

PRACTICE EXAM 5: 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: $\frac{5}{8} + \frac{1}{6} = ?$

- A. $\frac{19}{24}$
- B. $\frac{6}{14}$
- C. $\frac{17}{24}$
- D. $\frac{3}{4}$

2. Calculate: $0.65 \times 80 = ?$

- A. 5.2
- B. 520
- C. 52
- D. 48

3. Evaluate: $16 + 3 \times (11 - 8) = ?$

- A. 57
- B. 33
- C. 19
- D. 25

4. What is 45% of 220?

- A. 88
- B. 99
- C. 110
- D. 45

5. A reading rises from 40 to 46. What is the percent increase?

- A. 15%
- B. 13%
- C. 20%
- D. 6%

6. A drawing uses a scale of 1 inch = 20 feet. A driveway measures 6 inches on the drawing. What is its actual length?

- A. 114 feet
- B. 26 feet
- C. 120 feet
- D. 126 feet

7. Bearings cost \$6.25 each. What is the total cost of 12 bearings?

- A. \$72.00
- B. \$75.00
- C. \$78.50
- D. \$71.50

8. Solve for x : $7x - 8 = 34$

A. $x = 3.7$

B. $x = 6.7$

C. $x = 4$

D. $x = 6$

9. Simplify: $6(3x - 2) + 4x$

A. $22x - 12$

B. $18x - 2$

C. $22x - 2$

D. $10x - 12$

10. Simplify: $2^4 \times 2^3$

A. 256

B. 64

C. 128

D. 14

11. Simplify the square root: $\sqrt{80}$

A. $16\sqrt{5}$

B. $20\sqrt{5}$

C. $4\sqrt{20}$

D. $4\sqrt{5}$

12. Find the next term: 9, 15, 21, 27, ____

- A. 30
- B. 33
- C. 35
- D. 31

13. Find the next term in this geometric sequence: 4, 12, 36, 108, ____

- A. 216
- B. 324
- C. 432
- D. 150

14. A line passes through the points (1, 5) and (6, 20). What is its slope?

- A. 15
- B. $\frac{1}{3}$
- C. 3
- D. 4

15. 36 is what percent of 90?

- A. 40%
- B. 36%
- C. 44.4%
- D. 25%

16. Two technicians can each complete a filter change route alone in 4 hours and 8 hours respectively. Working together at their combined rate, how long will the route take?

- A. 6 hours
- B. 4 hours

- C. 1 hour 20 minutes
- D. 2 hours 40 minutes

17. Convert 7.5 feet to inches.

- A. 84 inches
- B. 90 inches
- C. 92 inches
- D. 75 inches

18. Evaluate: $11 - (3 - 9)$

- A. -1
- B. 5
- C. 17
- D. -5

19. A value of 138 is 15% more than the original amount. What was the original amount?

- A. 120
- B. 117.3
- C. 158.7
- D. 126.5

20. Simplify the ratio 28:42 to lowest terms.

- A. 4:6
- B. 2:3
- C. 3:5
- D. 1:2

21. Evaluate: $7^0 + 5^{(-1)}$

- A. 0
- B. 7.2
- C. 1
- D. $1 \frac{1}{5}$

22. Multiply the mixed numbers: $2 \frac{1}{4} \times 1 \frac{1}{3}$

- A. 3
- B. 3.25
- C. 2.75
- D. 2.5

23. A 63-foot conduit run is cut into sections that are each 4.5 feet long. How many full sections result?

- A. 15
- B. 13
- C. 14
- D. 12

24. Solve for x: $8x - 5 = 3x + 30$

- A. $x = 5$
- B. $x = 14$
- C. $x = 4.7$
- D. $x = 7$

25. A payroll table shows 4 hours worked pays \$74, and 7 hours worked pays \$129.50. What is the hourly rate?

- A. \$37.00
- B. \$18.00
- C. \$129.50
- D. \$18.50

26. A pair of pliers, joined at a shared pivot pin, 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 movable pulley, attached directly to the load rather than to a fixed frame, provides:

- A. No effect on the required force at all
- B. Genuine mechanical advantage
- C. A change in force direction only
- D. Increased friction only, with no other benefit

28. A driving gear with 9 teeth meshes with a driven gear with 36 teeth. How does the driven gear's speed compare to the driving gear's speed?

- A. It turns at $\frac{1}{4}$ the speed
- B. It turns 4 times as fast
- C. It turns at the same speed
- D. It turns at $\frac{1}{9}$ the speed

29. A pry bar's fulcrum is positioned so the effort arm is 28 inches and the load arm is 7 inches. What is its mechanical advantage?

- A. 4
- B. 21
- C. 0.25
- D. 196

30. Which of Newton's laws explains why a technician pushing on a stuck valve handle feels the handle pushing back with equal force?

- A. The first law, describing inertia
- B. The second law, describing $F=ma$
- C. A separate, unrelated principle
- D. The third law

31. Which type of friction generally requires less force to overcome for the same pair of surfaces: static or kinetic?

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

32. A block-and-tackle system uses 4 rope segments to support a 360-pound load. Ignoring friction, what effort force is required?

- A. 360 pounds
- B. 1440 pounds
- C. 90 pounds
- D. 180 pounds

33. A screw converts rotational effort applied at its head into which type of force along its axis?

- A. Rotational force only, with no conversion
- B. Linear force
- C. Sideways spreading force
- D. No mechanical advantage at all

34. A hydraulic system has an input piston with an area of 3.5 square inches and an output piston with an area of 28 square inches. What is its mechanical advantage?

- A. 24.5
- B. 3.5
- C. 98
- D. 8

35. A circuit has a 24-volt source and a total resistance of 8 ohms. Using Ohm's law, what is the current?

- A. 3 amps
- B. 192 amps
- C. 0.33 amps
- D. 16 amps

36. In a series circuit, if one component fails open, the rest of the circuit will:

- A. Continue operating normally
- B. Draw exactly double the normal current
- C. Stop working entirely
- D. Reverse its voltage polarity

37. Adding more branches to a parallel circuit always ____ the circuit's total resistance.

- A. increases
- B. decreases

- C. does not change
- D. doubles

38. Standing near a running motor and feeling warm air moving across your skin demonstrates which mode of heat transfer?

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

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

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

40. Which valve type allows flow in only one direction, automatically closing to prevent reverse flow?

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

41. A fine-pitch screw requires more turns to advance a given distance but provides ____ mechanical advantage than a coarse-pitch screw.

- A. less
- B. the same

- C. no measurable
- D. greater

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

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

43. A compound machine combines a lever with a mechanical advantage of 5 and a screw with a mechanical advantage of 16. What is the overall mechanical advantage?

- A. 21
- B. 5
- C. 80
- D. 16

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

45. A gauge reads 62 psi. What is the approximate absolute pressure?

- A. 62 psi
- B. 76.7 psi
- C. 47.3 psi

D. 91.4 psi

46. A driving pulley with a 4-inch diameter turns at 1000 RPM and drives a belt connected to a 10-inch driven pulley. What is the driven pulley's speed?

A. 2500 RPM

B. 1000 RPM

C. 400 RPM

D. 250 RPM

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

A. Second-class lever

B. First-class lever

C. Third-class lever

D. A pulley, not a lever at all

48. Once an object is already sliding across a surface, the friction resisting its continued motion is best described as:

A. Static friction

B. Rolling resistance exclusively

C. No friction at all

D. Kinetic friction

49. A rotary hammer drill delivers high impact force to masonry primarily through which mechanism?

A. Continuous smooth rotation alone

B. Hydraulic fluid pressure

C. Rapid percussive hammering combined with rotation

D. A large fixed gear reduction alone

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

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

51. Passage: "A deaerator removes dissolved oxygen and other gases from boiler feedwater before it enters the system, reducing internal corrosion." What is the main idea?

- A. Deaerators actually increase corrosion inside the boiler
- B. A deaerator reduces corrosion by removing dissolved gases before feedwater enters the boiler
- C. Dissolved gases have no real connection to corrosion
- D. Feedwater never contains any dissolved oxygen at all

52. Passage: "Before restarting a chiller after a filter change, first confirm the refrigerant sight glass shows no bubbles. Then verify subcooling is within spec. Only after both checks should the compressor be started." If bubbles are visible in the sight glass, what should happen?

- A. The compressor should not be started until the bubbles are resolved
- B. Start the compressor anyway, since subcooling can be checked later
- C. Skip directly to starting the compressor regardless of the sight glass
- D. Address the bubbles only after the compressor has already started

53. Passage: "The technician described the vibration as pronounced, clearly noticeable through the floor even from several feet away." In this context, "pronounced" most likely means:

- A. strong and clearly noticeable
- B. barely detectable and easily missed

- C. completely absent from the equipment
- D. recorded incorrectly due to a faulty sensor

54. Passage: "After the impeller was cleared of debris, the pump's discharge flow returned to its rated value." What can be validly inferred?

- A. The pump motor was replaced during this repair
- B. The debris-clogged impeller had likely been restricting the discharge flow
- C. Discharge flow has no real connection to the impeller
- D. The impeller will never require clearing again in the future

55. Passage: "A high-discharge-pressure switch shuts down the compressor when pressure exceeds its set point, protecting the system from damage." Which statement accurately reflects this passage?

- A. The switch shutting down causes the pressure to rise
- B. System damage is what actually triggers this particular switch
- C. The switch only ever activates after damage has already occurred
- D. The switch shuts down the compressor to protect the system from high pressure

56. Passage: "Infrared scanning detects abnormal heat signatures in electrical panels long before insulation failure would otherwise be noticed. Acting on this data during scheduled inspection avoids unplanned outages." What is the main idea?

- A. Infrared scanning is rarely useful in real maintenance work
- B. Electrical panels do not actually develop abnormal heat signatures
- C. Infrared scanning enables proactive maintenance that avoids unplanned electrical outages
- D. Unplanned outages have no real connection to inspection data

57. Passage: "To isolate a heat exchanger for cleaning, first close the inlet valve. Next, close the outlet valve. Then drain the shell side. Finally, remove the access cover." What is the correct third step in this sequence?

- A. Drain the shell side
- B. Close the inlet valve
- C. Close the outlet valve
- D. Remove the access cover

58. Passage: "The inspection report noted the gasket had begun to extrude, showing material pushed outward beyond the flange's edge." In this context, "extrude" most likely means:

- A. shrink inward away from the flange edge
- B. push or squeeze outward beyond the normal boundary
- C. remain perfectly flush with no movement at all
- D. change color without any physical movement

59. Passage: "Before entering a permit-required confined space, first post a warning sign at the entrance. Next, test the atmosphere. Finally, station an attendant outside for the duration of entry." What must happen before the atmosphere is tested?

- A. Stationing an attendant outside
- B. Entering the confined space itself
- C. No step is required before testing the atmosphere
- D. Posting a warning sign at the entrance

60. Passage: "To verify a relief valve's set point, first record the current reading. Next, slowly increase system pressure while observing the gauge. If the valve opens within 2 psi of its rated setting, no adjustment is needed." The valve opens exactly at its rated setting. What should the technician do?

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

61. Passage: "The technician described the mounting as rigid, showing no detectable flex when pushed by hand." In this context, "rigid" most likely means:

- A. loose and prone to significant flexing
- B. impossible to test by hand at all
- C. firm and resistant to bending or flexing
- D. recently loosened and awaiting adjustment

62. Passage: "Since the new pressure regulator was installed, no further fluctuation has been detected during daily inspections." What can be validly inferred?

- A. The pump itself was replaced during this repair
- B. Fluctuation has no real connection to the pressure regulator
- C. The old pressure regulator had likely been the source of the fluctuation
- D. The new regulator will never require replacement in the future

63. Passage: "The specification calls for a fastener torque of 35 to 45 ft-lbs." Which of the following values falls within the specified range?

- A. 30 ft-lbs
- B. 40 ft-lbs
- C. 48 ft-lbs
- D. 52 ft-lbs

64. Passage: "Safety showers provide immediate flushing for chemical exposure to the skin. Monthly activation testing ensures the valve mechanism still functions when needed." What is the main idea?

- A. Monthly testing ensures safety showers remain functional for chemical exposure incidents
- B. Safety showers require no testing once installed
- C. Chemical exposure incidents are extremely rare and unlikely
- D. Testing has no real connection to how well the valve performs

65. Passage: "Confirm the tag is verified, then check that stored energy has been released, and only then begin work." If stored energy cannot yet be confirmed as released, what should happen?

- A. Begin work anyway, since the tag is verified
- B. Skip the stored-energy check entirely this time
- C. Work should not begin until stored energy has been confirmed released
- D. Verify the tag a second time before proceeding

66. Passage: "The readings were described as intermittent, appearing briefly and then disappearing without any consistent timing." In this context, "intermittent" most likely means:

- A. occurring on and off without a consistent pattern
- B. occurring continuously without any interruption
- C. occurring only once and never again
- D. never occurring under any circumstances at all

67. Passage: "After the shaft coupling was realigned, the unusual grinding sound during startup no longer occurred." What can be validly inferred?

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

68. Passage: "A restricted return air path increases static pressure and can cause a blower motor to draw excess amperage." Which statement correctly reflects this passage?

- A. Excess amperage is what actually causes the return path to restrict
- B. An open return path is what increases static pressure instead
- C. Return path condition has no measurable effect on amperage draw
- D. A restricted return path causes increased static pressure and excess amperage draw

69. Passage: "Fall protection anchor points must be rated for the intended load and inspected before each use. This protects workers from anchor failure during a fall arrest event." What is the main idea?

- A. Rating and pre-use inspection of anchor points protects workers from anchor failure during a fall
- B. Anchor points require no rating or inspection at all
- C. Fall arrest events never actually involve anchor points
- D. Inspection only matters after a fall has already occurred

70. Passage: "The work order specifies equipment serial number and requested completion time." Based only on this passage, which of the following is NOT stated as required?

- A. The equipment serial number
- B. The requesting supervisor's name
- C. The requested completion time
- D. That the work order specifies certain requirements at all

71. Passage: "Once the strainer basket upstream of the pump was cleared, the abnormal cavitation noise stopped entirely." What can be validly inferred?

- A. The pump impeller was replaced during this repair
- B. Cavitation noise has no real connection to the strainer
- C. The basket will never require clearing again in the future
- D. The clogged strainer basket had likely been restricting flow into the pump

72. Passage: "Isolate the panel, verify zero voltage with a meter, then apply personal locks before beginning work." What is the correct final step before work begins?

- A. Isolating the panel
- B. Verifying zero voltage with a meter
- C. Applying personal locks
- D. No step is required before work begins

73. Passage: "The compressor exhibited slugging, liquid refrigerant entering the cylinder and causing a distinctive knocking sound during operation." In this context, "slugging" refers to:

- A. a complete and permanent shutdown of the compressor
- B. a type of scheduled preventive maintenance procedure
- C. liquid refrigerant entering the cylinder and causing knocking
- D. an electrical short circuit within the compressor motor

74. Passage: "The manual specifies a belt tension of 25 to 35 pounds under moderate thumb pressure." Which of the following values falls within the specified range?

- A. 20 pounds
- B. 30 pounds
- C. 38 pounds
- D. 42 pounds

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

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

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

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

77. A flat shape has a small shaded mark in its bottom-left 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-right corner
- C. In the top-left corner
- D. It remains in the bottom-left corner

78. A flat shape has a small tab attached to its right 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 left edge
- B. The top edge
- C. The right edge, unchanged in left-right position
- D. The bottom edge

79. A cross-shaped cube net has a central square W, with squares X (above W), Y (below W), V (left of W), and Z (right of W), plus a sixth square U attached below Y, so that X, W, Y, and U form one continuous column of four. Once folded into a cube, which face is opposite face W?

- A. Face X
- B. Face U
- C. Face Y
- D. Face V

80. In the same net described above (X above W, Y below W, V left of W, Z right of W, U below Y), which two squares become opposite each other as the cube's remaining pair of faces?

- A. X and Y
- B. W and U
- C. X and U
- D. V and Z

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

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

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

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

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

- A. The top edge
- B. The left edge
- C. The right edge

D. The bottom edge, unchanged in top-bottom position

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. 3
- D. 6

86. A blueprint uses a scale of 1:40. A wall measures 3 centimeters on the drawing. What is the wall's actual length?

- A. 120 centimeters
- B. 40 centimeters
- C. 43 centimeters
- D. 300 centimeters

87. On a technical drawing, a solid, thick continuous line typically represents:

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

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

89. An object's front view shows two circles side by side, and its top view shows a matching rectangle with two circles in the same horizontal 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. Two holes are drilled through the object from front to back, aligned horizontally
- D. The two holes are located on completely different sides of the object

90. A flat shape has a small shaded mark on its top 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 bottom edge
- D. The top 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. Invalid, since a valid cube net cannot produce overlapping faces
- C. Valid, but only when folded in a specific reverse order
- 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. Always makes the shape appear smaller
- B. Only changes the shape's outline thickness
- C. Produces an identical result to a 270-degree rotation

D. Reverses the shape's handedness, which no rotation can ever reproduce

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

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

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

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

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

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

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

- A. beside (to the side of)
- B. below
- C. diagonally opposite

D. inside

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 larger 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 top-right corner. If the shape is rotated 180 degrees, where will the shaded mark now appear?

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

99. A cube net has a vertical column of four squares, with one additional square attached to the right of the second square in the column, and another additional square attached to the left of the third square in the column. 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, and it contains six total squares
- C. Yes, it is valid, but it contains only five total squares
- D. No, it is invalid because two of the squares overlap

100. A candidate finishes the timed math and mechanical sections early and still has extra time remaining before the section ends. According to the strategy covered in this chapter, the candidate should:

- A. Stop working immediately once every question has an answer selected
- B. Change every answer at random to see if the score improves
- C. Use the remaining time to review flagged or uncertain answers rather than stopping early
- D. Skip reviewing entirely and move straight to the next section

Practice Exam 5: Answer Key and Explanations

1. **A** — Convert to a common denominator of 24: $\frac{5}{8}$ becomes $\frac{15}{24}$, and $\frac{1}{6}$ becomes $\frac{4}{24}$. Adding the numerators gives $\frac{19}{24}$. Adding numerators and denominators straight across produces $\frac{6}{14}$, a different value that ignores the need for a shared denominator before any two fractions can be combined correctly. This same common-denominator method works for adding any two unlike fractions.
2. **C** — Multiplying 0.65 by 80 gives 52. Misplacing the decimal point in either direction produces 5.2 or 520, since the total number of decimal places across both factors must be counted carefully before the decimal point is placed in the final calculated product. Counting total decimal places across both original factors avoids this shortfall.
3. **D** — Parentheses first: $11 - 8 = 3$. Then multiplication: $3 \times 3 = 9$. Finally addition: $16 + 9 = 25$. Adding before multiplying ($16+3=19$, then roughly $19 \times 3=57$) applies the operations in the wrong order, producing the incorrect distractor shown in this question. Rewriting the expression after each individual step avoids this specific sequencing trap.
4. **B** — Convert 45% to a decimal (0.45) and multiply: $0.45 \times 220 = 99$. A distractor of 45 simply restates the percentage value itself rather than calculating the actual portion of 220, confusing the stated percentage with the final calculated answer entirely. This same decimal-multiplication approach applies to finding any percentage of a number.
5. **A** — Percent change = $(\text{new} - \text{original}) / \text{original} \times 100 = (46-40)/40 \times 100 = 15\%$. Using the new value (46) as the denominator instead of the original (40) produces the incorrect 13% distractor, a common and entirely avoidable setup error covered earlier in this book. Always use the original starting value as the denominator, never the new value.
6. **C** — Multiply the drawing measurement by the scale factor: $6 \times 20 = 120$ feet. Adding instead of multiplying ($6+20=26$) confuses the scale relationship with simple addition, ignoring that a scale factor is a multiplying ratio applied to the drawing measurement, not an offset. Confirming which unit the scale factor multiplies before applying it prevents this error.
7. **B** — Multiply unit price by quantity: $6.25 \times 12 = \$75.00$. Rounding \$6.25 down to \$6.00 before multiplying ($6.00 \times 12 = \$72.00$) drops part of the true unit price, understating the actual total cost by ignoring the extra 25 cents on each individual bearing. Confirming both factors' full decimal places before multiplying prevents an understated total here.

8. D — Add 8 to both sides: $7x = 42$. Divide both sides by 7: $x = 6$. Dividing 34 by 7 first without adding 8 back produces an incorrect rounded distractor; undoing subtraction before undoing multiplication is the correct order for solving this type of equation. Undoing addition before undoing multiplication is the standard, correct balance-method order.

9. A — Distribute first: $6(3x-2) = 18x - 12$. Then combine like terms: $18x + 4x = 22x$, giving $22x - 12$. Forgetting to distribute the 6 across the -2 term, leaving it as -2 rather than -12, produces the $22x - 2$ distractor shown here. Distributing every term inside the parentheses, including the constant, prevents this specific mistake.

10. C — Using the same-base exponent rule, add the exponents: $2^4 \times 2^3 = 2^7 = 128$. Multiplying the base by the sum of the exponents ($2 \times 7 = 14$) confuses this exponent rule with simple multiplication, a common mechanical error under time pressure on this exam. Adding exponents only works correctly when the two base numbers actually match.

11. D — 80 factors as 16×5 , and 16 is a perfect square, so $\sqrt{80} = \sqrt{16} \times \sqrt{5} = 4\sqrt{5}$. Leaving the perfect-square factor un-square-rooted, treating 80 as 4 times 20 rather than 16 times 5, produces the unsimplified $4\sqrt{20}$ distractor shown here. Factoring out the largest available perfect square first gives the fully simplified radical.

12. B — This is an arithmetic sequence with a common difference of 6 ($15-9=6$, $21-15=6$, $27-21=6$). The next term is $27 + 6 = 33$. Using an incorrect difference of 3 instead of 6 produces the 30 distractor, a common miscount when scanning too quickly. Confirming the common difference by subtracting consecutive terms first prevents a miscounted pattern.

13. B — Each term is multiplied by a common ratio of 3 ($12/4=3$, $36/12=3$, $108/36=3$). The next term is $108 \times 3 = 324$. Adding the most recent difference between terms instead ($108+108=216$) mistakenly treats this geometric sequence as if it were arithmetic instead. Confirming the common ratio by dividing consecutive terms first prevents this sequencing error.

14. C — Slope equals the change in y divided by the change in x: $(20-5)/(6-1) = 15/5 = 3$. Reporting only the change in y without dividing by the change in x produces the distractor of 15, dropping the required second half of the slope calculation entirely. This same method applies to any two coordinate points on a line.

15. A — Divide the part by the whole and convert to a percent: $36 / 90 = 0.40 = 40\%$. Dividing 90 by 36 instead, or rounding the division imprecisely, produces the incorrect distractors shown here; always confirm which value is the part before starting the division. Confirming which value represents the part and which represents the whole comes first.

16. D — Combined rate = $1/4 + 1/8 = 3/8$ of the route per hour, so time = $1 / (3/8) = 8/3$ hours, or 2 hours 40 minutes. Averaging the two individual times directly, $(4+8)/2 = 6$ hours, ignores that combined work rates add together rather than average. Confirming the combined rate before inverting it avoids a common setup error here.

17. B — Multiply by the conversion factor 12 inches per foot: $7.5 \times 12 = 90$ inches. Rounding 7.5 down to 7 before multiplying ($7 \times 12 = 84$) drops the half-foot, producing an answer that is 6 inches short of the actual correct total length. Multiplying by the full decimal value of the given measurement avoids this shortfall.

18. C — Parentheses first: $3 - 9 = -6$. Then $11 - (-6) = 11 + 6 = 17$. Treating the subtraction sign as applying only to the 3 and not the full parenthetical result ($11-3-9=-1$) is a common order-of-operations trap covered earlier in this book. Rewriting the parentheses as one signed value before combining terms prevents this trap.

19. A — If 138 is 15% more than the original, then $138 = \text{original} \times 1.15$, so $\text{original} = 138 / 1.15 = 120$. Multiplying 138 by 0.85 instead of dividing by 1.15 produces the incorrect 117.3 distractor, confusing a percent increase with a percent decrease. Dividing by the full multiplier, not a partial percentage figure, gives the correct value.

20. B — Both numbers share a greatest common factor of 14: $28/14 = 2$ and $42/14 = 3$, giving 2:3. The distractor 4:6 divides by only 7 instead of the full greatest common factor of 14, leaving the ratio only partially, not fully, reduced. Dividing both numbers by their true greatest common factor gives the fully reduced ratio.

21. D — Any nonzero base to the zero power equals 1, and a negative exponent indicates a reciprocal: $5^{-1} = 1/5$. Adding these gives $1 + 1/5 = 1 \frac{1}{5}$. Treating 5^{-1} as -5 instead of $1/5$ produces an incorrect distractor, confusing a negative exponent with a negative result. Applying the zero-exponent and negative-exponent rules separately, then adding, avoids this mix-up.

22. A — Convert both to improper fractions first: $2 \frac{1}{4} = 9/4$ and $1 \frac{1}{3} = 4/3$. Multiply: $(9 \times 4)/(4 \times 3) = 36/12 = 3$. Multiplying only the whole-number parts and fraction parts separately, rather than converting to improper fractions first, produces the incorrect distractor of 2.75. Converting every mixed number to an improper fraction before multiplying prevents this shortfall.

23. C — Divide the total length by the section length: $63 / 4.5 = 14$ sections, with no length left over. Rounding 4.5 up to 5 feet per section before dividing ($63/5=12.6$, rounded to 12) produces an incorrect count based on the wrong section length. Dividing by the exact stated section length, not a rounded value, gives the correct count.

24. D — Subtract $3x$ from both sides: $5x - 5 = 30$. Add 5 to both sides: $5x = 35$. Divide by 5: $x = 7$. Subtracting $8x$ from both sides instead of the smaller term ($3x$) leads to extra sign-flipping and is a common source of the $x = 5$ distractor.

25. D — Divide pay by hours using either data point: $74/4 = \$18.50$ per hour (confirmed by $129.50/7 = \$18.50$). Dividing 74 by 2 instead of 4, or otherwise misreading the table's rows, produces the incorrect \$37.00 distractor shown in this question. Confirming the correct row before dividing pay by hours avoids this specific misread.

26. C — Pliers are essentially two first-class levers joined at a shared fulcrum (the pivot pin), with the fulcrum positioned between the effort applied by the hand and the load being gripped. A second-class

lever instead places the load between the fulcrum and the effort, as in a wheelbarrow. Locating the fulcrum's position relative to effort and load classifies any lever.

27. B — Unlike a single fixed pulley, which only redirects the applied force, a movable pulley attached to the load actually reduces the effort force required to lift it, providing genuine mechanical advantage rather than simply redirecting the force to a more convenient direction of pull. Recognizing this distinction between fixed and movable pulleys is essential mechanical reasoning content here.

28. A — Gear ratio is inversely proportional to speed: with 4 times as many teeth (36 vs 9), the driven gear turns at $1/4$ the speed of the driving gear while delivering more torque. Assuming more teeth means faster rotation reverses this actual inverse relationship entirely. This inverse tooth-count relationship holds true for any pair of meshed gears encountered.

29. A — Mechanical advantage for a lever equals the effort arm length divided by the load arm length: $28/7 = 4$. Dividing the load arm by the effort arm instead ($7/28 = 0.25$) inverts the correct ratio and produces the incorrect distractor shown in this question. Placing the effort arm length in the numerator, not the load arm, avoids this reversal.

30. D — Newton's third law specifically describes this equal-and-opposite reaction: every action force produces a reaction force of equal magnitude in the opposite direction. The first law instead describes inertia, and the second law relates force, mass, and acceleration, both different relationships from this scenario. Recognizing each law's distinct relationship prevents confusing one Newtonian principle for another entirely.

31. B — Kinetic friction, which resists motion already underway, is generally smaller than static friction, which resists the start of motion from rest, for the same pair of surfaces. This is why an object often takes more force to start moving than it does to keep it moving. Confirming which phase of motion a question describes determines the correct friction type here.

32. C — Mechanical advantage equals the number of supporting rope segments: 4. $\text{Effort} = \text{load} / \text{mechanical advantage} = 360/4 = 90$ pounds. Failing to divide by the number of supporting segments, and simply restating the full load weight, produces the 360-pound distractor shown in this question. Dividing load by the correct segment count, not guessing, gives the accurate effort force.

33. B — A screw is an inclined plane wrapped around a cylinder, and turning it converts the rotational effort applied to linear force directed along the screw's axis. This is what allows a screw driven with modest twisting force to generate very high axial clamping force overall. This same rotational-to-linear conversion distinguishes a screw from a wedge or a lever.

34. D — Hydraulic mechanical advantage equals the output piston area divided by the input piston area: $28/3.5 = 8$. Subtracting the areas instead of dividing them ($28-3.5=24.5$) applies the wrong operation entirely and produces the incorrect distractor shown in this question. Dividing output area by input area, not subtracting them, gives the true mechanical advantage.

35. A — Ohm's law states current equals voltage divided by resistance: $I = V/R = 24/8 = 3$ amps. Multiplying voltage by resistance instead of dividing ($24 \times 8 = 192$) inverts the correct operation and

produces the 192-amp distractor shown in this question. Dividing voltage by resistance, not multiplying them, is the correct application of Ohm's law.

36. C — A series circuit provides only one continuous path for current, so a single open failure anywhere along that path breaks current flow through the entire circuit. This differs from a parallel circuit, where other branches continue operating normally if one branch fails open instead. This single-path behavior is exactly what distinguishes a series circuit from a parallel one.

37. B — Each additional parallel branch provides another independent path for current, which lowers the overall combined resistance of the circuit. This is the opposite of a series circuit, where adding more components always increases the total resistance instead of decreasing it as branches are added. This independent-path behavior is exactly what distinguishes a parallel circuit from a series one.

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

39. D — The continuity principle requires flow rate to remain constant, so when the pipe narrows, the fluid must speed up to maintain that same overall flow rate through the smaller cross-sectional area. This is the same principle that makes a garden hose spray farther when narrowed. This inverse relationship between pipe width and fluid velocity follows directly from the continuity principle.

40. C — A check valve is specifically designed to allow flow in one direction only, automatically closing to prevent reverse flow, unlike a gate valve, which is designed for full open or closed operation without any directional restriction on the flow passing through it. Recognizing this one-way flow function distinguishes a check valve from other valve types.

41. D — A fine thread pitch, with threads spaced closely together, requires more rotations to advance the same distance, which increases mechanical advantage at the cost of needing more turns. This mirrors the same force-for-distance trade-off found in every simple machine covered earlier in this book. This same force-for-distance trade-off applies to every simple machine covered throughout this chapter.

42. A — 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 trade-off between force and distance applies to every simple machine here.

43. C — The overall mechanical advantage of a compound machine is found by multiplying the individual mechanical advantages of its components: $5 \times 16 = 80$. Adding the two values instead ($5+16=21$) is a common error, since compound advantage compounds multiplicatively, never additively, across its parts. Multiplying, rather than adding, the individual mechanical advantages gives the correct compound result.

44. B — 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 present at all. Recognizing that only direction changes with an idler gear prevents this common confusion here.

45. B — Absolute pressure equals gauge pressure plus atmospheric pressure: $62 + 14.7 = 76.7$ 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. Adding the standard atmospheric constant to the gauge reading gives the correct absolute value.

46. C — Speed ratio equals the driving diameter divided by the driven diameter: $4/10 = 2/5$. Driven speed = $1000 \times 2/5 = 400$ RPM. Multiplying instead of dividing by the diameter ratio ($1000 \times 5/2 = 2500$) inverts the relationship and produces the incorrect distractor shown in this question. Dividing by the correct diameter ratio, not multiplying incorrectly, gives the true driven speed.

47. A — A second-class lever places the load between the fulcrum and the effort, exactly as in a wheelbarrow. A first-class lever instead places the fulcrum between effort and load, as in a seesaw, an arrangement that behaves quite differently in terms of overall mechanical advantage. Recognizing the fulcrum's position relative to load and effort confirms this lever classification quickly.

48. D — Kinetic friction specifically opposes motion that is already occurring, while static friction only opposes the initial start of motion from rest. Friction does not disappear once an object begins moving; it simply transitions to this generally smaller but still very real kinetic form instead. Recognizing that friction persists, just in a smaller form, once motion begins is key.

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

50. D — 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. B — The passage's central point connects the deaerator's function, removing dissolved gases before feedwater enters, directly to the stated benefit of reduced corrosion. The other options either contradict this stated benefit or deny a relationship the passage explicitly and directly describes in its own wording. Recognizing which sentence the others support finds the true main idea reliably.

52. A — The passage requires both checks, a clear sight glass and correct subcooling, to be confirmed before the compressor starts. Visible bubbles do not satisfy the passage's stated first condition; starting must wait until that specific check is also successfully completed first. Requiring both stated checks before proceeding is exactly what the passage's own wording demands.

53. A — The passage directly illustrates "pronounced" through the phrase "clearly noticeable through the floor even from several feet away," which describes a vibration strong enough to be obvious rather than subtle. This is a direct-illustration context clue rather than one requiring an outside contrasting comparison. Recognizing this kind of direct illustration is a fast, reliable way to determine word meaning.

54. B — The passage's cause-and-effect sequence, clearing the impeller followed immediately by flow returning to its rated value, directly supports the inference that the debris was restricting flow beforehand. The passage says nothing about motor replacement or any future maintenance schedule for the pump. This kind of direct cause-and-effect sequence is exactly what supports a valid inference here.

55. D — The passage states plainly that exceeding the set point triggers the switch, which exists to protect the system from damage. Reversing this relationship, claiming the shutdown causes the pressure to rise, inverts the passage's actual stated cause-and-effect logic entirely and incorrectly. Demanding this kind of textual proof is what reliably defeats a reversed-logic distractor here.

56. C — The passage's overall point connects early detection through infrared scanning directly to avoiding unplanned outages through proactive, scheduled inspection. The other options either dismiss the passage's stated value of the practice or deny a connection it explicitly and directly makes throughout. Recognizing how supporting details connect to one central claim is the core main-idea skill.

57. A — The passage lists four sequential steps: closing the inlet valve first, closing the outlet valve second, draining the shell side third, and removing the access cover last. The word "then" explicitly marks draining the shell side as the step that follows closing both valves. The sequence words in this passage explicitly mark which action comes immediately after which.

58. B — The passage directly defines "extrude" through its own description: material pushed outward beyond the flange's edge. This direct restatement is one of the clearest possible forms of a context clue, requiring no outside knowledge of gasket materials to answer this question correctly. Recognizing this kind of illustrative context clue is a fast, dependable reading strategy here.

59. D — The passage's sequence word "first" establishes that posting the warning sign comes before testing the atmosphere, which itself comes before stationing the attendant. Skipping ahead to test the atmosphere before posting the sign would violate this explicitly stated required order. Following the passage's explicit stated order, rather than assuming, is essential on this item type.

60. D — The passage's conditional statement is explicit: if the valve opens within 2 psi of its rated setting, no adjustment is needed. Opening exactly at the rated setting easily satisfies this condition, so adjusting the valve anyway would apply an unnecessary step the passage rules out. Applying a stated condition exactly as written, rather than assuming otherwise, is the key skill.

61. C — The phrase "showing no detectable flex when pushed by hand" directly defines "rigid" here as firm and resistant to bending, not loose, which is exactly what this specific word conveys given the surrounding sentence and the described hand test performed. Recognizing this kind of direct-illustration context clue takes careful, deliberate reading of the sentence.

62. C — The before-and-after comparison, installing a new regulator followed by no further detected fluctuation, directly supports the inference that the old regulator was the source of the problem. The passage never mentions a pump replacement anywhere in the text provided. This kind of clear cause-and-effect sequence is exactly what a valid inference should rest on.

63. B — The stated range is 35 to 45 ft-lbs inclusive, and 40 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 habits. Checking every specific numeric detail against the stated range, not just its shape, catches this.

64. A — The passage's overall point connects monthly testing directly to confirming the protective mechanism still functions, which is exactly what keeps the shower ready for a real chemical exposure incident. The other options either contradict or ignore the passage's stated purpose entirely and directly. Recognizing how two supporting details connect to one central protective purpose is the key skill.

65. C — The passage's conditional step, beginning work, applies only once both the tag and the stored-energy release are confirmed. A verified tag alone does not satisfy this condition; work must wait until the stored-energy requirement is also fully addressed and confirmed. Applying the passage's stated condition exactly, rather than skipping ahead, is essential on this item.

66. A — The phrase "appearing briefly and then disappearing without any consistent timing" directly defines "intermittent" here as occurring on and off irregularly, the opposite of what a reader might otherwise assume without this specific surrounding context provided in the passage. No outside knowledge of the specific equipment is needed to determine this meaning correctly.

67. B — The immediate resolution of the grinding sound right after the coupling realignment directly supports the inference that the misalignment was the source of the noise. The passage gives no information suggesting the motor, rather than the coupling, was the actual cause. This kind of immediate, direct cause-and-effect sequence is exactly what supports this valid inference.

68. D — The passage states plainly that a restricted return path increases pressure and can cause excess amperage draw. Reversing this relationship, claiming amperage draw causes the restriction, inverts the passage's actual stated cause-and-effect direction entirely, a common reversed-logic trap on this item type. Demanding this kind of textual proof reliably defeats a reversed-logic distractor on this item type.

69. A — The passage directly connects both requirements, proper rating and pre-use inspection, to the stated benefit of preventing anchor failure during an actual fall event. The other options either deny the passage's stated precautions or misplace when the inspection actually needs to happen. Recognizing how two stated requirements connect to one central protective purpose is the key skill.

70. B — The passage explicitly names serial number and completion time as what the work order specifies. A requesting supervisor's name is never mentioned anywhere in the text, making it the one detail that cannot be supported by what the passage actually states in writing. Searching the passage's exact wording, rather than assuming an unstated detail, catches this trap reliably.

71. D — The direct sequence, clearing the basket followed by cavitation noise stopping entirely, supports the inference that the clogged basket was restricting suction flow beforehand. The passage never mentions an impeller replacement or makes any claim about future maintenance needs. Recognizing this kind of borderline, edge-of-range numeric detail takes careful, deliberate reading here.

72. C — 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 panel and verifying zero voltage in that specific stated order given. Recognizing how two stated hazards connect to one central protective purpose is the key skill.

73. C — The passage directly defines slugging through its own description: liquid refrigerant entering the cylinder and causing a distinctive knocking sound. This direct restatement is one of the clearest possible forms of a context clue available anywhere in this particular passage. Recognizing this kind of direct, illustrative definition is a clear, reliable form of context clue.

74. B — The stated range is 25 to 35 pounds inclusive, and 30 pounds 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 stated range catches this trap reliably.

75. D — The passage's central point connects the jumper's function, maintaining continuity across an interrupted flexible connector, 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. Recognizing how the passage's stated benefit connects to its underlying mechanism is the key skill.

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

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

78. C — A reflection across a horizontal axis flips a shape's top-to-bottom orientation but does not change its left-right position at all. A tab on the right edge stays on the right edge after this specific reflection; only its vertical position within that edge would actually change. Recognizing that a horizontal-axis reflection only affects top-bottom position, not left-right, is the key insight.

79. B — In the four-square column X-W-Y-U, the first and third squares become opposite faces (X and Y), and the second and fourth squares become opposite faces (W and U). Tracing this same column-position rule confirms that face W ends up opposite face U once the net is fully folded. The same rule applies to any four-square column in a net.

80. D — With X and Y already opposite, and W and U already opposite, from the four-square vertical column, the two remaining squares, V and Z, attached to the sides of the central square W, become the cube's final pair of opposite faces once folded together. Identifying the two squares left over after the column pairing confirms this remaining opposite pair.

81. B — 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 path. Confirming which views show a feature prevents this misread.

82. C — 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 surface. Matching positions across two views reveals the hole's true orientation clearly.

83. A — A 270-degree clockwise rotation equals three consecutive 90-degree clockwise steps. Tracking the corner through each step, bottom-right to bottom-left, to top-left, to top-right, shows it ends in the top-right corner after the full 270-degree rotation is fully complete. Tracking a single marked corner through three consecutive quarter-turns gives this final position directly.

84. D — A reflection across a vertical axis flips a shape left-to-right but does not change its top-to-bottom position at all. A tab on the bottom edge stays on the bottom edge after this specific reflection; only its left-right position within that edge would actually change. Recognizing that a vertical-axis reflection only affects left-right position, not top-bottom, is the key insight.

85. C — 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. Counting each pair of matching faces, rather than each individual square, confirms this specific total.

86. A — A scale of 1:40 means every unit on the drawing represents 40 of that same unit in reality. Multiply the drawing measurement by the scale factor: $3 \times 40 = 120$ centimeters. Adding instead of multiplying ($3+40=43$) misapplies the scale as an offset rather than a true multiplying ratio. Multiplying by the scale factor, not adding, gives the true length.

87. D — A solid, thick line is the standard convention for a visible object edge, distinct from the evenly spaced dashed line used for a hidden edge and the long-short-long pattern used for a center line marking a round feature's axis on the same drawing. Distinguishing this line type from the dashed and center-line conventions covered elsewhere matters here.

88. B — A 90-degree counterclockwise rotation moves each corner one position in the reverse direction of a clockwise rotation, following the cycle top-right to top-left to bottom-left to bottom-right. Starting at top-right, the next counterclockwise step lands directly at top-left. Tracking a single marked corner through the counterclockwise cycle gives this new position directly.

89. C — Because the two circles appear in matching horizontal positions in both the front view and the top 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, aligned side by side. Confirming which two views show matching circle positions reveals the hole's true orientation clearly.

90. A — A 90-degree clockwise rotation cycles edges the same way it cycles corners: top moves to right, right moves to bottom, bottom moves to left, and left moves to top. Tracking this one marked edge through the cycle gives the correct new position directly and reliably. Tracking a single marked edge through the clockwise cycle gives its new position directly.

91. B — 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 overall. A cube always requires exactly six faces, the key rule tested.

92. D — 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. Recognizing that rotation always preserves handedness, while reflection always reverses it, is key here.

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

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

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

96. A — 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 height and depth dimensions between views by looking straight across or straight down between the related drawings on the sheet. Verifying against the original source drawing, rather than guessing, resolves this discrepancy correctly here.

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 full half-turn gives its exact diagonal opposite position.

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

99. B — Counting carefully: the vertical column itself contains four squares, plus one square to the right of the second and one square to the left of the third, for a total of six squares, each sharing exactly one edge with a neighboring square, making this a valid net. Maintaining a consistent, proven method under time pressure protects accuracy on remaining questions.

100. C — Extra time remaining in a section is best spent reviewing genuinely flagged or uncertain answers, checking specific details against the question rather than re-reading everything generally. Stopping early wastes an opportunity to catch a real error while time to fix it is still available. Reviewing flagged answers with specific doubts first makes the best use of any leftover time.