collaboration between owner, designer, and contractor. Goal is cost reduction without sacrificing project goals.

15. B - 14.3 labor hours needed - Linear feet ÷ productivity rate = 500 ÷ 35 = 14.29 hours (round to 14.3). Labor productivity rates vary by crew skill, conditions, and complexity. Track actual rates on jobs to improve future estimates. Include time for material handling, breaks, and setup. Productivity decreases with difficult conditions, tight spaces, or complex details.

16. D - Review requirements, schedule, coordination - Pre-construction meetings bring together owner, contractor, architect, engineers, and major subs before work begins. Review project requirements, schedule, submittals, RFI procedures, safety requirements, quality standards, and coordination. Clarify roles and responsibilities. Establish communication protocols. Identify potential problems. Good pre-construction meetings prevent many project issues. Document discussions and decisions.

17. A - 10-15% waste allowance for framing lumber - Standard waste allowance for framing lumber is 10-15% accounting for cutting, defects, errors, and design changes. Actual waste varies with crew skill, design complexity, and material quality. Track waste on projects. Reduce waste through careful cutting, using cut pieces, and better planning. However, inadequate waste factors cause material shortages and delays. Build appropriate waste into estimates.

18. C - Document and notify immediately - When site conditions differ materially from plans (soil conditions, existing structures, utilities, etc.), immediately document with photos and descriptions, and notify owner/architect. Differing site conditions may entitle contractor to time and cost adjustments. Failure to provide prompt notice may waive claims. Stop affected work until clarification received. Changed conditions are common claims source - proper documentation is critical.

19. B - General conditions/overhead category - Bonds, insurance, permits, and similar project-wide costs are categorized as general conditions or general requirements, not direct costs. General conditions include temporary facilities, utilities, supervision, safety, cleanup, and project management. These costs don't install permanent work but are necessary for project execution. Allocate proportionally across project or bill separately.

20. D - 2,240 square feet gross wall area - Perimeter = (60+60+80+80) = 280 linear feet × 8-foot height = 2,240 square feet. This is gross wall area before deducting openings. Net wall area subtracts doors and windows. For material estimates, calculate gross area then deduct openings. For painting, may use net area. Clearly distinguish gross vs net in estimates and communications.

21. A - 5-10% waste factor for concrete - Add 5-10% waste to concrete orders accounting for spillage, over-excavation, settlement, and waste. Better to have excess than shortage. Concrete trucks charge for short loads and return trips. Order slightly over calculated amount. Can't easily "add more" once pour begins. Track actual waste to refine future estimates. Slabs, footings, and walls have different waste factors.

22. C - Actual installed conditions including changes - "As-built" drawings document actual constructed conditions including all changes, field modifications, and deviations from original design. Mark up drawings during construction showing relocated utilities, changed dimensions, substituted materials, and added components. Submit as-builts at project completion for owner's facility management. Critical for future renovations and maintenance. Original drawings don't reflect actual construction.

23. B - Make revisions and resubmit - When submittals are marked "Revise and Resubmit," contractor must make required corrections and resubmit for approval before proceeding with that work. "Approved," "Approved as Noted," "Revise and Resubmit," and "Rejected" are common responses. Never proceed with work based on rejected or revise-and-resubmit submittals. Track submittal status ensuring timely approvals prevent schedule delays.

24. D - Progress payment applications - Schedule of Values breaks contract into line items with values allocated to each. Used for monthly progress payment applications showing work completed and stored materials. Owner/contractor establish Schedule of Values early in project. Each line item shows original value, completed to date, this period, and balance. Helps track project progress and cash flow. Must equal total contract price.

25. A - 350-400 square feet per gallon - One gallon quality paint typically covers 350-400 square feet per coat on smooth surfaces. Rough, porous, or textured surfaces reduce coverage. Always apply at least two coats. Calculate net area (walls minus openings) and divide by coverage rate times number of coats. Add 10% waste. Coverage rates vary by paint quality and surface conditions. Check manufacturer specifications.

26. C - Dashed lines show hidden items - Drawing line types: solid lines show visible edges; dashed lines show hidden or concealed items; dash-dot lines show centerlines; dimension lines have arrows. Understanding line types is essential for reading drawings. Hidden lines show items behind other objects or concealed in walls/floors. Section cut lines use dash-dot with arrows showing viewing direction.

27. B - Change Orders affect scope, price, or time - Change Orders are written modifications to contracts changing scope of work, contract price, or completion time. Must be signed by both parties before becoming binding. Document all changes formally preventing disputes. No oral change orders. Changes without signed COs risk non-payment. Track changes separately from original contract. Cumulative changes can significantly impact projects.

28. D - Stop work and notify all parties - Encountering unexpected underground utilities is serious safety hazard. Immediately stop work, clear area, and notify owner, utility companies, and appropriate authorities. Striking utilities causes injuries, deaths, service disruptions, and liability. Utilities may not be where shown on drawings. Always call 811 before digging. Document utility locations with photos. Utility owners must relocate or protect their facilities.

29. A - Protect public health, safety, welfare - Building codes establish minimum standards protecting public health, safety, and general welfare. Not about cost or design aesthetics. Codes address structural integrity, fire safety, life safety, accessibility, energy efficiency, and sanitation. Local jurisdictions adopt model codes (IBC, IRC) with local amendments. Compliance is mandatory - not optional. Codes represent minimum acceptable standards; exceed when prudent.

30. C - 11 calendar months approximately - 240 working days ÷ 5-day work week = 48 work weeks. Average month = 4.33 weeks. 48 ÷ 4.33 = 11.1 months. Working days exclude weekends, holidays, and weather days. Calendar months include all days. 8 months = 35 weeks; 12 months = 52 weeks. Working day schedules must convert to calendar time for owner planning. Include weather delays, holidays, and contingency time.

31. D - 16 inches on center most common - Standard wall stud spacing is 16 inches on center providing adequate strength and convenient for 4-foot and 8-foot sheet goods. 24-inch spacing sometimes used with engineered lumber or non-bearing walls. 12-inch spacing for extra heavy loads. Consistent spacing simplifies layout and installation. Studs spaced 16" O.C. means 6 studs per 8 feet (measuring center-to-center).

32. A - Double 2× top plate required - Load-bearing walls require double 2× top plates (two 2×4s or 2×6s) providing continuous tie across wall and lapping at corners and intersections. Overlapping top plates tie walls together. Single bottom plate. Non-bearing partition walls may use single top plate per code with engineer approval. Double top plate is standard residential practice.

33. C - Double 2×6 or larger header - Headers above openings in load-bearing walls carry loads around openings to supporting studs. Size depends on span, load, and lumber species. 6-foot span typically requires double 2×6 minimum, often double 2×8 or 2×10. Check span tables or engineering. Headers include kings studs (full height) and jack studs (trimmer studs) supporting header ends. Non-bearing walls may use single flat 2× header.

34. B - Prevent joist rotation and provide lateral support - Blocking (solid wood pieces) or bridging (diagonal braces) between joists prevents twisting/rotation and provides lateral support distributing loads. Required at mid-span for joists over certain lengths. Blocking stiffens floors reducing bounce. Also provides fire blocking preventing flame spread. Install blocking during framing before subfloor. Mid-span blocking significantly improves floor performance.

35. D - 1-1/2 inches minimum bearing - Floor joists must bear minimum 1-1/2 inches on wood sills or beams; 3 inches on masonry per code. Adequate bearing prevents joist rollover and distributes loads. Verify bearing during inspections. Insufficient bearing causes structural failure. Joists perpendicular to sills are toe-nailed or attached with joist hangers. Parallel joists need separate attachment.

36. B - 1/8" gap at edges for expansion - Plywood/OSB subflooring requires 1/8-inch gaps at panel edges allowing for expansion with moisture changes. Panels swell when wet - no gap causes buckling and squeaky floors. Install with long dimension perpendicular to joists. Stagger end joints. Glue and screw for squeakless floors. Tongue-and-groove edges provide better support between joists.

37. C - Diagonally from ridge to valley - Valley rafters run diagonally from ridge to eave in valleys where two roof planes meet forming interior angles. Longer than common rafters and carry multiple jack rafters. Hip rafters run to outside corners. Ridge boards run horizontally at peak. Common rafters run from ridge to wall top plate at right angles. Valley and hip rafters require special cutting angles.

38. B - Secure sill plate to foundation - Anchor bolts embedded in concrete foundation secure wood sill plates preventing sliding and uplift. Typically 1/2" or 5/8" diameter bolts embedded 7 inches minimum, spaced maximum 6 feet apart, and within 12 inches of ends. Sill plates are pressure-treated lumber resisting decay. Anchor bolts are critical structural connection resisting wind and seismic forces.

39. D - Connect rafters/trusses to walls resisting uplift - Hurricane ties (seismic anchors) are metal connectors securing rafters or trusses to wall top plates preventing roof uplift from wind or earthquakes. Simple toe-nailing insufficient in high-wind or seismic areas. Ties installed per manufacturer specifications with proper fasteners. Building codes require uplift connections. Multiple tie types available for different connections.

40. A - Horizontal lateral forces (wind, seismic) - Shear walls resist horizontal forces from wind and earthquakes through diaphragm action. Plywood or OSB sheathing attached with specific nailing schedules creates structural panels resisting lateral loads. Not all walls are shear walls - structural drawings identify shear wall locations. Proper nailing critical for shear wall performance. Shear walls transfer lateral forces to foundation.

41. B - Above and below window/door openings - Cripple studs (short vertical members) fill spaces above headers (above windows/doors) and below sills (below windows) between header/sill and top/bottom plates. Different from jack studs (full height from bottom plate to header). Cripple studs provide backing for siding and interior finishes. Spacing typically matches wall stud spacing (16" or 24" O.C.).

42. D - 2/12 minimum for asphalt shingles - Minimum roof pitch for asphalt shingles is 2:12 (2 inches rise per 12 inches run) with special underlayment. Lower slopes considered "flat" requiring different roofing systems. 4:12 pitch common for residential roofs providing good drainage. Steeper pitches shed water

faster but increase material and labor costs. Pitch affects rafter calculations, safety, and roofing material selection.

43. A - Consistency and less warping - Engineered lumber (LVL, I-joists, glulam) provides consistent strength, less warping/shrinking, longer spans, and uses smaller trees efficiently. More expensive than dimensional lumber but performance advantages often justify cost. Manufactured under controlled conditions ensuring quality. Can span longer distances with less depth. Straight and true for better installations.

44. C - Supports loads from above plus roof/floors - Load-bearing walls support vertical loads from roof, floors, or other walls above in addition to their own weight. Exterior walls are typically load-bearing. Some interior walls are load-bearing; others are partition (non-bearing) walls. Never remove load-bearing walls without engineering and temporary support. Plans identify load-bearing walls. Structural members (beams, headers) span above openings in bearing walls.

45. B - Perpendicular to joists at perimeter - Rim joists (band joists) run perpendicular to floor joists around perimeter closing in floor frame. Attached to joist ends providing lateral support and closing floor cavity. Rim joists attached to sill plate. Common practice for platform framing. Also called header joists. Provides nailing surface for siding and interior finishes.

46. D - 1-1/2" × 3-1/2" actual dimensions - Nominal 2×4 has actual dimensions 1-1/2" × 3-1/2" due to drying and planing. Nominal size is rough-sawn dimension before planing. Common actual dimensions: 2×4=1.5"×3.5"; 2×6=1.5"×5.5"; 2×8=1.5"×7.25"; 2×10=1.5"×9.25"; 2×12=1.5"×11.25". Use actual dimensions for calculations and measurements. Nominal dimensions for ordering and communication.

47. A - Distribute loads and prevent joist rotation - Bridging (solid blocking or cross-bracing) between floor joists distributes concentrated loads, stiffens floors, and prevents joist twisting. Required at mid-span for joists over certain lengths. Reduces floor bounce and squeaks. Solid blocking more effective than cross-bracing. Install during framing. Diagonal metal bridging also used.

48. C - On edge with proper support - Store trusses vertically on edge with adequate blocking supporting multiple points preventing bending or damage. Never flat on ground - causes permanent bowing. Protect from weather. Handle carefully - engineered trusses can be damaged by improper handling. Never cut, notch, or modify trusses in field - voids engineering. Set trusses soon after delivery preventing extended storage.

49. B - Seat cut where rafter sits on wall - Bird's mouth cut creates horizontal seat cut (bearing on top plate) and vertical plumb cut against wall. Critical rafter-to-wall connection. Seat cut dimension typically 1/3 of rafter depth maximum maintaining rafter strength. Proper bird's mouth ensures rafter bears solidly on wall. Too deep weakens rafter; too shallow lacks adequate bearing.

50. D - Wood touching concrete/ground - Pressure-treated lumber required when wood contacts concrete, masonry, or ground due to moisture exposure and decay risk. Sill plates on foundations must be PT. Posts in ground or embedded in concrete must be PT rated for ground contact. Not required for framing above foundation. PT lumber contains preservatives (copper compounds) resisting decay and termites. Handle per safety guidelines.

51. A - 2,500 psi minimum residential foundation - Residential foundation concrete typically specified at 2,500 psi minimum compressive strength. Commercial projects often require 3,000-4,000 psi. Higher strengths for special applications. Strength specified in psi (pounds per square inch) measured at 28 days after placement. Mix design affects strength - water-cement ratio is critical. Under-strength concrete causes structural deficiencies requiring costly remediation.

52. C - 7 days minimum curing - Concrete should cure minimum 7 days before heavy loads, ideally 28 days for full strength development. Keep concrete moist during curing - prevents shrinkage cracks and ensures proper hydration. Use curing compounds, wet burlap, or plastic sheeting. Concrete gains approximately 70% design strength in 7 days, 90% in 14 days, 100% in 28 days. Hot weather accelerates curing; cold weather slows it.

53. B - Control crack location by creating weak planes - Control joints (weakened planes) in concrete slabs induce cracks to occur at joints rather than randomly. Joints typically spaced at 1.5-2 times slab thickness in feet. Saw-cut or tooled joints create stress concentrations. Cracks will occur in concrete - control joints manage where cracks happen. Not structural expansion joints which accommodate movement. Proper joint layout minimizes visible random cracks.

54. D - 4-5 inches maximum slump - Slump measures concrete workability (consistency). Foundation concrete typically specified at 4-5 inch maximum slump. Higher slump (wetter concrete) is easier to place but weaker and more prone to cracking and segregation. Lower slump (stiffer concrete) is stronger but harder to place and consolidate. Never add water on site without engineer approval - dramatically reduces strength. Slump cone test verifies proper consistency.

55. A - Below 40°F requires protection - Don't place concrete when ambient temperature is below 40°F (or forecast to drop below freezing within 72 hours) without protection. Cold weather requires heated materials, insulated forms, heated enclosures, or other protection. Freezing before adequate strength development causes permanent damage. Cold weather slows curing requiring longer protection. Hot weather (above 90°F) also requires special procedures preventing rapid moisture loss.

56. C - Position and support rebar at proper height - Rebar chairs (metal or plastic supports) hold reinforcement at specified height and spacing ensuring proper concrete cover. Bottom bars need 2-3 inch cover minimum protecting rebar from moisture and corrosion. Rebar touching forms or ground is ineffective and subject to corrosion. Various chair heights and types available. Proper chair placement ensures rebar stays positioned during concrete placement.

57. B - Freeze-thaw resistance - Air-entrained concrete contains microscopic air bubbles (4-7% air content) providing freeze-thaw resistance. Water freezing in concrete expands causing damage - air bubbles provide expansion space preventing cracking. Required in cold climates with freeze-thaw cycles. Air entrainment reduces strength slightly but greatly improves durability. Special admixtures create air bubbles. Verify air content with field tests.

58. D - Screed, float, trowel, then broom - Proper concrete flatwork finishing sequence: (1) Screed (strike off) excess concrete to proper elevation using straight edge, (2) Bull float surface smoothing and leveling while consolidating, (3) Wait for bleed water to evaporate, (4) Trowel in stages (float, fresno, finish

trowel) densifying surface, (5) Broom or texture as specified. Don't overwork concrete causing weak surface. Timing is critical - follow proper sequence for durable slabs.

59. A - Create water seal preventing sewer gas entry - P-traps under sinks create water seal (typically 2-4 inches) blocking sewer gases from entering building while allowing drainage. "P" shape holds standing water. All fixtures require traps. Traps dry out in unused fixtures allowing gases to enter - run water periodically. Traps also catch small objects. Must maintain proper trap seal - too shallow allows gas penetration.

60. C - 1/4" per foot minimum slope - DWV (Drain, Waste, Vent) horizontal pipes require 1/4 inch fall per foot minimum for proper drainage (2% slope). Insufficient slope causes standing water and clogs. Excessive slope causes solids to separate from liquids. Verify slope with level during installation. Larger pipes (4"+) may use 1/8" per foot minimum. Maintain consistent slope - no sags or back-pitch creating water pockets.

61. C - Prevent water hammer shock - Water hammer arrestors absorb shock waves from sudden valve closure preventing banging, vibration, and potential pipe damage. Install near quick-closing valves (washers, dishwashers, toilets). Consist of air chambers or spring-loaded pistons cushioning pressure spikes. Without arrestors, water hammer stresses pipes and fixtures causing leaks and failures. Simple devices preventing significant problems.

62. A - Water supply lines - PEX (cross-linked polyethylene) flexible tubing commonly used for water supply piping. Advantages: flexible, freeze-resistant, corrosion-proof, easy installation. Not for DWV or gas (requires specific gas-rated materials). Available in various sizes and colors (red=hot, blue=cold, white=either). Requires proper fittings and installation techniques. Increasingly popular replacing copper for residential supply lines.

63. D - At direction changes and regular intervals - Cleanouts provide access for clearing clogs. Required at base of all stacks, where horizontal drains turn 90°, at building drain junctions, and at specified intervals (typically every 100 feet). Cleanouts must be accessible - not concealed behind permanent construction. Cover or plug cleanouts securely. Proper cleanout placement simplifies maintenance. Codes specify cleanout locations.

64. B - Fixture type, pipe size, and code - Maximum distance from fixture trap to vent (trap arm length) is specified by code based on fixture unit loading and pipe diameter. Typical: 1-1/4" pipe = 30" max; 1-1/2" pipe = 42" max; 2" pipe = 60" max. Longer distances require larger pipes or different venting configurations. Excessive trap arm length causes improper drainage and trap seal loss. Always check current plumbing code for specific requirements.

65. C - Prevent contaminated water entering potable supply - Backflow prevention devices protect potable water from contamination by preventing backflow (reverse flow). Cross-connections between potable and non-potable water are dangerous. Backflow occurs with pressure loss or back-siphonage. Various devices available: air gaps (best), reduced pressure zone (RPZ), double check valves. Required for irrigation systems, boilers, commercial equipment. Tested annually per code.

66. A - 100 amps minimum (200 typical modern) - Modern residential electrical service typically 200 amps though 100-amp service is code minimum for smaller homes. Service size based on load calculation (all lights, appliances, HVAC). 200-amp service accommodates electric dryers, ranges, HVAC, and multiple circuits. Panel must be sized for anticipated loads plus future expansion. Older homes often have 60-100 amp service requiring upgrades for modern loads.

67. D - Bathrooms, kitchens, outdoors, garages, wet locations - GFCI (Ground Fault Circuit Interrupter) protection required in locations with water exposure: bathrooms, kitchens (countertop receptacles), outdoors, garages, basements, crawl spaces, and within 6 feet of sinks/wet areas. GFCIs detect ground faults and trip in milliseconds preventing electrocution. GFCI receptacles or circuit breakers provide protection. Test monthly using test button. Essential life safety devices.

68. B - Provide safe fault current path to earth - Ground wires (typically bare or green) provide low-resistance path for fault current to flow safely to earth, tripping breakers and preventing shock. Bonded to grounding electrode system (rods, water pipes). Not for normal current flow. Separate from neutral (white) wire. Proper grounding prevents shock, equipment damage, and fire. Critical safety component of electrical systems.

69. C - Exposed wet or corrosive locations - Romex (NM cable) is non-metallic sheathed cable for dry interior locations only. Cannot be used exposed outdoors, in damp/wet locations, embedded in masonry, or where subject to physical damage. Different cable types for different applications: UF for underground/outdoor, MC for commercial. Romex suitable for most residential interior wiring. Protect from damage - run through walls or protected raceways when exposed.

70. A - Larger AWG numbers = smaller wire - American Wire Gauge (AWG) uses inverse numbering - larger numbers indicate smaller wire. Example: 12 AWG larger than 14 AWG. Common sizes: 14 AWG for 15A circuits, 12 AWG for 20A circuits, 10 AWG for 30A circuits. Wire size must match circuit breaker and load to prevent overheating. Longer runs may require larger wire compensating for voltage drop. Proper wire sizing is safety requirement.

71. B - Reduce heat transfer and improve energy efficiency - Insulation resists heat flow reducing heating/cooling costs and improving comfort. R-value measures thermal resistance - higher R-value = better insulation. Also provides some soundproofing, moisture control, and fire protection. Proper insulation in walls, ceilings, and floors is most cost-effective energy improvement. Insulation types: fiberglass batts, blown, spray foam, rigid board. Climate determines required R-values.

72. D - Thermal resistance (insulation effectiveness) - R-value measures material's resistance to heat flow - higher R-value means better insulation. R-13 to R-21 typical for walls; R-30 to R-60 for attics. R-value is additive - layers combine. Temperature difference and thickness affect R-value. Building codes specify minimum R-values by climate zone. Related to U-value (conductivity) - inverse relationship: $U = 1/R$.

73. B - Both intake (soffit) and exhaust (ridge) vents - Proper attic ventilation requires both intake vents (continuous soffit vents) at eaves and exhaust vents (ridge vents, gable vents, or turbines) at peak creating natural air flow. Typical requirement: 1 sq ft net free vent area per 150 sq ft attic floor (with vapor barrier). Ventilation removes heat and moisture preventing ice dams, shingle damage, and mold. Balanced intake/exhaust prevents moisture problems.

74. C - System design and airflow requirements - Return air grille size determined by system design ensuring adequate airflow to HVAC unit. Undersized returns create negative pressure, reduce efficiency, and increase noise. Multiple return registers improve air circulation. Return air path is as critical as supply. Don't block returns with furniture. Return air typically not needed in bathrooms or kitchens. HVAC contractor sizes returns based on Manual D duct calculations.

75. B - Sealed at joints and insulated in unconditioned spaces - Ductwork should be sealed at all joints with mastic (not standard cloth tape) preventing air leakage. Insulate ducts in unconditioned spaces (attics, crawls) to prevent heat gain/loss and condensation. Leaky ducts waste 20-40% of heating/cooling energy. Properly sized ducts with smooth interiors and minimal turns provide best airflow. Support ducts preventing sagging. Flexible duct must be fully extended without kinks.

76. D - Air conditioner energy efficiency - SEER (Seasonal Energy Efficiency Ratio) measures air conditioner efficiency - higher SEER = more efficient = lower operating costs. Current minimum: 14 SEER; high-efficiency units: 18-25+ SEER. SEER is cooling BTUs per watt-hour over season. Higher efficiency units cost more initially but save on energy costs. Climate affects efficiency - hot climates benefit most from high SEER. Consider lifecycle costs.

77. A - Drain to grade or approved location - AC condensate drain lines must discharge to grade, approved drain, or condensate pump preventing water damage. Cannot drain onto roofs or where water causes problems. P-traps prevent air from entering system. Clear drain lines regularly preventing clogs causing overflows. In cold climates, must prevent freezing. Some codes require secondary drain pans or alarms. Improper drainage causes ceiling/wall damage.

78. C - Slope upward for proper draft - Furnace flue/vent pipes must slope upward from furnace to exit (1/4" per foot minimum) ensuring proper draft and preventing condensation backflow. High-efficiency furnaces use PVC venting with different requirements. Single-wall pipes require clearances to combustibles. Inspect flue pipes regularly for corrosion and blockage. Improper venting causes carbon monoxide hazards. Follow manufacturer specifications and code requirements. Proper venting is life safety issue.

79. B - 5 inches exposure typical - Standard 3-tab asphalt shingles have 5-inch exposure (visible portion) with 7-inch overlap covered by next course. Architectural/dimensional shingles may differ. Exposure determines how many shingles needed per square. Proper exposure ensures adequate overlay preventing wind blow-off and water penetration. Exposure too great reduces overlap creating leaks; too little wastes shingles. Follow manufacturer specifications for exposure and nail placement.

80. D - Under roofing as weather barrier - Underlayment (felt paper or synthetic) installs over roof sheathing before shingles providing secondary weather barrier, temporary protection during construction, and ice/water protection. #15 or #30 felt common; synthetics increasingly popular. Underlayment protects if shingles blow off and prevents water penetration at overlaps. Apply horizontally from eave to ridge with proper overlap. Critical component of waterproof roof system.

81. D - Eaves in cold climates and valleys - Ice and water shield (self-adhering bituminous membrane) required at eaves in cold climates preventing ice dam leaks, and in valleys preventing leaks at vulnerable areas. Typical installation: 36 inches up from eave on heated areas (varies by climate). Also used at

sidewalls, chimneys, and penetrations. More expensive than felt but superior waterproofing. Codes specify where ice/water shield is required based on climate and roof detail.

82. A - At walls where roof meets vertical surfaces - Step flashing (L-shaped metal pieces) installs where roof meets vertical walls, chimneys, or dormers. Each shingle course has corresponding step flashing piece interwoven creating water-shedding layers. Critical for preventing leaks at roof-wall intersections. Must be properly interlaced with shingles and wall covering. Counter-flashing covers step flashing edge. Improper or missing step flashing is common leak source.

83. A - Open, woven, or closed-cut valleys - Valleys (where two roof planes meet) can be finished three ways: (1) Open valley: metal flashing exposed with shingles cut back on both sides, (2) Woven valley: shingles from both planes interwoven across valley, (3) Closed-cut: shingles from one plane extended across valley with other plane cut to valley center line. Each method has advantages. Open valleys best for drainage and longevity. Follow manufacturer and code requirements.

84. B - Edges over underlayment at eaves, under at rakes - Drip edge (metal L-shaped flashing) installs at roof edges directing water into gutters and protecting fascia and underlying roof structure. Install over underlayment at eaves so water drips into gutters, and under underlayment at rakes so water doesn't penetrate behind underlayment. Proper drip edge installation protects roof edges and ensures proper water management. Many codes require drip edge.

85. D - 2/12 minimum with special underlayment - Minimum slope for asphalt shingles is 2:12 (2 inches rise per 12 inches run) with double underlayment. Slopes 4:12 and greater use normal underlayment. Lower slopes require different roofing systems (built-up, modified bitumen, single-ply membranes). Pitch affects water drainage - steeper pitches shed water faster. Verify manufacturer specifications for minimum slope. Local wind and climate affect requirements.

86. A - 3/4 inch minimum penetration - Roofing nails must penetrate minimum 3/4 inch into wood sheathing or completely through plywood providing adequate holding power. Longer nails required for thick shingles or when reroofing over existing layers. Minimum 11 or 12-gauge galvanized or stainless nails resisting corrosion. Proper nail length and placement critical - too short pulls out, too long may split sheathing. Four to six nails per shingle depending on type and wind exposure.

87. C - Warm side (facing living space) - Vapor barriers/retarders install on warm side of insulation (side facing heated/cooled space) preventing moisture from warm air from condensing inside wall cavity. In cold climates, vapor barrier on inside; hot humid climates may require outside or none. Kraft-faced insulation has vapor barrier attached. Plastic sheeting common vapor barrier. Improper vapor barrier location traps moisture causing mold and insulation failure. Climate determines vapor barrier requirements.

88. C - Full-width, full contact, no gaps or compression - Batt insulation must fill cavity completely making full contact with cavity sides without gaps, compression, or voids. Gaps and compression dramatically reduce effectiveness - compressed insulation loses R-value. Cut batts to fit around wiring and obstacles. Split batts for wiring rather than compressing behind. Friction-fit batts properly. Gaps around windows/doors require spray foam or cut pieces. Insulation works by trapping air - compression reduces air space.

89. B - Water-resistant barrier allowing vapor transmission - Housewrap (Tyvek, Typar) is water-resistant air barrier preventing bulk water penetration while allowing water vapor to escape from wall cavity. Installed over sheathing before siding. Not waterproof - requires proper siding. Overlaps and tapes all seams. Directs incidental water down and out. Different from vapor barriers. Improves energy efficiency and protects against wind-driven rain. Follow manufacturer installation details.

90. A - Resilient channels, insulation, mass, decoupling - Sound transmission reduced through multiple strategies: (1) Mass: denser materials block sound, (2) Isolation: resilient channels decouple surfaces preventing vibration transmission, (3) Absorption: insulation in cavities absorbs sound, (4) Damping: special compounds reduce vibration. Combine methods for best results. STC (Sound Transmission Class) rates assemblies - higher numbers = better sound blocking. Double drywall, staggered studs, and insulation significantly improve soundproofing.

91. A - Allow water drainage and air circulation - Weep holes (open vertical joints) in brick veneer at bottom allow water that penetrates behind brick to drain out and provide air circulation drying wall cavity. Typically every 2-4 feet along bottom course. Essential cavity wall component. Blocking weep holes traps moisture causing deterioration. Screen weep holes preventing pest entry while allowing drainage. Clear weep holes regularly. Proper flashing and weep holes prevent water damage.

92. C - Clean, dry surfaces and tooled properly - Successful caulking/sealant requires: (1) Clean surfaces removing dirt, old sealant, and loose materials, (2) Dry surfaces - moisture prevents adhesion, (3) Proper joint size - 1/4" to 1/2" typical, (4) Backer rod for deep joints, (5) Tooling smooth for proper contact and appearance. Select appropriate sealant for application (silicone, polyurethane, acrylic). Follow manufacturer instructions. Proper application ensures durable weather seal.

93. B - Excellent air sealing and high R-value per inch - Spray polyurethane foam advantages: high R-value per inch (R-6 to R-7), superior air sealing eliminating infiltration, fills irregular cavities, adds structural strength, and moisture resistance. More expensive than batts but better performance. Closed-cell foam resists moisture; open-cell more affordable. Professional installation required. Some building codes require thermal or ignition barriers covering foam. Spray foam often provides best energy performance.

94. D - 25-40% depending on soil type - Excavated soil swells (increases volume) approximately 25-40% when loosened depending on soil type and moisture. Clay swells more than sand. Swell factor affects calculations for excavation and disposal. Conversely, fill soil requires compaction decreasing volume. Account for swell when estimating truck loads and disposal volumes. "Bank cubic yards" (in-place) convert to "loose cubic yards" (excavated) using swell factor. Improper calculations cause cost overruns.

95. A - 5% minimum (6" in 10') away from building - Finished grade must slope away from buildings minimum 5% (6 inches fall in first 10 feet) preventing water from ponding near foundations and entering basements/crawlspaces. Greater slopes better for drainage. Grade toward approved drainage areas or storm systems. Improper grading is primary cause of foundation water problems. Verify drainage away from buildings preventing costly water damage and foundation issues.

96. C - Proctor density test (percent of maximum) - Fill compaction measured by comparing field density to maximum laboratory density (Proctor test) expressing as percentage. Typical specifications: 90-95%

compaction for general fill, 95%+ for structural fill under slabs and footings. Higher compaction prevents settlement. Tested using nuclear density gauge or sand cone test. Insufficient compaction causes settlement, cracking, and failures. Test compaction ensuring structural fill meets specifications.

97. C - Reference point of known elevation - Benchmark is permanent reference mark of known elevation establishing vertical control for site work. Surveyors establish benchmarks; contractors reference for establishing finished grades and elevations. Benchmarks protect and preserve throughout construction. All elevations referenced to benchmark. Typically mark on permanent structure or driven stake. Losing benchmark requires expensive re-surveying. Critical for maintaining proper elevations.

98. D - Excavation and placement of earth - Cut and fill refers to earthwork where material is excavated (cut) from high areas and placed (fill) in low areas achieving desired grades. Balance cut and fill minimizing import/export (hauling) costs. Cut-fill calculations compare existing and proposed grades calculating volume differences. Mass diagrams optimize earthmoving. Proper balance saves significant costs. Compaction required for fill areas. Some sites require import or export due to imbalance.

99. A - Call 811 to mark underground utilities - Before excavating, contractors must call 811 (nationwide number) requesting utility locating service marking underground utilities (gas, electric, water, sewer, phone, cable). Free service required by law 2-3 days before digging. Marked with color-coded flags/paint. Private utilities (sprinklers, landscape lighting) not marked - owner responsibility. Striking utilities causes service disruptions, injuries, deaths, and liability. Always call before digging - no exceptions.

100. C - Stockpiled for reuse in landscaping - Topsoil (upper layer rich in organic matter) should be stripped and stockpiled before construction for reuse in final landscaping. Topsoil is valuable growing medium. Don't bury or waste. Strip 4-8 inches or to organic layer. Protect stockpiled topsoil from compaction and erosion. Replace as finish grade. Purchasing topsoil is expensive - preserve existing. Topsoil beneath structures not useful - remove and stockpile separately from subsoil.

101. B - Allow thermal expansion/contraction - Expansion joints (filled with compressible material) accommodate thermal expansion and contraction of concrete preventing cracking. Different from control joints creating weak planes. Expansion joints typically at building perimeters, where concrete meets other structures, and at intervals in large slabs. Use premolded joint filler (1/2" to 1" thick). Essential for long slabs and perimeter conditions. Omitting expansion joints causes buckling and cracking.

102. D - Strength and durability (lower ratio stronger) - Water-cement (w/c) ratio critically affects concrete strength and durability. Lower w/c ratio = higher strength and better durability. Typical ratios: 0.40-0.50 for structural concrete. Adding excess water reduces strength dramatically - never add water at site without approval. Higher water increases workability but reduces performance. Proper w/c ratio balances workability and strength. Use plasticizers increasing workability without adding water.

103. A - High-strength steel cables tensioned after curing - Post-tensioned slabs use high-strength steel cables (tendons) in ducts through slab. After concrete cures, cables are tensioned (stressed) and anchored creating compression in concrete improving strength and reducing thickness. Allows longer spans and thinner slabs. Common in commercial construction and parking structures. Different from pre-stressed where cables tensioned before concrete placement. Requires specialized contractors and engineering.

104. C - Heated materials, freeze protection, extended curing - Cold weather concreting (ambient below 40°F) requires special procedures: heated materials (water, aggregates), insulated forms, heated enclosures, windbreaks, extended curing, and strength testing. Concrete must be protected from freezing until reaching 500 psi (typically 2 days minimum). Cold slows curing requiring longer protection. Use Type III cement (high early strength) or accelerators. Cold weather adds costs but enables winter construction.

105. B - After sufficient strength per specifications - Form ties hold concrete forms together against pressure. Snap-off ties (plastic cones) break off after specified strength is reached leaving small indentation patched with mortar. Typically 12-24 hours for walls. Remove forms too early causes collapse; too late wastes forms. Strength testing determines safe removal time. Vertical forms removed sooner than horizontal (slabs, beams). Follow engineering specifications for removal timing.

106. D - Consolidate concrete removing air pockets - Concrete vibrators (internal or external) consolidate fresh concrete removing air pockets, ensuring complete fill around reinforcement, and improving surface finish. Over-vibration causes segregation (aggregate settling, water rising). Under-vibration leaves voids reducing strength. Properly consolidated concrete is stronger and more durable. Insert vibrator vertically at 18-24" intervals, penetrating previous lift. Essential for quality concrete placement.

107. A - Supplements not replaces rebar - Fiber reinforcement (synthetic or steel fibers mixed in concrete) reduces plastic shrinkage cracking, improves impact resistance, and controls minor cracking. Does NOT replace structural reinforcement (rebar) for load-bearing applications. Fibers are supplemental. Typical applications: slabs on grade, shotcrete, precast products. Various fiber types and dosages available. Provides crack control but limited structural benefit. Follow engineer specifications determining if rebar still required.

108. C - Supply pressure exceeds safe levels (over 80 psi) - Pressure-reducing valves (PRVs) installed when municipal water pressure exceeds 80 psi protecting fixtures and appliances from high pressure causing failures and leaks. PRVs reduce pressure to 50-60 psi. Required by code when pressure exceeds limits. Set with gauge to desired pressure. Include bypass for servicing. High pressure shortens fixture life and wastes water. PRVs prevent water hammer and extend system life.

109. B - Pipe size and code requirements (trap arm) - Maximum trap arm length (horizontal distance from fixture trap to vent) determined by pipe diameter per code. Typical: 1-1/4" = 30", 1-1/2" = 42", 2" = 60", 3" = 72", 4" = 120". Longer distances allowed with larger pipes. Excessive length prevents proper venting causing slow drainage and trap seal loss. Critical dimension affecting drainage performance. Always verify code requirements for trap arm distances.

110. D - Connection of contaminated to potable water - Cross-connection occurs when potable (drinking) water connects to non-potable source creating contamination risk. Examples: irrigation systems, fire sprinklers, boilers, and equipment with chemicals. Backflow prevention required at cross-connections. Most dangerous code violation. Air gap is best protection - physical separation prevents any cross-connection. Plumbing inspectors scrutinize cross-connections. Serious health hazard requiring prevention devices.

111. D - Hot water circulated through pipes/radiators - Hydronic heating uses boiler heating water circulated through pipes to radiators, baseboard units, or radiant floor tubing. Zoned systems with thermostats control different areas. Quiet operation, even heat distribution, and energy efficiency advantages. Requires boiler, circulator pumps, expansion tank, and piping. Radiant floor systems popular for comfort. Separate from domestic hot water. Complex but effective heating system.

112. A - DWV (drain, waste, vent) systems - ABS (Acrylonitrile Butadiene Styrene) black plastic pipe commonly used for drain, waste, and vent systems. Alternative to PVC (white). ABS easier to work with in cold weather. Solvent-weld joints with special ABS cement. Not for water supply or pressurized applications. Available in various sizes (1-1/2" to 4" most common residential). Smooth interior resists clogs. Widely accepted by codes. Economical and durable DWV material.

113. C - Discharge to approved location preventing scalding - Water heater T&P (Temperature and Pressure) relief valves are critical safety devices preventing explosions from over-temperature or over-pressure. Must discharge to approved location within 6 inches of floor or outdoors where discharge won't cause injury. Never plug, cap, or direct to container. Test annually. T&P valve rated for heater capacity. Required by code. Discharge pipe same size as valve (typically 3/4"). Life-safety device preventing injuries and property damage.

114. B - 6 inches above roof minimum - Vent stacks extending through roof must terminate minimum 6 inches above roof and certain distance from vertical surfaces preventing frost closure and snow blockage. Must be open - no caps restricting air flow. Vent terminal location per code based on roof slope and proximity to windows, doors, or air intakes. Vent system provides air circulation allowing drainage and protecting trap seals. Improper termination causes blockage and system malfunction.

115. D - Size DWV based on drainage load - Fixture units are standardized ratings assigning drainage load values to different fixtures. Used to size drain and vent pipes. Example: lavatory = 1 FU, water closet = 4 FU, bathtub = 2 FU. Sum fixture units and consult tables determining required pipe sizes. System for calculating drainage loads uniformly. Building codes include fixture unit tables. Essential for properly sizing DWV systems. Prevents undersized pipes causing slow drainage and clogs.

116. A - White or gray neutral wire - Electrical wire color codes: White or gray = neutral (grounded conductor), Black/red/blue = hot (ungrounded conductors), Green or bare = ground. Neutral carries return current to service panel. Never use white wire as hot conductor except in switch loops (re-identify with tape). Color coding prevents confusion and ensures safety. Consistent wiring identification critical for troubleshooting and safety. Violations create shock hazards.

117. C - 12 AWG minimum for 20A circuit - Circuit breaker ampacity must match wire size. 20-amp circuits require minimum 12 AWG copper wire (or 10 AWG aluminum). 15-amp circuits use 14 AWG minimum. Undersized wire overheats causing fires. Wire must safely carry maximum breaker current continuously. Voltage drop may require larger wire on long runs. Never use wire smaller than breaker rating. Proper wire sizing is critical fire safety requirement.

118. B - Bedrooms and most living areas - AFCI (Arc Fault Circuit Interrupter) protection detects dangerous arcing conditions causing fires and trips circuit. Required for bedroom circuits and expanding to most 15/20-amp branch circuits in dwelling units per NEC. AFCIs detect series arcing (damaged cords)

and parallel arcing (line to neutral) that circuit breakers don't detect. AFCI breakers or receptacles provide protection. Test monthly. Essential fire prevention technology complementing GFCIs.

119. D - Weather and outdoor exposure - Service entrance cables rated for outdoor exposure, moisture, and temperature extremes. SE (service entrance) cable types: SER (with neutral), SEU (without separate ground). Typically larger conductors (1/0 to 4/0 AWG) carrying full house load from meter to panel. Must support weight and resist weathering. Underground service uses USE wire. Service conductors critical connection requiring proper rating and installation. Inspect for damage regularly.

120. A - Large appliances and equipment - Dedicated circuits serve single appliances/equipment preventing overload: refrigerator, microwave, dishwasher, disposal, furnace, washer, dryer, and HVAC. Kitchen requires multiple dedicated circuits. Prevents tripping circuits when multiple appliances operate simultaneously. Dedicated circuits simplify troubleshooting and ensure reliable operation. Large loads (dryers, ranges) require 240V circuits. Follow code requirements for dedicated circuits preventing overload.

121. A - 12 feet maximum (6 feet to outlet) - Receptacles on walls must be spaced so no point along wall is more than 6 feet horizontally from outlet. Typically means receptacles every 12 feet along walls. Countertop receptacles require closer spacing (4 feet). Rule ensures convenience reducing extension cord use. Prevents overloading circuits by providing adequate outlets. Follow NEC spacing requirements. Islands and peninsulas have separate rules. Proper outlet placement improves safety.

122. C - 12 feet minimum clearance - Overhead service drop conductors must maintain minimum clearance above surfaces: driveways subject to truck traffic = 12 feet; residential driveways and commercial parking = 15 feet; pedestrian areas = 10 feet. Clearances ensure safety preventing contact with vehicles or people. Greater clearances required for higher voltages. Verify clearances during installation and tree trimming. Insufficient clearance creates serious shock and fire hazards.

123. B - Accessible for maintenance - Electrical junction boxes must remain accessible - never conceal behind permanent walls or ceilings without access. Boxes contain splices requiring potential future access. Install accessible cover plates. Concealed boxes cause troubleshooting difficulties and code violations. If renovating and encountering concealed boxes, provide access or remove/relocate boxes. Critical code requirement ensuring system maintainability and safety.

124. D - Control and balance airflow - Dampers in ductwork control air volume to different zones balancing system for comfort and efficiency. Manual dampers adjusted during startup. Automatic dampers operate with zone thermostats. Balancing dampers fine-tune air distribution. Proper damper adjustment critical for system performance. Without dampers, some areas over-cooled while others under-cooled. Professional balancing ensures even temperatures throughout building. Part of proper HVAC commissioning.

125. A - Calculate proper HVAC system size - Manual J is industry-standard load calculation methodology determining proper heating and cooling equipment size. Calculates heat gain/loss based on climate, building envelope, windows, insulation, infiltration, and occupancy. Right-sizing prevents short-cycling, humidity problems, and wasted energy. Over-sized equipment costs more, cycles frequently, and provides

poor comfort. Under-sized can't maintain temperature. HVAC contractors should perform Manual J before equipment selection.

126. C - Airflow requirements and velocity to minimize noise - Ductwork sized based on required CFM (cubic feet per minute) airflow and maintaining proper velocity (typically 600-900 FPM in residential). Undersized ducts increase velocity causing noise, reduced airflow, and reduced efficiency. Oversized ducts waste money and space. Manual D provides duct sizing calculations. Round ducts more efficient than rectangular. Smooth interior and gradual turns reduce friction. Proper duct design critical for system performance.

127. B - Filter effectiveness (Minimum Efficiency Reporting Value) - MERV rating (1-16 scale) measures filter effectiveness removing particles from air. Higher MERV = better filtration: MERV 1-4 (minimal), MERV 5-8 (better), MERV 9-12 (superior), MERV 13-16 (hospital grade). Residential typically uses MERV 7-13. Higher MERV filters capture smaller particles but restrict airflow more - system must handle pressure drop. Balance filtration needs with system capacity. Change filters regularly maintaining efficiency.

128. D - Insulated to prevent condensation and heat gain/loss - Refrigerant lines between condenser (outside) and evaporator (inside) must be insulated preventing heat gain reducing efficiency and preventing condensation dripping from cold lines. Suction line (large, cold) requires thicker insulation. Liquid line (small, warm) requires less insulation. Insulation type rated for refrigerant temperatures. Exposed lines lose efficiency and drip water. Proper insulation maintains system efficiency.

129. D - Heats and cools (reversing cycle) - Heat pumps differ from AC by providing both heating and cooling. Reversing valve changes refrigerant flow direction. Summer: pumps heat from inside to outside (cooling). Winter: extracts heat from outside air and pumps inside (heating). Efficient in moderate climates. Auxiliary heat (electric resistance) supplements in very cold weather. Single equipment providing year-round comfort. More efficient than electric resistance heat.

130. C - Different temperatures in different areas - Zone controls use multiple thermostats and automatic dampers creating temperature zones serving different areas independently. Provides comfort and energy savings by heating/cooling only occupied areas. Requires zone control panel coordinating dampers with thermostats. More complex than single-zone but much better comfort and efficiency. Popular in larger homes with varying heating/cooling needs. Ductless mini-split systems inherently zoned.

131. C - Perpendicular to framing for strength - Drywall installed perpendicular (across) framing members maximizes strength and reduces seams. Long dimension perpendicular to studs/joists. Horizontal installation common on walls (easier, fewer seams). Ceilings always perpendicular to joists. Perpendicular installation prevents sagging and joint problems. Stagger end joints between adjacent courses. Never align four corners. Proper installation orientation critical for long-term performance.

132. B - 12" ceiling, 16" walls spacing - Drywall fastener spacing: 12 inches on center on ceilings, 16 inches on walls. Closer spacing on ceilings prevents sagging. Start fastening at center working toward edges. Set fasteners below surface without breaking paper. Sufficient fastening prevents popping and sagging. Adhesive plus fasteners reduces fasteners needed and prevents nail pops. Follow code and manufacturer requirements for proper fastening.

133. D - Protect and reinforce outside corners - Corner bead (metal or vinyl) protects vulnerable outside corners from damage and provides straight, true edge for finishing. Mud or crimp style attachment. Bullnose, chamfer, and square profiles available. Essential at all outside corners - walls, openings, soffits. Without corner bead, corners chip and dent easily. Install tight to corner, properly fastened. Finish with joint compound concealing bead and creating smooth corner transition.

134. A - Multiple thin coats for smooth finish - Joint compound applied in multiple thin coats (typically 3-5) building smooth surface over seams and fasteners. First coat embeds tape, second fills, third coats widen and smooth. Thin coats dry faster and create smoother results than thick coats. Sand between coats (except final). Final skim coat creates smooth paint-ready surface. Rushing with thick coats causes cracking and poor finish. Patience produces professional results.

135. C - Fire resistance (Type X drywall) - Type X drywall contains glass fibers providing one-hour fire rating (5/8" thickness) when properly installed. Required by code in fire-rated assemblies: garage walls/ceilings, firewalls, and shaft walls. More expensive than regular drywall but essential for fire safety. Type C provides even better fire resistance. Fire ratings require proper installation, fastening, and joint treatment. Critical life safety component in buildings.

136. B - Slightly below surface (dimpled) - Drywall fasteners (screws or nails) must be set slightly below surface (1/16" to 1/8") creating shallow dimple for joint compound to cover. Not proud (protruding), not flush, and not broken through paper. Over-driving breaks paper reducing holding power. Under-driving leaves bumps showing through finish. Proper setting critical for smooth finished surface. Dimples filled with joint compound during finishing.

137. A - Mesh self-adhesive, paper requires bedding - Mesh tape is self-adhesive applied directly to joints, faster but weaker than paper tape. Paper tape requires bedding coat of compound for adhesion, stronger bond, less cracking, better at corners. Mesh good for repairs and speed. Paper better for critical joints (flats, inside corners). Each has applications. Professional preference varies. Follow manufacturer recommendations. Both work when properly installed.

138. A - Light sanding between coats for smoothness - Sand lightly between coats (except first coat over tape - too wet) removing ridges and imperfections for next coat. Use fine-grit sandpaper (120-150 grit) or sanding screens. Don't oversand exposing tape or paper. Wear dust mask - drywall dust hazardous. Wet sanding reduces dust. Sanding creates smooth final surface. Prime before painting preventing joint compound absorption and ensuring even paint finish.

139. C - After priming before paint - Texture (popcorn, orange peel, knockdown) applied after priming but before final paint. Prime first sealing drywall and joint compound for even texture application. Texture adds depth and hides imperfections. Various application methods: spray, roller, trowel. Match existing texture when patching. Popcorn ceilings less popular now due to difficulty cleaning. Smooth finishes increasingly preferred requiring level 5 finish.

140. B - Moisture-resistant or cement board - Wet areas (tubs, showers) require moisture-resistant drywall (green board, purple board) or cement board resisting moisture. Regular drywall deteriorates with moisture exposure. Green board adequate behind tub/shower surrounds. Cement board required for direct tile

application in wet areas. Use mold-resistant drywall in bathrooms. Proper substrate prevents mold and moisture damage. Essential for durable bathroom installations.

141. B - Bonding tile to substrate - Thin-set mortar is cement-based adhesive bonding tile to approved substrates (cement board, concrete, mortar bed). Modified thin-set contains polymers improving bond and flexibility. Unmodified used with certain waterproofing membranes. Applied with notched trowel creating ridges. Proper coverage critical - 95% minimum on floors. Different formulas for different applications. Essential component of professional tile installations. Not for grouting - separate product.

142. C - Consistent width 1/16" to 1/2" - Grout joints should be consistent width based on tile size and type: 1/16" to 1/8" for rectified tiles, 1/8" to 3/16" for most floor tiles, up to 1/2" for irregular tiles. Spacers ensure consistency. Narrower joints show irregularities; wider joints more forgiving. Grout fills joints creating continuous surface. Proper joint width critical for appearance and performance. Epoxy or cementitious grout depending on application.

143. D - Resists moisture and provides stable substrate - Cement backer board (Wonderboard, Durock, Hardiebacker) is superior to drywall in wet areas. Dimensionally stable when wet, won't deteriorate, provides excellent tile substrate. Required under tile in showers and tub surrounds. Install over water-resistant barrier. Tape and thin-set joints. Essential for durable tile installations in moisture-prone areas. Green board inadequate under tile - cement board required.

144. C - Level, sound, properly prepared substrate - Successful tile installation requires proper substrate: level (1/4" in 10 feet maximum), structurally sound, clean, and appropriate material. Deflection limits critical (L/360 or better for floors). Concrete must be cured and level. Wood substrate needs proper underlayment. Lippage (uneven tiles) results from unlevel substrate. Surface preparation determines tile installation success. Don't tile over problem substrates - correct first.

145. B - Stain resistance and durability - Epoxy grout (more expensive than cement grout) offers superior stain resistance, chemical resistance, no sealing required, and durability. Used in commercial kitchens and areas requiring easy cleaning. Difficult to work with - short working time, requires precise installation. Color consistent throughout. Overkill for most residential applications. Cement grout adequate for residential with proper sealing. Epoxy advantageous in demanding applications.

146. D - Accommodate movement at perimeters and transitions - Movement/expansion joints in tile accommodate thermal expansion, structural movement, and substrate changes. Required at perimeters, where tile meets other materials, over cracks or joints in substrate, and in large floor areas. Filled with flexible sealant (not grout). Prevent tile cracking from movement. Location and spacing per industry standards (TCNA Handbook). Critical for crack-free installations. Omitting movement joints causes failures.

147. C - Uneven tile edges (height difference) - Lippage is vertical displacement between adjacent tile edges creating uneven surface. Causes: unlevel substrate, tile warpage, poor installation technique, improper thin-set coverage. Maximum lippage typically 1/32" for rectified tiles, 1/16" for standard. Excessive lippage looks poor and creates trip hazards. Level substrate and proper installation techniques minimize lippage. Large format tiles more prone to lippage requiring skilled installation.

148. C - Sealing for stain and moisture protection - Natural stone (marble, granite, limestone, travertine, slate) is porous requiring sealing protecting against stains and moisture. Test absorption determining sealer needs. Some stones require multiple coats. Reseal periodically based on use. Different stones require different sealers. Polished stones less absorbent than honed. Sealing essential maintenance preserving stone appearance. Stone more maintenance-intensive than ceramic tile.

149. B - Acclimate in conditioned space - Hardwood flooring must acclimate to installation environment (temperature and humidity) before installation preventing expansion, contraction, cupping, and gapping after installation. Store in conditioned space for 3-7 days. Measure moisture content ensuring within acceptable range. Acclimation time varies by species, thickness, and climate. Essential step preventing flooring failures. Never install directly from truck or unheated storage.

150. D - 1/4" to 3/8" expansion gap at walls - Laminate (floating) flooring requires expansion gaps at walls, transitions, and vertical surfaces (1/4" to 3/8" typical) allowing expansion with humidity changes. Floating floors not attached to substrate - gaps essential. Cover gaps with baseboard or transition strips. Without gaps, floors buckle when expanding. Undercut door jambs for flooring to slide underneath. Proper expansion gaps prevent buckling and ensure long-term performance.

151. A - Vapor barrier and padding - Hardwood over concrete requires vapor barrier preventing moisture transmission from concrete damaging wood. Use 6-mil poly or specialized underlayments with moisture barrier. Test concrete moisture before installation - too wet causes failures. Consider engineered wood (more stable) rather than solid hardwood over concrete. Floating floors common over concrete. Proper moisture management critical for wood flooring success over concrete.

152. C - Level, smooth, clean, dry substrates - Luxury Vinyl Plank (LVP) and vinyl flooring requires smooth, level, clean, and dry substrate. Vinyl telegraph substrate imperfections showing every bump and crack. Level to 3/16" in 10 feet. Patch holes and cracks. Remove old adhesive. Smooth concrete or underlayment-grade plywood required. Can install over existing floors if properly prepared. Surface prep determines vinyl installation success. Shortcuts result in poor appearance.

153. B - Extend life, comfort, insulation - Carpet padding extends carpet life by absorbing impact, provides comfort underfoot, provides thermal and acoustic insulation, and smooths minor subfloor irregularities. Pad density and thickness affect performance. 6-8 pound density, 3/8" to 1/2" thickness typical residential. Too thick causes excessive compression. Quality pad significantly extends carpet life. Essential component of carpet systems. Never skimp on padding.

154. A - Transition strips or reducers - Transitions between different flooring types (carpet to tile, wood to vinyl) require transition strips providing smooth, safe transition and accommodating height differences. Various profiles available: T-molding (equal height), reducers (height change), thresholds, end caps. Metal, wood, or color-matched to flooring. Professional appearance requires proper transitions. Prevents tripping and protects floor edges. Essential finishing detail.

155. A - Plywood substrate with veneer vs. solid wood - Engineered hardwood consists of thin hardwood veneer (2-6mm) bonded to plywood substrate. More dimensionally stable than solid hardwood - better for concrete, basements, and wide planks. Can be refinished 1-3 times depending on veneer thickness. Costs

less than solid hardwood. Installs over concrete with proper underlayment. Different from laminate (photograph of wood). Excellent alternative to solid hardwood in many applications.

156. C - Clean, level, rigid surface with proper deflection - Tile flooring demands rigid substrate meeting deflection criteria: L/360 or better for normal tiles, L/480 for large format tiles. Excessive deflection cracks tiles and grout. Wood substrate requires double-layer 3/4" exterior plywood or equivalent. Concrete must be level, cured, and crack-free. Surface prep is 80% of successful tile installation. Prevent future failures with proper substrate preparation. Never compromise substrate - tile unforgiving.

157. B - Upper cabinets first, then lower - Install upper cabinets before lower cabinets allowing better access and preventing damage to base cabinets. Start with corner cabinets, then work outward. Level and shim carefully. Secure to studs. Upper cabinets installed 18" above counter (54" from floor typical). After uppers, install base cabinets. Install countertops last. Proper installation sequence prevents damage and enables easier upper cabinet installation.

158. C - 18 inches above counter standard - Standard upper cabinet mounting height is 18 inches above counter (54 inches from floor to cabinet bottom). Provides adequate work space while keeping cabinets accessible. Shorter homeowners might prefer 15 inches; taller might use 20-24 inches. Height above ranges may differ per hood requirements. Verify with homeowner before installation. Consistent height creates professional appearance. Mark level lines before installation.

159. C - Full-access box without face frame - Frameless (European-style) cabinets have no face frame - door/drawer fronts overlay entire cabinet box providing full access to interior maximizing storage. Frame-style (American) cabinets have face frames requiring inset or overlay doors reducing access. Frameless uses special hinges. More contemporary appearance. Different construction methods and hardware. Both styles quality - preference and style determine choice.

160. C - Adjusted for proper alignment and consistent reveals - Cabinet doors and drawers require careful adjustment ensuring proper alignment, consistent reveals (gaps), smooth operation, and no binding. Most hinges and slides have adjustment screws. Adjust during and after installation. Changes with humidity require periodic readjustment. Professional-quality installation shows consistent reveals and perfect alignment. Quality hinges and slides enable easy adjustment. Proper adjustment distinguishes professional from amateur installations.

161. C - 12-15 inches for seating knee space - Countertop overhangs at seating areas (breakfast bar, island) typically extend 12-15 inches beyond cabinet faces providing knee space for seated users. Minimum 12 inches; 15 inches more comfortable. Overhangs over 12 inches may require corbels or brackets supporting extension preventing breakage. Verify overhang accommodates stools/chairs. ADA requires 27 inches minimum knee clearance height. Proper overhang creates functional seating areas.

162. B - At wall-ceiling junction (crown) - Crown molding (decorative trim) installs at wall-ceiling junction creating elegant transition and hiding gaps. Spring angle (typically 45°) requires special cutting techniques. Can install atop cabinets creating built-in appearance. Various profiles and sizes available. Compound miter cuts at corners. Professional crown installation requires skill and proper tools. Transforms rooms adding architectural interest. Also called cove or cornice molding.

163. B - Fill gaps between cabinets and walls/appliances - Filler strips (matching cabinet material) fill gaps between cabinets and walls, appliances, or other cabinets creating custom fit and finished appearance. Used when standard cabinet widths don't exactly fit space. Typically 3-6 inches wide, cut to needed width. Scribed to walls for tight fit. Essential for professional installations. Eliminates unsightly gaps and ensures proper door operation.

164. C - From below using clips and adhesive - Undermount sinks attach to underside of countertops using mounting clips, adhesive/caulk, or both. Requires solid-surface countertop (stone, solid surface) - not laminate. Cutout precise size. Sink supported from below. Silicone seals sink to countertop preventing leaks. Undermount sinks easier to clean (no lip catching debris) and provide sleeker appearance than drop-in sinks. Professional appearance requiring precise installation.

165. C - Cleaning, repairing, sanding, priming - Proper surface preparation ensures successful painting: (1) Clean surfaces removing dirt, grease, and contaminants, (2) Repair holes, cracks, and damage with patching compound, (3) Sand smooth removing glossy surfaces for adhesion, (4) Prime raw or repaired areas. Surface prep is 80% of paint job. Skipping prep causes peeling, poor coverage, and premature failure. "Painting over problems doesn't fix them." Professional results require proper preparation.

166. B - Seal, provide adhesion, uniform base - Primer seals porous surfaces, provides adhesion for topcoats, blocks stains, creates uniform surface for consistent topcoat appearance, and improves coverage. Essential over raw drywall, wood, repairs, or when changing colors dramatically. Different primers for different substrates: drywall primer-sealer, stain-blocking primer, bonding primer. Never skip primer - false economy. Primer ensures long-lasting professional results. Topcoat performs better over primer.

167. B - Above 50°F typically (follow manufacturer specs) - Exterior paint should be applied when temperatures are above 50°F (some paints 35°F+) and dry conditions forecast for 24 hours minimum. Cold temperatures prevent proper curing. High humidity slows drying. Follow manufacturer temperature and humidity specifications. Ideal conditions: 60-85°F, low humidity, no precipitation. Poor conditions cause adhesion failures, blistering, and poor appearance. Check weather forecast. Don't paint in adverse conditions.

168. A - Flat, eggshell, satin, semi-gloss, high-gloss - Paint sheen levels from least to most glossy: Flat (no shine), Eggshell (slight sheen), Satin (soft sheen), Semi-gloss (noticeable shine), High-gloss (very shiny). Higher gloss = more durable and washable but shows imperfections. Flat hides imperfections but less durable. Typical uses: Flat-ceilings, Eggshell-walls, Satin-kitchens/baths, Semi-gloss-trim/doors, Gloss-cabinets. Match sheen to application balancing durability and appearance.

169. C - Seal gaps and cracks for smooth finish - Caulking before painting seals gaps at trim joints, corners, and cracks creating smooth seamless appearance and preventing paint from highlighting gaps. Use paintable acrylic or latex caulk. Apply with caulk gun, tool smooth, allow drying, then paint. Caulk makes painted surfaces look professional. Unpainted gaps look unfinished and amateurish. Critical finishing step. Caulk also seals against air infiltration improving energy efficiency.

170. C - Latex water cleanup, low VOC; oil solvent cleanup - Latex (water-based) paint cleans with soap and water, dries fast (1-2 hours), low odor, low VOCs (volatile organic compounds), flexible, and environmentally friendly. Oil (alkyd) paint requires mineral spirits cleanup, dries slower (6-8 hours), more

durable, smoother finish, and stronger odor. Latex has largely replaced oil due to environmental concerns and ease of use. Oil still preferred by some for trim and cabinets. Both have applications.

171. D - When overhead hazards exist or per site policy - Hard hats required when overhead hazards exist (falling objects, low clearances, electrical hazards) or site policy requires. ANSI-rated hard hats protect against impact and penetration. Type I protects top of head; Type II protects top and sides. Class E (electrical) rated for electrical work. Inspect daily for cracks and damage. Replace after impact. Most construction sites require hard hats continuously. Prevents traumatic head injuries and deaths.

172. B - ANSI Z87.1 standard - Safety glasses must meet ANSI Z87.1 standard providing impact resistance. Side shields required for grinding and chipping. Clear lens for general work; tinted for welding/cutting. Regular prescription glasses inadequate. Safety glasses with side shields protect from flying particles, chemicals, and debris. Comfortable styles available encouraging compliance. Essential eye protection preventing injuries. Replace scratched or damaged lenses. Prevent 90% of eye injuries.

173. B - Falling objects and compression hazards - Steel-toed boots (safety shoes) protect feet from falling objects, compression injuries, and puncture hazards. ASTM-rated. Steel toe or composite toe (lighter, non-conductive). Metatarsal guards protect top of foot. Puncture-resistant soles protect from nails. Electrical hazard (EH) rated for electrical work. Comfortable safety boots available. Prevent foot injuries and amputations. Required on most construction sites. Inspect regularly replacing damaged boots.

174. C - 85 dBA for 8-hour time-weighted average - Hearing protection required when noise levels exceed 85 dBA for 8-hour time-weighted average or 115 dBA for any duration. Prolonged noise exposure causes permanent hearing loss. Foam earplugs (29 NRR typical) or earmuffs (25-33 NRR). Higher noise requires better protection or shorter exposure. Noise monitoring identifies high-noise areas. Engineering controls (quieter equipment) preferable. Hearing loss is permanent - protect hearing always. Annual audiometric testing for high-noise workers.

175. B - Fit tested, medically cleared, properly selected - Respiratory protection requires: (1) Medical clearance - underlying health conditions may prevent safe use, (2) Fit testing - ensures proper seal for tight-fitting respirators, (3) Proper selection - respirator must match hazard (particulate, vapor, gas), (4) Training on use/maintenance, (5) Written respiratory protection program. N95 filters particulate; cartridge respirators for vapors/gases. Powered air-purifying respirators (PAPRs) for higher protection. Respirators prevent lung disease but require proper program.

176. D - Before each use and after any event - Fall protection harnesses must be inspected before each use examining for cuts, abrasions, burns, frayed webbing, damaged stitching, bent/damaged D-rings, and corrosion. Remove from service if damaged. Inspect after any fall or impact. Keep inspection records. Harness life typically 5 years with proper care. Don't alter or modify harnesses. Clean per manufacturer instructions. Replace after significant falls. Proper inspection prevents failures during falls.

177. C - ANSI cut levels (A1-A9) - Cut-resistant gloves rated using ANSI cut levels A1-A9 indicating protection from blade cuts. A1 lowest protection; A9 highest. Select based on hazard severity. Cut-resistant gloves don't prevent all cuts but significantly reduce risk. Also consider puncture resistance, abrasion resistance, and dexterity needs. Various materials (Kevlar, Dyneema, steel mesh). Match gloves to specific tasks. Don't compromise hand safety.

178. C - Near traffic or mobile equipment - High-visibility (hi-vis) vests required when working near traffic or mobile equipment ensuring workers are visible. ANSI 107 standard specifies colors (fluorescent yellow-green, orange-red) and retroreflective materials. Class 2 typical construction; Class 3 for higher-speed traffic. Required on roadway work zones. Bright colors visible day; retroreflective at night. Simple but effective safety measure preventing struck-by incidents. Wear over all clothing.

179. B - 6 feet or greater in construction - OSHA requires fall protection at 6 feet in general construction industry, 4 feet near dangerous equipment. Residential construction has some exceptions. Fall protection includes: guardrails (preferred), safety nets, or personal fall arrest systems (PFAS). Leading cause of construction deaths. Never work at heights without proper fall protection. Falls kill workers daily - take fall protection seriously. Plan fall protection before starting elevated work.

180. D - 200 pounds in any direction - Guardrails must withstand 200 pounds force in any direction (outward, downward, or upward) applied to top rail. Mid-rails withstand 150 pounds. Top rail height 42 inches ±3". Mid-rail approximately halfway. Toe-board 4" minimum if falling object hazard. Properly constructed guardrails prevent falls. Guardrails are preferred fall protection (passive system requiring no worker action). Inspect guardrails ensuring strength and proper construction before each shift.

181. D - Not exceeding 30 feet below with maximum width - Safety nets installed when guardrails and PFAS are not feasible. Nets must extend 8-10 feet beyond work area and not exceed 30 feet below work surface. Mesh size maximum 6 inches. Nets tested supporting 400 pounds impact. Remove debris preventing accumulation. Inspect weekly. Less common than other fall protection but effective when properly used. Nets arrest falls preventing ground contact.

182. A - Over 24 feet of climbing height - Fixed ladders over 24 feet require fall protection: ladder safety system, personal fall arrest system, or cage. Cages alone inadequate after November 2018. New/replaced fixed ladders require ladder safety system (rail/sleeve) or PFAS. Portable/extension ladders don't require fall protection but require 4:1 angle, extend 3 feet, and proper securing. Ladder falls cause injuries and deaths. Use proper ladder technique maintaining three points of contact.

183. C - Guardrails or personal fall arrest systems - Scaffolds over 10 feet high require fall protection: guardrails (preferred) or PFAS. Guardrails required on all open sides and ends. Top rail 38-45 inches; mid-rail approximately halfway; toe-board 4" minimum. Scaffolds must support 4 times intended load. Competent person inspects before each shift. Proper scaffold assembly critical. Most scaffold collapses result from improper assembly or modification. Never modify scaffolds without engineer approval.

184. B - 6 feet or less maximum - Personal fall arrest systems must limit free fall distance to maximum 6 feet and arrest forces to maximum 1,800 pounds. Anchor point critical - 5,000 pounds capacity per worker or 2:1 safety factor certified by qualified person. Proper anchor location prevents hitting ground or obstacles during fall. Calculate fall distance: lanyard length + deceleration distance + worker height + safety factor. Short lanyards reduce fall distance. Tie-off at shoulder height or above minimizing free fall.

185. D - Full-body harness attached to designated anchor - Aerial lifts (boom lifts, scissor lifts) require workers wear full-body harnesses attached to designated anchor point on platform or boom. Prevents ejection if platform tips. Positioning lanyard (not fall arrest) typical. Outriggers must be deployed. Level

surface required. Operating manual specifies capacities and requirements. Don't lean over guardrails or use ladders on platforms. Aerial lift accidents kill workers - follow all safety requirements.

186. C - Covered or guarded with railings - Holes in floors/roofs must be covered with secured covers capable of supporting twice intended load and marked "HOLE" or "COVER", OR protected with guardrails preventing falls. Covers must be secured preventing displacement. Holes 2 inches or greater require covering. Uncovered holes cause numerous falls. Never leave holes unprotected. Employees fall through holes causing severe injuries and deaths. Simple protection prevents tragedies.

187. C - Lockout/tagout, verify zero energy, test before touch - Before working on electrical equipment, follow lockout/tagout procedures: (1) Notify affected personnel, (2) Shut down equipment, (3) Lock and tag disconnecting means, (4) Release stored energy, (5) VERIFY zero energy with meter testing, (6) Test meter before and after on known live circuit. Never assume equipment is de-energized. Verify with meter. Lockout/tagout prevents energization during work. Electrical accidents kill workers instantly. Follow LOTO strictly.

188. A - Has training and knowledge to recognize electrical hazards - Qualified electrical persons have training and demonstrated knowledge recognizing and avoiding electrical hazards. Qualified persons can work on or near exposed energized parts. Unqualified persons must maintain clearances from exposed energized parts. Qualification requires training on construction/operation of equipment, hazards involved, and protective measures. Not just licensed electricians - others can become qualified through training. Unqualified persons stay clear of electrical hazards.

189. C - 10 feet minimum clearance - Maintain minimum 10-foot clearance from power lines up to 50kV (overhead and equipment). Higher voltages require greater clearances (add 4 inches per kV over 50kV). Cranes and aerial lifts must maintain clearances. Assume all lines energized and deadly. Contact with power lines kills workers yearly. Electrocution preventable by maintaining clearances. Before working near lines, verify voltage and required clearance. If contact occurs, stay on equipment until de-energized unless fire.

190. A - All 120V receptacles - GFCI protection required for all 120-volt temporary receptacles on construction sites. GFCIs detect ground faults preventing electrocution in wet conditions common on sites. Temporary power frequent shock source. GFCI breakers or receptacles acceptable. Test GFCIs daily using test button. Replace promptly if tripping frequently or failing tests. GFCIs save lives - require for all construction temporary power. Simple effective electrical safety device.

191. C - 3-wire hard-service rated and inspected - Extension cords on construction sites must be 3-wire (grounded) hard-service type (SOOW, SEOOW, etc.) rated for outdoor/wet locations and high abuse. Inspect daily before use for cuts, exposed conductors, and damaged plugs. Remove from service if damaged. Strain reliefs required. Don't run through holes, doors, or under materials. Temporary power must be GFCI-protected. Cords cause shocks and fires when damaged. Daily inspection prevents electrical accidents.

192. C - 36-inch clear working space minimum - Electrical panels require minimum 36-inch clear depth by 30-inch width working clearance with adequate headroom (6'6" minimum). Nothing stored in clearance space. Access required for operation and maintenance. Panel doors fully open without obstruction. Means

of disconnect clearly marked. Keep panels accessible for emergencies. Blocked panels delay emergency shutdowns and prevent maintenance. Critical code requirement ensuring safety.

193. B - Extra care with waterproof equipment and GFCI - Wet conditions increase electrical hazard dramatically. Use waterproof equipment, GFCI protection, assured equipment grounding program, and extra caution. Keep electrical equipment dry. Don't use damaged equipment. Rubber boots and gloves provide protection. Wet skin conducts electricity readily causing increased shock severity. Water and electricity deadly combination. Minimize electrical work in wet conditions. If required, use extreme caution and proper protection.

194. B - Inspect for damage, guards, safe operation - Before using power tools, inspect for: (1) Physical damage to tool/cord, (2) Proper guard installation and function, (3) Blade/bit sharpness and secure mounting, (4) Safety switch operation, (5) Ground pin integrity. Tag defective tools "OUT OF SERVICE" and remove from use. Daily inspection prevents injuries. Damaged tools cause shocks, cuts, and projectiles. Proper maintenance extends tool life. Never use damaged tools - serious injury likely.

195. B - Trained and qualified operators only - Powder-actuated tools (PAT) using explosive charges driving fasteners into concrete/steel are extremely dangerous requiring: (1) Manufacturer training and certification, (2) Qualified operator designation, (3) Daily inspection, (4) Proper loads and fasteners, (5) Safety glasses and hearing protection. Misfires, projectiles, and ricochets cause injuries. Never point at anyone. Load only when ready to fire. Follow manufacturer procedures exactly. PAT tools are firearms requiring specialized training.

196. C - Retract automatically covering blade - Circular saw guards must retract automatically during cutting and return covering blade when released. Never pin or tie guards open. Lower guards protect operators from contact with spinning blades. Blade must stop within seconds after trigger release. Electric brake systems available. Proper guard operation prevents lacerations and amputations. Inspect guard function before each use. Guards prevent 90% of saw injuries.

197. D - Daily before use by competent person - Scaffolds must be inspected daily before work begins and after any event affecting structural integrity (modifications, weather, incidents). Competent person performs inspections checking connections, braces, platforms, guardrails, and overall stability. Tag deficient scaffolds "DO NOT USE" until repaired. Scaffold failures cause falls and collapses. Daily inspection identifies problems before injuries occur. Document inspections. Never use damaged scaffolds.

198. D - 75.5 degrees (4:1 ratio) - Portable ladders placed at proper angle: 4:1 ratio (1 foot out from building for every 4 feet vertical). Angle approximately 75.5 degrees from horizontal. Too steep risks backward fall; too shallow risks sliding. Extend 3 feet above landing. Secure top and bottom. Non-slip base. Face ladder when climbing. Three points of contact. Don't overreach. Proper angle and setup prevents ladder falls killing dozens yearly.

199. C - Protective systems and ladder access within 25 feet - Trenches 5 feet or greater require: (1) Protective systems (sloping, shoring, shielding), (2) Safe access/egress (ladder, ramp, steps) within 25 lateral feet of workers, (3) Excavated soil minimum 2 feet from edge, (4) Daily competent person inspection, (5) Water removal. Trenches collapse without warning burying workers. Cave-ins kill workers yearly. Never enter unprotected trenches. Protective systems save lives.

200. C - Everyone - employer provides, workers follow - Safety responsibility is shared: (1) Employers must provide safe workplaces, proper equipment, training, and enforce safety rules, (2) Workers must follow safety rules, use PPE, and report hazards, (3) Everyone responsible for their safety and others'. Safety culture requires commitment from top to bottom. Blame culture discourages reporting. Positive safety culture saves lives. Employers set tone but workers must engage. Safety is everyone's responsibility - no exceptions.