

PRACTICE EXAM 10: STATIONARY ENGINEER APPRENTICE SIMULATION (100 QUESTIONS)

This practice exam contains 100 questions covering Math and Algebra, Mechanical Reasoning, Reading Comprehension, and Spatial Reasoning, mirroring the aptitude-test format commonly used by IUOE local Joint Apprenticeship and Training Committees for stationary engineer apprenticeship entrance screening. Time limit and passing score vary by administering local; work at a steady pace and answer every question, since most locals rank candidates competitively by score rather than applying a single fixed cutoff.

1. Add the fractions: $\frac{7}{10} + \frac{1}{4} = ?$

- A. $\frac{8}{14}$
- B. $\frac{17}{20}$
- C. $\frac{9}{10}$
- D. $\frac{19}{20}$

2. Calculate: $0.35 \times 120 = ?$

- A. 42
- B. 4.2
- C. 420
- D. 36

3. Evaluate: $22 - 4 \times (8 - 5) = ?$

- A. 54
- B. 18
- C. 10
- D. 6

4. What is 25% of 340?

- A. 68
- B. 85
- C. 102
- D. 25

5. A reading rises from 55 to 66. What is the percent increase?

- A. 20%
- B. 17%
- C. 25%
- D. 11%

6. A drawing uses a scale of 1 inch = 25 feet. A parking area measures 8 inches on the drawing. What is its actual length?

- A. 192 feet
- B. 200 feet
- C. 33 feet
- D. 208 feet

7. Valve stems cost \$5.50 each. What is the total cost of 16 valve stems?

- A. \$80.00
- B. \$93.50
- C. \$79.50
- D. \$88.00

8. Solve for x : $9x - 6 = 39$

A. $x = 3.7$

B. $x = 5.7$

C. $x = 5$

D. $x = 4$

9. Simplify: $7(2x - 3) + 5x$

A. $19x - 21$

B. $14x - 3$

C. $19x - 3$

D. $12x - 21$

10. Simplify: $3^3 \times 3^2$

A. 729

B. 81

C. 15

D. 243

11. Simplify the square root: $\sqrt{45}$

A. $9\sqrt{5}$

B. $3\sqrt{5}$

C. $15\sqrt{5}$

D. $3\sqrt{15}$

12. Find the next term: 4, 11, 18, 25, ____

- A. 29
- B. 35
- C. 32
- D. 30

13. Find the next term in this geometric sequence: 2, 8, 32, 128, ____

- A. 256
- B. 512
- C. 640
- D. 160

14. A line passes through the points (2, 3) and (8, 21). What is its slope?

- A. 18
- B. $\frac{1}{3}$
- C. 3
- D. 6

15. 32 is what percent of 80?

- A. 40%
- B. 36%
- C. 44.4%
- D. 32%

16. Two technicians can each complete a lighting retrofit route alone in 5 hours and 10 hours respectively. Working together at their combined rate, how long will the route take?

- A. 7.5 hours
- B. 5 hours

- C. 1 hour 40 minutes
- D. 3 hours 20 minutes

17. Convert 9.5 feet to inches.

- A. 114 inches
- B. 108 inches
- C. 116 inches
- D. 95 inches

18. Evaluate: $13 - (5 - 11)$

- A. -3
- B. 19
- C. 7
- D. -7

19. A value of 161 is 15% more than the original amount. What was the original amount?

- A. 136.85
- B. 185.15
- C. 147.5
- D. 140

20. Simplify the ratio 32:48 to lowest terms.

- A. 4:6
- B. 3:4
- C. 2:3
- D. 1:2

21. Evaluate: $8^0 + 2^{(-3)}$

- A. 0
- B. 8.375
- C. $1 \frac{1}{8}$
- D. 1

22. Multiply the mixed numbers: $1 \frac{2}{5} \times 2 \frac{1}{2}$

- A. 3
- B. 3.5
- C. 4
- D. 2.8

23. A 72-foot conduit run is cut into sections that are each 4.8 feet long. How many full sections result?

- A. 15
- B. 16
- C. 14
- D. 12

24. Solve for x: $10x - 7 = 4x + 29$

- A. $x = 3.7$
- B. $x = 12$
- C. $x = 5$
- D. $x = 6$

25. A payroll table shows 5 hours worked pays \$92.50, and 8 hours worked pays \$148. What is the hourly rate?

- A. \$37.00
- B. \$18.50
- C. \$18.00
- D. \$148.00

26. A door hinge, where the pivot sits between the applied push and the door's resisting weight, is an example of which class of lever?

- A. Second-class lever
- B. Third-class lever
- C. First-class lever
- D. Not a lever at all

27. A block-and-tackle system's overall mechanical advantage depends most directly on which factor?

- A. The number of rope segments supporting the moving load
- B. The total length of rope used in the system
- C. The color or material of the rope itself
- D. The number of hands used to pull the rope

28. A driving gear with 14 teeth meshes with a driven gear with 42 teeth. How does the driven gear's speed compare to the driving gear's speed?

- A. It turns 3 times as fast
- B. It turns at the same speed
- C. It turns at $\frac{1}{14}$ the speed
- D. It turns at $\frac{1}{3}$ the speed

29. A pry bar's fulcrum is positioned so the effort arm is 27 inches and the load arm is 9 inches. What is its mechanical advantage?

- A. 18
- B. 3
- C. 0.33
- D. 243

30. Which of Newton's laws explains why a heavier piece of equipment requires more force to accelerate at the same rate as a lighter one?

- A. The second law
- B. The first law, describing inertia alone
- C. The third law, describing action and reaction
- D. None of Newton's laws; this is a separate, unrelated principle

31. Which type of friction resists the very start of motion from rest, rather than motion already occurring?

- A. Kinetic friction
- B. Rolling resistance exclusively
- C. Zero friction, since nothing is moving yet
- D. Static friction

32. A block-and-tackle system uses 5 rope segments to support a 400-pound load. Ignoring friction, what effort force is required?

- A. 400 pounds
- B. 2000 pounds
- C. 80 pounds
- D. 160 pounds

33. An inclined plane allows a load to be raised using less applied force, at the cost of moving the load a greater:

- A. Amount of friction
- B. Total weight
- C. Mechanical disadvantage
- D. Distance

34. A hydraulic system has an input piston with an area of 4.5 square inches and an output piston with an area of 36 square inches. What is its mechanical advantage?

- A. 31.5
- B. 8
- C. 4.5
- D. 162

35. A circuit has a 21-volt source and a total resistance of 7 ohms. Using Ohm's law, what is the current?

- A. 3 amps
- B. 147 amps
- C. 0.33 amps
- D. 14 amps

36. In a parallel circuit, the voltage measured across each individual branch will be:

- A. Different for each individual branch
- B. Zero unless a series component is also present
- C. The same across every branch
- D. Impossible to determine without knowing the current

37. Adding more components in series to a circuit always ____ the circuit's total resistance.

- A. increases
- B. decreases
- C. does not change
- D. cuts in half

38. Standing near operating equipment and feeling warm air moving across your face demonstrates which mode of heat transfer?

- A. Conduction
- B. Convection
- C. Radiation
- D. Insulation

39. As fluid moves from a narrow section of pipe into a wider section, its velocity ____, according to the continuity principle.

- A. increases
- B. stays the same
- C. decreases
- D. reverses direction

40. Which valve type is designed for a fully open or fully closed position, with minimal flow restriction when open?

- A. Globe valve
- B. Check valve
- C. Needle valve
- D. Gate valve

41. A coarse-pitch screw advances farther per turn than a fine-pitch screw, but provides ____ mechanical advantage.

- A. less
- B. greater
- C. the same
- D. no measurable

42. A wedge splits material apart by converting a forward driving force into which type of force?

- A. A purely rotational force
- B. A purely vertical lifting force
- C. No conversion occurs at all
- D. A sideways spreading force

43. A compound machine combines a lever with a mechanical advantage of 6 and a screw with a mechanical advantage of 14. What is the overall mechanical advantage?

- A. 20
- B. 84
- C. 6
- D. 14

44. Inserting an idler gear into a two-gear train reverses rotation direction back to the original. What happens to the overall gear ratio between the first and last gear?

- A. It doubles
- B. It is cut in half
- C. It stays exactly the same, unaffected by the idler
- D. It reverses along with the direction

45. A gauge reads 48 psi. What is the approximate absolute pressure?

- A. 48 psi

- B. 62.7 psi
- C. 33.3 psi
- D. 77.4 psi

46. A driving pulley with a 3-inch diameter turns at 1500 RPM and drives a belt connected to a 9-inch driven pulley. What is the driven pulley's speed?

- A. 4500 RPM
- B. 1500 RPM
- C. 500 RPM
- D. 750 RPM

47. A seesaw, where the fulcrum sits between the applied effort and the resisting load, is a classic example of which lever class?

- A. Second-class lever
- B. Third-class lever
- C. A pulley, not a lever at all
- D. First-class lever

48. For the same pair of surfaces, which generally requires less force to overcome: static friction or kinetic friction?

- A. Kinetic friction
- B. Static friction
- C. They always require exactly equal force
- D. No effect on required force

49. A rotary hammer drill delivers effective impact force into masonry primarily through which mechanism?

- A. Continuous smooth rotation alone
- B. Hydraulic fluid pressure
- C. A large fixed gear reduction alone
- D. Rapid percussive hammering combined with rotation

50. An object's mass stays the same everywhere it is measured, while its weight changes because weight depends on:

- A. The object's mass changing between locations
- B. The local force of gravity
- C. The object's material composition changing
- D. Nothing; weight never actually changes anywhere at all

51. Passage: "A blowdown valve periodically releases a small volume of boiler water to control the concentration of dissolved solids, preventing scale and foaming." What is the main idea?

- A. Periodic blowdown prevents scale and foaming by controlling dissolved solids concentration in boiler water
- B. Blowdown valves actually increase scale formation in the boiler
- C. Dissolved solids concentration has no real connection to scale
- D. Boiler water never actually contains any dissolved solids at all

52. Passage: "Before restarting an air compressor after service, first confirm the belt guard is reinstalled. Then verify the drain valve is closed. Only after both checks should the motor be started." If the drain valve is still open, what should happen?

- A. Start the motor anyway, since the belt guard is reinstalled
- B. Skip directly to starting the motor regardless of the valve
- C. The motor should not be started until the drain valve is closed
- D. Close the drain valve only after the motor has already started

53. Passage: "The technician described the reading as suppressed, noticeably lower than the value expected under normal operating conditions." In this context, "suppressed" most likely means:

- A. unusually higher than the expected normal value
- B. perfectly matching the expected normal value
- C. impossible to measure under current conditions
- D. unusually lower than the expected normal value

54. Passage: "After the strainer screen was replaced, the pump's inlet pressure returned to its normal reading." What can be validly inferred?

- A. The pump motor was replaced during this repair
- B. Inlet pressure has no real connection to the strainer screen
- C. The clogged strainer screen had likely been restricting the inlet pressure
- D. The screen will never require replacement again in the future

55. Passage: "A high-vibration alarm shuts down the fan when vibration exceeds its set threshold, protecting the bearings from further damage." Which statement accurately reflects this passage?

- A. The alarm shutting down causes vibration to exceed the threshold
- B. The alarm shuts down the fan to protect the bearings from vibration damage
- C. Bearing damage is what actually triggers this particular alarm
- D. The alarm only ever activates after the bearings have already failed

56. Passage: "Oil analysis detects early signs of internal wear metals long before a bearing failure would otherwise be noticed. Acting on this data during scheduled maintenance avoids unplanned downtime." What is the main idea?

- A. Oil analysis enables proactive maintenance that avoids unplanned equipment downtime
- B. Oil analysis is rarely useful in real maintenance work
- C. Bearings do not actually wear under normal operating conditions
- D. Unplanned downtime has no real connection to maintenance data

57. Passage: "To isolate a valve for repair, first close the upstream shutoff. Next, close the downstream shutoff. Then bleed residual pressure. Finally, tag the valve out of service." What is the correct third step in this sequence?

- A. Close the upstream shutoff
- B. Close the downstream shutoff
- C. Tag the valve out of service
- D. Bleed residual pressure

58. Passage: "The inspection log noted the fitting had begun to seep, showing a slow accumulation of fluid rather than an active spray." In this context, "seep" most likely means:

- A. spray forcefully in a visible stream
- B. remain completely dry with no fluid at all
- C. leak slowly and gradually accumulate
- D. change color without any fluid present

59. Passage: "Before opening an electrical panel, first confirm the breaker is off. Next, verify zero voltage with a meter. Finally, apply a lock and tag before beginning work." What must happen before the panel is opened?

- A. Confirming the breaker is off and verifying zero voltage with a meter
- B. Applying a lock and tag before any other step
- C. Opening the panel as quickly as possible
- D. No steps are required before opening the panel

60. Passage: "To verify a thermostat's calibration, first record the current setpoint. Next, compare it against a certified reference thermometer. If the readings match within one degree, no adjustment is needed." The readings match exactly. What should the technician do?

- A. Adjust the thermostat anyway, just to be certain
- B. No adjustment is needed
- C. Repeat the comparison a second time regardless
- D. Replace the thermostat immediately regardless of the reading

61. Passage: "The technician described the mounting bracket as loose, showing noticeable play when tested by hand." In this context, "loose" most likely means:

- A. firmly fastened with no detectable movement
- B. impossible to test by hand at all
- C. not firmly fastened, with detectable movement
- D. recently tightened and awaiting further adjustment

62. Passage: "Since the new belt tensioner was installed, no further squealing has been detected during weekly inspections." What can be validly inferred?

- A. The motor itself was replaced during this repair
- B. The old belt tensioner had likely been the source of the squealing
- C. Squealing has no real connection to the belt tensioner
- D. The new tensioner will never require replacement in the future

63. Passage: "The specification calls for a fastener torque of 50 to 60 ft-lbs." Which of the following values falls within the specified range?

- A. 45 ft-lbs
- B. 63 ft-lbs
- C. 68 ft-lbs
- D. 55 ft-lbs

64. Passage: "Fire extinguishers provide immediate suppression for small incipient fires. Monthly inspection tags confirm the pressure gauge still reads in the operable range." What is the main idea?

- A. Monthly inspection confirms fire extinguishers remain operable for suppressing small fires
- B. Fire extinguishers require no inspection once installed
- C. Small incipient fires are extremely rare and unlikely
- D. Inspection has no real connection to how well the extinguisher performs

65. Passage: "Confirm the permit is posted, then verify the atmosphere has been tested, and only then begin confined space entry." If the atmosphere has not yet been tested, what should happen?

- A. Begin entry anyway, since the permit is posted
- B. Entry should not begin until the atmosphere has been tested
- C. Skip the atmosphere testing requirement entirely this time
- D. Post the permit a second time before proceeding further

66. Passage: "The readings were described as volatile, swinging sharply between extremes with no stable middle value." In this context, "volatile" most likely means:

- A. rapidly and unpredictably changing between extremes
- B. perfectly stable at a consistent middle value
- C. extremely slow to change over a long period
- D. completely absent, with no readings recorded at all

67. Passage: "After the exhaust fan bearing was replaced, the unusual squeaking sound during startup no longer occurred." What can be validly inferred?

- A. The fan motor itself was rewound during this repair
- B. The squeaking sound was actually unrelated to the bearing
- C. The squeaking sound will return regardless of any repair made
- D. The worn bearing had likely been causing the squeaking sound

68. Passage: "A dirty condenser coil reduces heat rejection and can cause a chiller to run at higher head pressure than normal." Which statement correctly reflects this passage?

- A. High head pressure is what actually causes the coil to get dirty
- B. A clean coil is what increases head pressure instead
- C. A dirty coil reduces heat rejection, which can raise head pressure
- D. Coil condition has no measurable effect on head pressure at all

69. Passage: "Hot work permits require a fire watch and clearance of nearby combustibles. This protects the facility from ignition and limits fire spread if one occurs." What is the main idea?

- A. A fire watch and cleared combustibles protect against ignition and limit fire spread
- B. Hot work permits require no special precautions at all
- C. A fire watch only matters after a fire has already started
- D. Clearing combustibles has no real connection to fire spread

70. Passage: "The work order specifies asset number and priority level." Based only on this passage, which of the following is NOT stated as required?

- A. The asset number
- B. The priority level
- C. The estimated labor hours
- D. That requirements are specified at all

71. Passage: "Once the discharge line was cleared of a partial blockage, the pump's abnormal noise stopped entirely." What can be validly inferred?

- A. The pump impeller was replaced during this repair
- B. The partial blockage had likely been causing the abnormal noise
- C. Abnormal noise has no real connection to the discharge line
- D. The line will never require clearing again in the future

72. Passage: "Isolate the disconnect, test for zero energy with a meter, then apply personal locks before beginning work." What is the correct final step before work begins?

- A. Isolating the disconnect
- B. Testing for zero energy with a meter
- C. No step is required before work begins
- D. Applying personal locks

73. Passage: "The compressor exhibited hunting, the control system continuously overcorrecting and cycling rather than settling at a stable setpoint." In this context, "hunting" refers to:

- A. a complete and permanent shutdown of the compressor
- B. a type of scheduled preventive maintenance procedure
- C. the control system continuously overcorrecting rather than stabilizing
- D. an electrical short circuit within the compressor motor

74. Passage: "The manual specifies a shaft end play of 0.005 to 0.010 inch." Which of the following values falls within the specified range?

- A. 0.003 inch
- B. 0.007 inch
- C. 0.012 inch
- D. 0.015 inch

75. Passage: "Bonding jumpers maintain electrical continuity across a dielectric union, preventing a spark hazard where the metal path is otherwise broken." What is the main idea?

- A. Bonding jumpers prevent spark hazards by maintaining continuity across a broken metal path
- B. Bonding jumpers actually increase spark hazard risk at unions
- C. Electrical continuity has no real connection to spark hazards
- D. Bonding jumpers only matter where the metal path is not broken

76. A flat shape has a small notch cut into its bottom-left corner. If the shape is rotated 90 degrees clockwise, where will the notch now appear?

- A. In the bottom-right corner
- B. In the top-right corner
- C. It remains in the bottom-left corner
- D. In the top-left corner

77. A flat shape has a small shaded mark in its top-right corner. If the shape is rotated 180 degrees, where will the shaded mark now appear?

- A. In the bottom-right corner
- B. In the top-left corner
- C. In the bottom-left corner
- D. It remains in the top-right corner

78. A flat shape has a small tab attached to its bottom edge. If the shape is reflected (mirrored) across a horizontal axis, flipping it top-to-bottom, which edge will the tab now be attached to?

- A. The bottom edge, unchanged
- B. The left edge
- C. The right edge
- D. The top edge

79. A cross-shaped cube net has a central square E, with squares F (above E), G (below E), H (left of E), and I (right of E), plus a sixth square J attached below G, so that F, E, G, and J form one continuous column of four. Once folded into a cube, which face is opposite face E?

- A. Face J
- B. Face F
- C. Face G
- D. Face H

80. In the same net described above (F above E, G below E, H left of E, I right of E, J below G), which two squares become opposite each other as the cube's remaining pair of faces?

- A. F and G
- B. H and I
- C. E and J
- D. F and J

81. An object's front view shows a circular hole, but its top view and side view are both plain rectangles with no opening shown. What does this indicate about the hole?

- A. The hole passes completely through the object from top to bottom
- B. The hole passes completely through the object from side to side
- C. There is actually no hole present in the object at all
- D. The hole does not extend through the object in any other direction; it is visible only from the front

82. An object's front view is a plain rectangle, but its top view and side view both show a rectangular notch cut from the same corner. What does this indicate about the object?

- A. A hole passes completely through the object
- B. A corner is cut from the top, visible in both views
- C. The object is a perfect, unmodified rectangular block
- D. The notch appears only in the top view, not the side view

83. A flat shape has a small notch cut into its top-left corner. If the shape is rotated 270 degrees clockwise, where will the notch now appear?

- A. In the bottom-left corner
- B. In the top-right corner
- C. In the bottom-right corner
- D. It remains in the top-left corner

84. A flat shape has a small tab attached to its left edge. If the shape is reflected (mirrored) across a vertical axis, which edge will the tab now be attached to?

- A. The left edge, unchanged
- B. The top edge
- C. The right edge
- D. The bottom edge

85. A net for a rectangular box (cuboid) shows six connected rectangles of varying sizes. How many pairs of opposite, identically-sized faces will the folded box have?

- A. 2
- B. 4
- C. 6
- D. 3

86. A blueprint uses a scale of 1:50. A wall measures 4 centimeters on the drawing. What is the wall's actual length?

- A. 50 centimeters
- B. 54 centimeters
- C. 200 centimeters
- D. 400 centimeters

87. On a technical drawing, a long-short-long dash pattern typically represents:

- A. A hidden edge blocked from direct view
- B. A center line marking the axis of a round or symmetrical feature
- C. A visible edge seen directly in this view
- D. A dimension line showing a measured distance

88. A flat shape has a small notch cut into its bottom-right corner. If the shape is rotated 90 degrees counterclockwise, where will the notch now appear?

- A. In the top-right corner
- B. In the bottom-left corner
- C. In the top-left corner
- D. It remains in the bottom-right corner

89. An object's front view shows two circles stacked vertically, and its side view shows a matching rectangle with two circles in the same vertical spacing. What does this indicate about the object?

- A. The holes are drilled from top to bottom only, not front to back
- B. Only one hole actually exists in the object
- C. The two holes are located on completely different sides of the object
- D. Two holes are drilled through the object from front to back, stacked vertically

90. A flat shape has a small shaded mark on its bottom edge. If the shape is rotated 90 degrees clockwise, which edge will the shaded mark now be on?

- A. The right edge
- B. The left edge
- C. The top edge
- D. The bottom edge, unchanged

91. A proposed cube net contains six squares, but two of them are attached at positions that would cause them to occupy the exact same face once folded. This net is best described as:

- A. Valid, since all cube nets allow minor overlap between faces
- B. Valid, but only when folded in a specific reverse order
- C. Invalid, since a valid cube net cannot produce overlapping faces
- D. Invalid only if it also has fewer than six squares

92. A shape's mirror image (reflection) differs from any rotation of the same shape because a reflection:

- A. Reverses the shape's handedness, which no rotation can ever reproduce
- B. Always makes the shape appear larger
- C. Only changes the shape's outline thickness
- D. Produces an identical result to a 90-degree rotation

93. A flat shape has a small shaded mark on its right edge. If the shape is rotated 180 degrees, which edge will the shaded mark now be on?

- A. The top edge
- B. The bottom edge
- C. The right edge, unchanged
- D. The left edge

94. A proposed cube net contains only five connected squares rather than the usual six. This net is best described as:

- A. Invalid, since a valid cube net must contain exactly six squares
- B. Valid, since five squares can still fold into a closed shape
- C. Valid, but only when folded in a specific reverse order
- D. Invalid only because two of the five squares would overlap

95. A flat shape has a small shaded mark on its left edge. If the shape is rotated 90 degrees clockwise, which edge will the shaded mark now be on?

- A. The right edge
- B. The top edge
- C. The bottom edge
- D. The left edge, unchanged

96. In a standard orthographic drawing layout, the top view is positioned directly ____ the front view.

- A. below
- B. to the right of
- C. above
- D. diagonally opposite

97. Two different views of the same blueprint show two different dimensions for what should be the identical feature. The best response is to:

- A. Flag the discrepancy and verify it against the source drawing before use
- B. Automatically assume the smaller dimension is correct
- C. Treat the difference as normal and take no action
- D. Average the two dimensions together and use that value

98. A flat shape has a small shaded mark in its bottom-right corner. If the shape is rotated 180 degrees, where will the shaded mark now appear?

- A. In the top-right corner
- B. In the bottom-left corner
- C. In the top-left corner
- D. It remains in the bottom-right corner

99. A cube net has a horizontal row of four squares, with one additional square attached above the second square in the row, and another additional square attached below the third square in the row. Is this a valid cube net, and how many total squares does it contain?

- A. No, it is invalid because only five squares are actually present
- B. Yes, it is valid, but it contains only five total squares
- C. No, it is invalid because two of the squares overlap
- D. Yes, it is valid, and it contains six total squares

100. A candidate answers a difficult spatial question, feels uncertain, and moves on. Time remains at the end of the section. According to the strategy covered in this chapter, the candidate should:

- A. Leave it exactly as answered and review only the easy questions instead
- B. Review that flagged question specifically, re-tracing the manipulation from the original figure
- C. Change the answer at random without re-examining the original figure
- D. Skip reviewing it since it was already answered once already

Practice Exam 10: Answer Key and Explanations

1. D — Convert to a common denominator of 20: $7/10$ becomes $14/20$, and $1/4$ becomes $5/20$. Adding the numerators gives $19/20$. Adding numerators and denominators straight across produces $8/14$, an entirely different value that ignores the requirement for a shared denominator before any two fractions can be combined together correctly. This same method works for adding any two unlike fractions.

2. A — Multiplying 0.35 by 120 gives 42. Misplacing the decimal point in either direction produces 4.2 or 420, since the total number of decimal places across both factors must be counted carefully before the decimal point is placed correctly in the final calculated product on this type of question. Careful decimal placement avoids this shortfall every time.

3. C — Parentheses first: $8 - 5 = 3$. Then multiplication: $4 \times 3 = 12$. Finally subtraction: $22 - 12 = 10$. Subtracting before multiplying ($22 - 4 = 18$, then roughly $18 \times 3 = 54$) applies the operations in the wrong order, producing the incorrect distractor shown here on this particular question. Rewriting each step avoids this specific sequencing trap.

4. B — Convert 25% to a decimal (0.25) and multiply: $0.25 \times 340 = 85$. A distractor of 25 simply restates the percentage value itself rather than calculating the actual portion of 340, confusing the stated percentage with the final calculated answer entirely on this type of question. This same method applies to finding any percentage.

5. A — Percent change = $(\text{new} - \text{original}) / \text{original} \times 100 = (66 - 55) / 55 \times 100 = 20\%$. Using the new value (66) as the denominator instead of the original (55) produces the incorrect 17% distractor, a common and entirely avoidable setup error covered earlier in this book's math chapter. Always use the original value as the denominator.

6. B — Multiply the drawing measurement by the scale factor: $8 \times 25 = 200$ feet. Adding instead of multiplying ($8 + 25 = 33$) confuses the scale relationship with simple addition, ignoring that a scale factor is a multiplying ratio applied to the drawing measurement, not a simple additive offset. Confirming the scale factor's unit prevents this error.

7. D — Multiply unit price by quantity: $5.50 \times 16 = \$88.00$. Rounding $\$5.50$ down to $\$5.00$ before multiplying ($5.00 \times 16 = \$80.00$) drops part of the true unit price, understating the actual total cost by ignoring the extra 50 cents on each individual valve stem purchased. Confirming full decimal places prevents an understated total.

8. C — Add 6 to both sides: $9x = 45$. Divide both sides by 9: $x = 5$. Dividing 39 by 9 first without adding 6 back produces an incorrect rounded distractor; undoing subtraction before undoing multiplication is the correct order for solving this type of linear equation. This same balance method solves any linear equation reliably.

9. A — Distribute first: $7(2x-3) = 14x - 21$. Then combine like terms: $14x + 5x = 19x$, giving $19x - 21$. Forgetting to distribute the 7 across the -3 term, leaving it as -3 rather than -21, produces the $19x - 3$ distractor shown in this particular question. Distributing every term prevents this specific mistake.

10. D — Using the same-base exponent rule, add the exponents: $3^3 \times 3^2 = 3^5 = 243$. Multiplying the base by the sum of the exponents ($3 \times 5 = 15$) confuses this exponent rule with simple multiplication, a common mechanical error under time pressure on this type of exam. Adding exponents only works when the bases match.

11. B — 45 factors as 9×5 , and 9 is a perfect square, so $\sqrt{45} = \sqrt{9} \times \sqrt{5} = 3\sqrt{5}$. Leaving the perfect-square factor un-square-rooted, treating 45 as 3 times 15 rather than 9 times 5, produces the unsimplified $3\sqrt{15}$ distractor shown in this question. Factoring the largest perfect square gives the simplified form.

12. C — This is an arithmetic sequence with a common difference of 7 ($11-4=7$, $18-11=7$, $25-18=7$). The next term is $25 + 7 = 32$. Using an incorrect difference of 4 instead of 7 produces the 29 distractor, a common miscount when scanning the sequence too quickly under pressure. Confirming the common difference first prevents a miscount.

13. B — Each term is multiplied by a common ratio of 4 ($8/2=4$, $32/8=4$, $128/32=4$). The next term is $128 \times 4 = 512$. Adding the most recent difference between terms instead ($128+128=256$) mistakenly treats this geometric sequence as though it were an arithmetic one instead. Confirming the common ratio first prevents this error.

14. C — Slope equals the change in y divided by the change in x: $(21-3)/(8-2) = 18/6 = 3$. Reporting only the change in y without dividing by the change in x produces the distractor of 18, dropping the required second half of the slope calculation on this question. This same method applies to any two coordinate points.

15. A — Divide the part by the whole and convert to a percent: $32 / 80 = 0.40 = 40\%$. Dividing 80 by 32 instead, or rounding the division imprecisely, produces the incorrect distractors shown here; always confirm which value is the part before starting the division on this type of problem.

16. D — Combined rate = $1/5 + 1/10 = 3/10$ of the route per hour, so time = $1 / (3/10) = 10/3$ hours, or 3 hours 20 minutes. Averaging the two individual times directly, $(5+10)/2 = 7.5$ hours, ignores that

combined work rates add together rather than average. Confirming the combined rate before inverting avoids this error.

17. A — Multiply by the conversion factor 12 inches per foot: $9.5 \times 12 = 114$ inches. Rounding 9.5 down to 9 before multiplying ($9 \times 12 = 108$) drops the half-foot, producing an answer that is 6 inches short of the actual correct total length on this problem. Multiplying by the full decimal value avoids this shortfall.

18. B — Parentheses first: $5 - 11 = -6$. Then $13 - (-6) = 13 + 6 = 19$. Treating the subtraction sign as applying only to the 5 and not the full parenthetical result ($13-5-11=-3$) is a common order-of-operations trap covered earlier in this book's math chapter. Rewriting the parentheses as one value prevents this trap.

19. D — If 161 is 15% more than the original, then $161 = \text{original} \times 1.15$, so $\text{original} = 161 / 1.15 = 140$. Multiplying 161 by 0.85 instead of dividing by 1.15 produces the incorrect 136.85 distractor, confusing a percent increase with a percent decrease calculation. Dividing by the full multiplier gives the correct value.

20. C — Both numbers share a greatest common factor of 16: $32/16 = 2$ and $48/16 = 3$, giving 2:3. The distractor 4:6 divides by only 8 instead of the full greatest common factor of 16, leaving the ratio only partially, not fully, reduced to its simplest form. Dividing by the true greatest common factor gives the reduced ratio.

21. C — Any nonzero base to the zero power equals 1, and a negative exponent indicates a reciprocal: $2^{-3} = 1/8$. Adding these gives $1 + 1/8 = 1 \frac{1}{8}$. Treating 2^{-3} as -8 instead of $1/8$ produces an incorrect distractor, confusing a negative exponent with a negative result entirely. Applying each exponent rule separately avoids this mix-up.

22. B — Convert both to improper fractions first: $1 \frac{2}{5} = 7/5$ and $2 \frac{1}{2} = 5/2$. Multiply: $(7 \times 5)/(5 \times 2) = 35/10 = 3.5$. Multiplying only the whole-number parts and fraction parts separately, rather than converting to improper fractions first, produces the incorrect distractor of 3 shown here. Converting to improper fractions first prevents this shortfall.

23. A — Divide the total length by the section length: $72 / 4.8 = 15$ sections, with no length left over. Rounding 4.8 up to 5 feet per section before dividing ($72/5=14.4$, rounded to 14) produces an incorrect count based on the wrong, rounded section length instead. Dividing by the exact section length gives the correct count.

24. D — Subtract $4x$ from both sides: $6x - 7 = 29$. Add 7 to both sides: $6x = 36$. Divide by 6: $x = 6$. Subtracting $10x$ from both sides instead of the smaller term ($4x$) leads to extra sign-flipping and is a common source of the incorrect distractor shown here.

25. B — Divide pay by hours using either data point: $92.50/5 = \$18.50$ per hour (confirmed by $148/8 = \$18.50$). Dividing 92.50 by 2.5 instead of 5, or otherwise misreading the table's rows, produces the incorrect \$37.00 distractor shown in this particular question. Confirming the correct row avoids this specific misread. Always confirm which column matches the requested value.

26. C — In a first-class lever, the fulcrum sits between the effort and the load, exactly as a door hinge sits between the push applied at the handle and the resistance of the door's own weight. A second-class lever instead places the load between the fulcrum and the effort. Locating the fulcrum's position classifies any lever quickly.

27. A — Mechanical advantage in a block-and-tackle system comes from how many rope segments actually bear the weight of the moving load, not from the rope's total length or any other unrelated factor. Carefully tracing each load-bearing segment in a diagram reliably determines this value. Tracing each load-bearing segment confirms the correct value.

28. D — Gear ratio is inversely proportional to speed: with 3 times as many teeth (42 vs 14), the driven gear turns at $1/3$ the speed of the driving gear while delivering more torque. Assuming more teeth means faster rotation reverses this actual inverse relationship entirely on this question. This inverse relationship holds true for any meshed gear pair.

29. B — Mechanical advantage for a lever equals the effort arm length divided by the load arm length: $27/9 = 3$. Dividing the load arm by the effort arm instead ($9/27 = 0.33$) inverts the correct ratio and produces the incorrect distractor shown in this particular question. Placing the effort arm in the numerator avoids this reversal.

30. A — Newton's second law relates force, mass, and acceleration directly through $F=ma$, meaning a greater mass requires proportionally more force to achieve the same acceleration. The first law instead describes inertia generally, and the third law describes equal and opposite reactions, both different relationships from this scenario. Recognizing each law's distinct relationship avoids this confusion.

31. D — Static friction opposes the start of motion from rest, while kinetic friction opposes motion already in progress, and static friction is generally the larger of the two for the same pair of surfaces. Confusing which type applies before motion begins is a common conceptual trap on this exam. Confirming which phase of motion applies determines the type.

32. C — Mechanical advantage equals the number of supporting rope segments: 5. $\text{Effort} = \text{load} / \text{mechanical advantage} = 400/5 = 80$ pounds. Failing to divide by the number of supporting segments, and simply restating the full load weight, produces the 400-pound distractor shown in this particular question. Dividing load by the segment count gives the accurate force.

33. D — This is the same force-for-distance trade-off found in every simple machine: an inclined plane reduces the required force but increases the distance the load travels along the slope compared to lifting it straight up, with total work staying roughly the same aside from friction losses. Wedges and screws share this same underlying force-distance trade-off.

34. B — Hydraulic mechanical advantage equals the output piston area divided by the input piston area: $36/4.5 = 8$. Subtracting the areas instead of dividing them ($36-4.5=31.5$) applies the wrong operation entirely and produces the incorrect distractor shown in this particular question. Dividing output by input area gives the true advantage. Never subtract piston areas when area is required.

35. A — Ohm's law states current equals voltage divided by resistance: $I = V/R = 21/7 = 3$ amps. Multiplying voltage by resistance instead of dividing ($21 \times 7 = 147$) inverts the correct operation and produces the 147-amp distractor shown in this particular question. Dividing voltage by resistance applies Ohm's law correctly.

36. C — A parallel circuit connects every branch across the same two points, so each branch experiences the identical voltage supplied by the source. This differs from current, which divides among the branches based on each branch's individual resistance rather than staying uniform throughout the whole circuit. This uniform-voltage behavior distinguishes parallel from series circuits.

37. A — Each additional series component adds its own resistance along the single shared path, so total resistance always increases as more components are added one after another. This is the opposite of a parallel circuit, where adding more branches actually decreases the combined total resistance instead of increasing it. This additive resistance behavior distinguishes series from parallel circuits.

38. B — Convection transfers heat through the circulation of a fluid or gas, exactly as moving air carries heat away from equipment and across a nearby person. Conduction instead requires direct contact, and radiation requires no medium at all, making both different mechanisms from this specific airflow scenario. Recognizing the heat-transfer mode explains real equipment behavior.

39. C — The continuity principle requires flow rate to remain constant, so when the pipe widens, the fluid slows down to maintain that same overall flow rate through the larger cross-sectional area. This is the reverse of what happens when a pipe narrows instead of widening along its length. This inverse relationship follows directly from the continuity principle.

40. D — A gate valve is designed specifically for full-open or full-closed operation with little restriction when open, while a globe valve is designed for throttling and regulating flow across a range of partial positions instead. Using a gate valve for sustained partial throttling can damage its seal. Matching valve type to function prevents premature seal wear.

41. A — A coarse thread pitch covers more distance per rotation, which trades away mechanical advantage in exchange for faster advancement along the screw's axis. This mirrors the same force-for-distance trade-off found in every other simple machine covered throughout the mechanical reasoning chapters of this book. This same trade-off applies to every simple machine here.

42. D — A wedge, such as an axe head or chisel, is essentially two inclined planes joined back to back, converting the forward driving force into a sideways spreading force that separates the material apart. This differs from a screw, which converts rotational force into linear force instead. This same trade-off applies to every simple machine in this chapter.

43. B — The overall mechanical advantage of a compound machine is found by multiplying the individual mechanical advantages of its components: $6 \times 14 = 84$. Adding the two values instead ($6+14=20$) is a common error, since compound advantage compounds multiplicatively, never additively, across its individual parts. Multiplying the advantages gives the correct compound result.

44. C — An idler gear's own tooth count cancels out of the overall ratio calculation between the first and last gear in the train, meaning only the rotation direction is affected. The speed and torque relationship stays exactly what it would be without the idler gear present at all. Recognizing only direction changes with an idler prevents confusion.

45. B — Absolute pressure equals gauge pressure plus atmospheric pressure: $48 + 14.7 = 62.7$ psi. Reporting the gauge reading alone as the absolute pressure ignores that gauge pressure is measured relative to the surrounding atmosphere, not relative to a true vacuum, and must be adjusted accordingly for this question. Adding the atmospheric constant gives the correct absolute value.

46. C — Speed ratio equals the driving diameter divided by the driven diameter: $3/9 = 1/3$. Driven speed = $1500 \times 1/3 = 500$ RPM. Multiplying instead of dividing by the diameter ratio ($1500 \times 3 = 4500$) inverts the relationship and produces the incorrect distractor shown in this question. Dividing by the correct diameter ratio gives the true speed.

47. D — A first-class lever places the fulcrum between the effort and the load, exactly as in a seesaw or a pry bar. A second-class lever instead places the load between the fulcrum and the effort, as in a wheelbarrow, a fundamentally different arrangement in terms of mechanical advantage. Recognizing the fulcrum's position confirms this lever classification.

48. A — Kinetic friction, which resists motion already underway, is generally smaller than static friction, which resists the initial start of motion from rest, for the same pair of surfaces. This is why an object often takes more force to start moving than to keep it moving once already sliding. Recognizing friction persists, just smaller, once motion begins.

49. D — A rotary hammer combines a piston-driven hammering mechanism with bit rotation, delivering rapid percussive impacts rather than smooth continuous torque alone, which allows effective drilling into masonry. This differs meaningfully from a standard drill, which relies on rotation alone without any hammering action whatsoever. This combined mechanism distinguishes a rotary hammer from a standard drill.

50. B — Weight measures the force of gravity acting on an object's mass, and gravity varies by location, such as being weaker on the moon than on Earth, so the same object weighs less there. Mass itself, the actual amount of matter present, stays constant everywhere it is measured. Mass and weight are related but genuinely distinct quantities.

51. A — The passage's central point connects the blowdown valve's function, releasing water to control dissolved solids, directly to the stated benefit of preventing scale and foaming. The other options either contradict this stated benefit or deny a relationship the passage explicitly and directly describes in its own wording. Recognizing supporting details connect to one claim finds the main idea.

52. C — The passage requires both checks, the belt guard and the drain valve, to be confirmed before the motor starts. An open drain valve does not satisfy the passage's stated second condition; starting must wait until that specific check is also successfully completed first. Requiring both checks is exactly what the passage demands.

53. D — The passage directly illustrates "suppressed" through the phrase "noticeably lower than the value expected under normal operating conditions," which describes a reading below what is typical. This is a direct-illustration context clue rather than one requiring an outside contrasting comparison to determine its meaning. Recognizing this direct illustration determines word meaning quickly.

54. C — The passage's cause-and-effect sequence, replacing the screen followed immediately by pressure returning to normal, directly supports the inference that the clogged screen was restricting flow beforehand. The passage says nothing about motor replacement or any future maintenance schedule for this specific piece of equipment. This direct cause-and-effect sequence supports a valid inference.

55. B — The passage states plainly that exceeding the vibration threshold triggers the shutdown, which exists to protect the bearings from damage. Reversing this relationship, claiming the shutdown causes the vibration, inverts the passage's actual stated cause-and-effect logic entirely and is not supported by the text. Demanding textual proof defeats a reversed-logic distractor here.

56. A — The passage's overall point connects early detection through oil analysis directly to avoiding unplanned downtime through proactive, scheduled maintenance. The other options either dismiss the passage's stated value of the practice or deny a connection it explicitly and directly makes throughout the passage. Recognizing supporting details connect to one claim is key.

57. D — The passage lists four sequential steps: closing the upstream shutoff first, closing the downstream shutoff second, bleeding residual pressure third, and tagging the valve last. The word "then" explicitly marks bleeding pressure as the step that follows closing both shutoff valves in order. The sequence words mark which action comes immediately after which.

58. C — The passage directly defines "seep" through its own description: a slow accumulation of fluid rather than an active spray. This direct restatement is one of the clearest possible forms of a context clue, requiring no outside knowledge of plumbing terminology to answer this question correctly. Recognizing this illustrative clue is a fast reading strategy.

59. A — The passage's sequence words "first" and "next" establish that confirming the breaker and verifying zero voltage both come before the lock and tag are applied, and well before the panel itself is opened. Skipping either earlier step would violate this explicitly stated required order. Following the passage's stated order is essential on this item.

60. B — The passage's conditional statement is explicit: if the readings match within one degree, no adjustment is needed. Matching exactly easily satisfies this condition, so adjusting the thermostat anyway would apply an unnecessary step the passage's own stated condition clearly rules out here. Applying the stated condition exactly, not assuming, is key.

61. C — The phrase "showing noticeable play when tested by hand" directly defines "loose" here as not firmly fastened, the opposite of a secure mounting, which is exactly what this specific word conveys given the surrounding sentence and the described hand test performed on it. Recognizing this context clue takes careful, deliberate reading.

62. B — The before-and-after comparison, installing a new tensioner followed by no further detected squealing, directly supports the inference that the old tensioner was the source of the problem. The passage never mentions a motor replacement anywhere in the text provided for this question. This clear cause-and-effect sequence supports a valid inference.

63. D — The stated range is 50 to 60 ft-lbs inclusive, and 55 ft-lbs falls directly within that range. The other values sit just outside the range on either end, exactly the kind of near-miss numeric distractor this exam commonly uses to test careful, deliberate reading of the passage. Checking the numeric detail against the range catches this trap.

64. A — The passage's overall point connects monthly inspection directly to confirming the extinguisher's operable condition, which is exactly what keeps it ready for a real incipient fire. The other options either contradict or ignore the passage's stated purpose entirely and are not supported by the text. Recognizing how details connect to one purpose is the key skill.

65. B — The passage's conditional step, beginning entry, applies only once both the permit and the atmosphere test are confirmed. A posted permit alone does not satisfy this condition; entry must wait until the atmosphere testing requirement is also fully addressed and confirmed first. Applying the condition exactly, not skipping ahead, is essential.

66. A — The phrase "swinging sharply between extremes with no stable middle value" directly defines "volatile" here as rapidly and unpredictably changing, the opposite of what a reader might otherwise assume without this specific surrounding context provided directly in the passage. No outside knowledge of the equipment is needed here. The passage's own wording fully answers this question.

67. D — The immediate resolution of the squeaking sound right after the bearing replacement directly supports the inference that the worn bearing was the source of the noise. The passage gives no information suggesting the motor, rather than the bearing, was the actual cause of the sound. This immediate cause-and-effect sequence supports this valid inference.

68. C — The passage states plainly that a dirty coil reduces heat rejection and can raise head pressure. Reversing this relationship, claiming high pressure causes the coil to get dirty, inverts the passage's actual stated cause-and-effect direction entirely, a common reversed-logic trap on this type of question. Demanding textual proof defeats a reversed-logic distractor here.

69. A — The passage directly connects both requirements, a fire watch and cleared combustibles, to two stated benefits, preventing ignition and limiting spread. The other options either deny the passage's stated precautions or misplace when the fire watch requirement actually needs to be in effect. Recognizing how requirements connect to one purpose is the key skill.

70. C — The passage explicitly names asset number and priority level as what the work order specifies. Estimated labor hours are never mentioned anywhere in the text, making that the one detail that cannot be supported by what the passage actually states in writing. Searching the passage's exact wording catches this trap reliably.

71. B — The direct sequence, clearing the blockage followed by noise stopping entirely, supports the inference that the partial blockage was causing the abnormal noise beforehand. The passage never mentions an impeller replacement or makes any claim about future maintenance needs for this equipment. Recognizing this borderline numeric detail takes careful reading.

72. D — The passage lists three sequential actions ending with applying personal locks, which the word "then" marks as the final step before work begins, coming after isolating the disconnect and testing for zero energy in that specific stated order given in the passage. Recognizing how hazards connect to one purpose is the key skill.

73. C — The passage directly defines hunting through its own description: the control system continuously overcorrecting and cycling rather than settling at a stable setpoint. This direct restatement is one of the clearest possible forms of a context clue available anywhere in this passage. Recognizing this direct definition is a clear context clue.

74. B — The stated range is 0.005 to 0.010 inch inclusive, and 0.007 inch falls directly within that range. The other values sit just outside the range on either end, exactly the kind of near-miss numeric distractor this exam commonly uses to test careful, deliberate reading of small tolerances. Checking the numeric detail against the range catches this trap.

75. A — The passage's central point connects the jumper's function, maintaining continuity across a broken dielectric union, directly to the stated benefit of preventing a spark hazard. The other options either reverse this stated benefit or contradict the specific scenario the passage actually describes in its wording. Recognizing how the benefit connects to its mechanism is key.

76. D — A 90-degree clockwise rotation cycles each corner one position clockwise: bottom-left to top-left, top-left to top-right, top-right to bottom-right, and bottom-right back to bottom-left. Tracking this single marked corner through the cycle gives the correct new position directly and reliably every single time. Tracking a single marked corner through the rotation gives this answer.

77. C — A 180-degree rotation moves every feature to its exact diagonal opposite position. A feature starting in the top-right corner therefore moves to the bottom-left corner, the corner diagonally across the shape from where it originally started before the full half-turn rotation was applied to it. Tracking a single marked corner through a half-turn gives this position.

78. D — A reflection across a horizontal axis flips a shape's top-to-bottom orientation, moving a feature on the bottom edge to the top edge, while its left-right position within that edge stays exactly the same. This is different from a vertical-axis reflection, which would leave the top-bottom position unchanged instead. Recognizing which axis a reflection affects is the key insight.

79. A — In the four-square column F-E-G-J, the first and third squares become opposite faces (F and G), and the second and fourth squares become opposite faces (E and J). Tracing this same column-position rule confirms that face E ends up opposite face J once the entire net is folded together. This same rule applies to any four-square column in a net.

80. B — With F and G already opposite, and E and J already opposite, from the four-square vertical column, the two remaining squares, H and I, attached to the sides of the central square E, become the cube's final pair of opposite faces once the net is fully folded together. Identifying the two leftover squares confirms the remaining pair.

81. D — Because the hole appears only in the front view and creates no opening in the top or side views, it cannot extend through the object in those directions; a hole passing all the way through in another direction would also appear in the view looking directly into that specific path.

82. B — Because the notch appears consistently in both the top view and the side view, but not in the front view, the modification must be a corner cut into the top surface of the object, visible from any angle that looks down onto or across that specific surface. Matching positions across two views reveals the true orientation.

83. A — A 270-degree clockwise rotation equals three consecutive 90-degree clockwise steps. Tracking the corner through each step, top-left to top-right, to bottom-right, to bottom-left, shows it ends in the bottom-left corner after the full 270-degree rotation is fully complete. Tracking the corner through three quarter-turns gives this position. This same three-step method works for any 270-degree turn.

84. C — A reflection across a vertical axis flips a shape's left-to-right orientation, moving a feature on the left edge to the right edge, while its top-bottom position within that edge stays exactly the same. This differs from a horizontal-axis reflection, which would leave the left-right position unchanged instead. Recognizing which axis a reflection affects is the key insight.

85. D — A rectangular box has six faces total, arranged as three pairs of opposite, identically-sized faces: top/bottom, front/back, and left/right. Every valid box net, regardless of its specific layout, always folds into exactly these three matching pairs, never more and never fewer than three total pairs. Counting matching face pairs, not individual squares, confirms this total.

86. C — A scale of 1:50 means every unit on the drawing represents 50 of that same unit in reality. Multiply the drawing measurement by the scale factor: $4 \times 50 = 200$ centimeters. Adding instead of multiplying ($4+50=54$) misapplies the scale as an offset rather than a true multiplying ratio applied correctly.

87. B — The long-short-long dash pattern is the standard convention for a center line, used specifically to mark the central axis of round features like holes and cylinders. A hidden edge instead uses a simple, evenly spaced dashed line, a visibly different pattern from this specific center-line convention. Distinguishing this line type from other conventions matters here.

88. A — A 90-degree counterclockwise rotation moves each corner one position in the reverse direction of a clockwise rotation, following the cycle bottom-right to top-right to top-left to bottom-left. Starting at bottom-right, the next counterclockwise step lands directly at top-right. Tracking the corner through the counterclockwise cycle gives this position. This same reverse-cycle method works for any counterclockwise turn.

89. D — Because the two circles appear in matching vertical positions in both the front view and the side view, both of which look along or across that same front-to-back path, the holes must run through the object from front to back, stacked one above the other. Confirming matching positions across two views reveals the orientation.

90. B — A 90-degree clockwise rotation cycles edges the same way it cycles corners: bottom moves to left, left moves to top, top moves to right, and right moves to bottom. Tracking this one marked edge through the cycle gives the correct new position directly and reliably every time. This same edge-cycling pattern applies to any single marked edge.

91. C — A valid cube net requires each of its six squares to fold into a distinct, non-overlapping face. Two squares folding to occupy the same face location makes the net structurally invalid, regardless of the fact that it happens to contain the correct total square count required for a cube. A cube always requires exactly six faces, the key rule tested.

92. A — A reflection flips a shape's handedness entirely, the way a printed letter becomes backward in a mirror, which no amount of rotation can ever reproduce, since rotation always preserves a shape's original handedness no matter how far the shape is actually turned around in space. Rotation always preserves handedness, while reflection always reverses it.

93. D — A 180-degree rotation moves every edge to its directly opposite edge. The edge directly opposite the right edge of a rectangle is the left edge, which is exactly where the shaded mark appears after the full half-turn rotation has been applied to the shape in this question. Tracking the edge through a half-turn gives its opposite position.

94. A — A cube has exactly six faces, so any valid net must contain exactly six squares, no more and no fewer. With only five squares present, one entire face of the finished cube would simply be missing, regardless of how those five squares happen to be arranged and folded together. A cube always requires exactly six faces, never fewer.

95. B — A 90-degree clockwise rotation cycles edges clockwise: left moves to top, top moves to right, right moves to bottom, and bottom moves to left. Tracking this one marked edge through the cycle shows it moves from the left edge to the top edge after the full rotation is applied. This positioning allows dimensions to be cross-checked between views.

96. C — The standard orthographic layout places the top view directly above the front view and the side view directly beside it, allowing a reader to align matching width and depth dimensions between views by looking straight down or straight across between the related drawings on the same sheet. Verifying against the source drawing resolves this discrepancy correctly.

97. A — Two accurate views of the same real feature should show consistent dimensions; a genuine mismatch is a real discrepancy that should be verified against the source drawing or confirmed with a supervisor, not resolved by simply guessing which of the two values happens to be correct. Tracking the corner through a half-turn gives its diagonal opposite.

98. C — A 180-degree rotation moves every feature to its exact diagonal opposite corner. The corner diagonally opposite the bottom-right corner of a square or rectangle is the top-left corner, which is exactly where the shaded mark ends up after the full half-turn rotation is applied to it. Counting every square carefully confirms this net's total count.

99. D — Counting carefully: the horizontal row itself contains four squares, plus one square above the second and one square below the third, for a total of six squares, each sharing exactly one edge with a neighboring square and none overlapping, making this a genuinely valid cube net. A consistent, proven method under time pressure protects accuracy.

100. B — Restarting the mental process from the original figure, specifically on questions where real uncertainty was flagged, is more reliable than leaving a doubtful answer unchecked or guessing again without re-tracing the actual manipulation from the start of the problem. This same review habit applies to any genuinely uncertain answer. It is worth the extra time it takes.