

PRACTICE EXAM 7: POSS SIMULATION

Use scratch paper and pencil only. Do not consult notes, study materials, or the answer key during the exam. Answer every question — there is no penalty for wrong answers.

SUBTEST 1 — MATHEMATICAL USAGE

46 questions | 17 minutes | No calculator

1. What is 45^2 ?

- A. 2,025
- B. 2,125
- C. 2,225
- D. 1,925

2. A pump moves 420 gallons in 14 minutes. How many gallons does it move in 35 minutes at the same rate?

- A. 980 gallons
- B. 1,000 gallons
- C. 1,050 gallons
- D. 1,100 gallons

3. What is 90% of 70?

A. 56

B. 60

C. 62

D. 63

4. Solve for x : $9x - 12 = 51$

A. 6

B. 7

C. 8

D. 9

5. Convert 6 hours and 25 minutes to total minutes.

A. 385 minutes

B. 395 minutes

C. 365 minutes

D. 375 minutes

6. A pipe is 252 inches long. How many feet is that?

A. 19 feet

B. 20 feet

C. 21 feet

D. 23 feet

7. What is $\frac{3}{4} + \frac{5}{8}$ expressed as a fraction in simplest form?

A. $\frac{8}{12}$

B. $\frac{4}{3}$

C. $\frac{9}{8}$

D. $\frac{11}{8}$

8. A motor runs at 1,500 RPM. How many revolutions does it complete in 18 seconds?

A. 400

B. 450

C. 500

D. 540

9. If 15 workers complete a project in 14 days, how many days would 21 workers take to complete the same project?

A. 10 days

B. 11 days

C. 12 days

D. 13 days

10. What is 0.65×0.4 ?

A. 0.20

- B. 0.24
- C. 0.26
- D. 0.30

11. A storage tank loses 23 gallons of water per hour. How many gallons does it lose in 6.5 hours?

- A. 138 gallons
- B. 149.5 gallons
- C. 152 gallons
- D. 165 gallons

12. Which fraction is equivalent to 0.125?

- A. $\frac{1}{8}$
- B. $\frac{2}{9}$
- C. $\frac{3}{16}$
- D. $\frac{5}{12}$

13. A worker is paid \$26 per hour. What are the gross earnings for 38 hours?

- A. \$948
- B. \$972
- C. \$988
- D. \$1,012

14. What is 36×25 ?

- A. 900

- B. 950
- C. 980
- D. 1,000

15. A pressure gauge reads 95 PSI. How many feet of water column does this represent? (Use 1 PSI = 2.31 feet of water.)

- A. 200 feet
- B. 219.45 feet
- C. 240 feet
- D. 260 feet

16. Solve for n: $8n + 9 = 6n + 25$

- A. 6
- B. 7
- C. 9
- D. 8

17. What is the average of 18, 24, 30, 42, and 56?

- A. 32
- B. 33
- C. 34
- D. 36

18. A pump's output is 125 gallons per minute. How many gallons does it produce in 1 hour and 12 minutes?

- A. 9,000 gallons
- B. 9,200 gallons
- C. 9,500 gallons
- D. 9,750 gallons

19. What is the square root of 169?

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

20. A truck travels at 80 miles per hour. How long does it take to travel 360 miles?

- A. 3.5 hours
- B. 4 hours
- C. 5 hours
- D. 4.5 hours

21. What is $\frac{7}{12}$ of 84?

- A. 49
- B. 52
- C. 56

D. 63

22. A water tank is 70% full. If the tank holds 1,800 gallons total, how many gallons of water are in the tank?

A. 1,200 gallons

B. 1,180 gallons

C. 1,260 gallons

D. 1,300 gallons

23. Convert 32 pints to gallons. (Use 1 gallon = 8 pints.)

A. 6 gallons

B. 5 gallons

C. 8 gallons

D. 4 gallons

24. What is $234 \div 18$?

A. 12

B. 13

C. 14

D. 15

25. A rectangular tank is 16 feet long, 11 feet wide, and 5 feet deep. What is its volume?

A. 720 cubic feet

- B. 800 cubic feet
- C. 840 cubic feet
- D. 880 cubic feet

26. If a number is decreased by 25% to give a result of 90, what is the original number?

- A. 100
- B. 120
- C. 130
- D. 110

27. What is the result of $27.6 \div 0.6$?

- A. 46
- B. 48
- C. 52
- D. 54

28. A chemical mixing tank uses water and chemical in a 9:4 ratio. If 108 gallons of water are used, how many gallons of chemical are needed?

- A. 36 gallons
- B. 40 gallons
- C. 48 gallons
- D. 54 gallons

29. What is $\frac{7}{8} \div \frac{1}{2}$ expressed as a fraction in simplest form?

- A. $\frac{7}{4}$
- B. $\frac{7}{16}$
- C. $\frac{1}{2}$
- D. $\frac{4}{7}$

30. A motor's speed decreases by 22%. If the original speed was 2,500 RPM, what is the new speed?

- A. 1,800 RPM
- B. 1,900 RPM
- C. 2,000 RPM
- D. 1,950 RPM

31. Solve for y : $6(y - 4) = 30$

- A. 7
- B. 8
- C. 9
- D. 10

32. What is 28% of 200?

- A. 50
- B. 56
- C. 60
- D. 64

33. A pump operates 11 hours per day. How many minutes does it operate over a 4-day period?

- A. 2,640 minutes
- B. 2,700 minutes
- C. 2,750 minutes
- D. 2,800 minutes

34. What is the value of 4^3 ?

- A. 32
- B. 48
- C. 56
- D. 64

35. If 84 is 56% of a number, what is the number?

- A. 140
- B. 150
- C. 160
- D. 170

36. A fuel tank holds 2,500 gallons. After a 12-hour shift, the level has dropped to 1,900 gallons. What is the average consumption rate per hour?

- A. 40 gallons per hour
- B. 45 gallons per hour
- C. 48 gallons per hour

D. 50 gallons per hour

37. What is $11/12 + 1/4$ expressed as a fraction in simplest form?

A. $7/6$

B. $5/6$

C. $12/16$

D. $1 \frac{1}{2}$

38. A worker earns \$40 per hour for the first 40 hours and \$60 per hour for overtime. What are the total earnings for a 46-hour week?

A. \$1,840

B. \$1,960

C. \$2,000

D. \$2,100

39. What is the perimeter of a rectangle that is 26 feet long and 18 feet wide?

A. 80 feet

B. 84 feet

C. 88 feet

D. 92 feet

40. A pipe with a 16-inch diameter has a cross-sectional area of approximately how many square inches? (Use $\pi \approx 3.14$.)

A. 150 square inches

- B. 175 square inches
- C. 188 square inches
- D. 200.96 square inches

41. What is 0.125 expressed as a fraction in simplest form?

- A. $\frac{1}{8}$
- B. $\frac{2}{15}$
- C. $\frac{3}{22}$
- D. $\frac{5}{36}$

42. A boiler heats water from 80°F to 245°F . What is the temperature increase?

- A. 145°F
- B. 155°F
- C. 165°F
- D. 175°F

43. Two pumps work together to fill a tank. Pump A delivers 35 gallons per minute and Pump B delivers 65 gallons per minute. How long will it take both pumps together to fill a 2,500-gallon tank?

- A. 20 minutes
- B. 22 minutes
- C. 24 minutes
- D. 25 minutes

44. What is 7% of 400?

- A. 26
- B. 28
- C. 30
- D. 32

45. A 288-foot length of pipe is cut into sections that are each 12 feet long. How many full sections can be cut?

- A. 22 sections
- B. 23 sections
- C. 24 sections
- D. 26 sections

46. If $x = 5$ and $y = 3$, what is the value of $2x^2 - 3y + 1$?

- A. 42
- B. 47
- C. 50
- D. 56

SUBTEST 2 — MECHANICAL CONCEPTS

44 questions | 20 minutes | Pictorial questions

47. A first-class lever has a fulcrum 6 feet from a 540-pound load and 9 feet from the effort. What force is required to balance the load?

- A. 240 pounds
- B. 300 pounds
- C. 360 pounds
- D. 420 pounds

48. Two meshing gears have 25 and 75 teeth. If the smaller gear rotates clockwise at 600 RPM, the larger gear rotates:

- A. Counterclockwise at 200 RPM
- B. Clockwise at 200 RPM
- C. Counterclockwise at 1,800 RPM
- D. Clockwise at 1,800 RPM

49. A hydraulic system has an input piston of 4 square inches and an output piston of 100 square inches. If 70 pounds of force is applied to the input, what force is produced at the output?

- A. 1,200 pounds
- B. 1,500 pounds
- C. 1,600 pounds
- D. 1,750 pounds

50. In a block-and-tackle system with 9 supporting rope segments, what force is required to lift a 3,600-pound load (ignoring friction)?

- A. 300 pounds
- B. 400 pounds
- C. 500 pounds
- D. 600 pounds

51. Water flows through a 36-square-inch pipe at 3 feet per second. The pipe narrows to 9 square inches. What is the new water velocity?

- A. 9 feet per second
- B. 10 feet per second
- C. 12 feet per second
- D. 15 feet per second

52. A wheel-and-axle system has a wheel radius of 32 inches and an axle radius of 4 inches. What mechanical advantage does it provide?

- A. 8
- B. 6
- C. 10
- D. 12

53. According to Pascal's law, in an enclosed incompressible fluid:

- A. Pressure increases only at the point of force application
- B. Pressure decreases as it moves through the fluid

- C. Pressure exists only in the direction of flow
- D. Pressure is transmitted equally in all directions

54. A 4-inch driver pulley turns at 1,500 RPM and is connected by a belt to a 12-inch driven pulley. What is the speed of the driven pulley?

- A. 4,500 RPM
- B. 500 RPM
- C. 1,500 RPM
- D. 750 RPM

55. A wedge that is 20 inches long and 4 inches thick at the wide end has a mechanical advantage of:

- A. 5
- B. 4
- C. 6
- D. 8

56. A globe valve is best suited for which type of service?

- A. Quick on/off operation only
- B. Preventing reverse flow
- C. Throttling and partial flow control
- D. Releasing overpressure automatically

57. A pneumatic tank contains 24 cubic feet of air at 50 PSI. If the air is compressed to 6 cubic feet at constant temperature, what is the new pressure?

- A. 100 PSI
- B. 200 PSI
- C. 250 PSI
- D. 300 PSI

58. A loading ramp is 36 feet long and rises 6 feet. What is its mechanical advantage?

- A. 4
- B. 5
- C. 7
- D. 6

59. The primary direction-of-rotation difference between meshing gears and belt-driven pulleys is that:

- A. Meshing gears and belt drives both rotate in the same direction
- B. Meshing gears rotate in opposite directions; belt drives rotate in the same direction
- C. Meshing gears rotate in the same direction; belt drives rotate in opposite directions
- D. Both rotate in alternating directions depending on speed

60. The hydrostatic pressure exerted by a fluid column depends on:

- A. The height of the column and the fluid density
- B. The width of the container at the base
- C. The shape of the surrounding equipment

D. The temperature of the surrounding atmosphere

61. As back pressure on a centrifugal pump approaches the shutoff head:

A. Flow rate increases substantially

B. Flow rate remains constant

C. Flow rate fluctuates randomly

D. Flow rate decreases toward zero

62. A second-class lever produces a mechanical advantage that is:

A. Always less than 1

B. Always greater than 1

C. Always exactly equal to 1

D. Equal to zero

63. A vertical column of water 110 feet tall produces a pressure at its base of approximately:

A. 38 PSI

B. 42 PSI

C. 47.6 PSI

D. 55 PSI

64. According to Newton's second law of motion:

A. Force equals mass times acceleration

B. An object at rest stays at rest unless acted on by a force

- C. Pressure transmits equally in all directions
- D. For every action there is an equal and opposite reaction

65. A check valve installed at a pump discharge serves primarily to:

- A. Reduce friction loss in the discharge piping
- B. Throttle the flow to a precise rate
- C. Provide overpressure protection for the pump
- D. Prevent reverse flow when the pump stops

66. Two meshing gears: the driver has 90 teeth and the driven has 30 teeth. If the driver rotates at 100 RPM, the driven rotates at:

- A. 150 RPM
- B. 200 RPM
- C. 300 RPM
- D. 100 RPM

67. The conservation principle that applies to all simple machines states that:

- A. Work (force \times distance) is conserved across input and output
- B. Force is conserved without any cost in distance
- C. Distance is conserved without any cost in force
- D. Energy can be created if mechanical advantage is high enough

68. A worker pushes a 540-pound crate up a 18-foot ramp that rises 3 feet. The minimum theoretical force required is:

- A. 80 pounds
- B. 90 pounds
- C. 120 pounds
- D. 150 pounds

69. The relationship $W = m \times g$ defines weight as the product of:

- A. Volume and density
- B. Mass and the acceleration due to gravity
- C. Pressure and area
- D. Velocity and time

70. A centrifugal pump operating against a fully closed discharge valve will:

- A. Operate at maximum efficiency
- B. Reverse flow direction automatically
- C. Produce maximum pressure but zero flow with rapid fluid heating
- D. Maintain stable normal operation indefinitely

71. Friction between two surfaces in contact:

- A. Always opposes the direction of motion
- B. Acts in the direction of motion to assist movement
- C. Decreases as the normal force pressing them increases

D. Has no measurable effect on rotating equipment

72. The mechanical advantage of a single fixed pulley is:

A. 2

B. 3

C. 4

D. 1

73. When the driven gear has fewer teeth than the driver gear in a meshed pair:

A. The driven gear rotates faster than the driver

B. The driven gear rotates slower than the driver

C. No power is transmitted between the gears

D. The driven gear rotates at the same speed as the driver

74. When a long steel pipe carrying steam is heated significantly:

A. The pipe shrinks in length

B. The pipe expands in length and requires expansion provisions

C. The pipe density increases

D. The pipe loses mass

75. The principle that an object continues in motion at constant velocity unless acted on by an external force is part of:

A. Pascal's law

- B. Bernoulli's principle
- C. Newton's first law (inertia)
- D. The continuity equation

76. A 35-pound force on a balanced lever produces a 280-pound output force. The mechanical advantage is:

- A. 6
- B. 8
- C. 10
- D. 12

77. The primary function of a thrust bearing in a rotating shaft is to:

- A. Increase the rotational speed
- B. Convert linear motion to rotational
- C. Provide overspeed protection
- D. Support axial loads along the shaft

78. The reason hydraulic systems can produce very high output forces with relatively small input forces is that:

- A. The fluid generates additional force through chemical reactions
- B. The system uses electrical amplification of input force
- C. The same pressure acts across a much larger output piston area
- D. Friction in the system multiplies the applied force

79. By the continuity equation, when fluid flows from a wider pipe section into a narrower section:

- A. The fluid speeds up
- B. The fluid stops entirely
- C. The fluid pressure increases at the narrow section
- D. The fluid reverses direction

80. A V-belt drive is preferred over a flat belt drive because:

- A. The wedging action increases friction and grip
- B. V-belts cost less to manufacture
- C. V-belts last forever and never require replacement
- D. V-belts can transmit electricity in addition to mechanical power

81. Heat transfer through the bulk movement of a fluid is called:

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

82. A 30-tooth driver sprocket connected by a chain to a 90-tooth driven sprocket. If the driver rotates at 600 RPM, the driven sprocket rotates at:

- A. 1,800 RPM
- B. 200 RPM
- C. 300 RPM

D. 100 RPM

83. The outward sensation experienced on a rotating object is best understood as:

- A. A real fundamental force unique to rotation
- B. The result of magnetic forces from nearby equipment
- C. The result of inertia attempting to maintain straight-line motion
- D. The result of pressure differences in surrounding air

84. A flexible coupling between two shafts is required when:

- A. The shafts are perfectly aligned and identical
- B. No power transmission is needed
- C. The shafts will operate at different speeds
- D. Some shaft misalignment is anticipated during operation

85. The energy released when steam at 212°F condenses into water at 212°F (with no temperature change) is called the:

- A. Latent heat of vaporization
- B. Sensible heat
- C. Specific heat capacity
- D. Convective heat

86. A pressure relief valve that fails to open at the setpoint creates the immediate risk of:

- A. Reduced operating efficiency only

- B. Faster than expected component wear
- C. Catastrophic failure of the pressurized equipment
- D. Lower than normal operating temperatures

87. In a hydraulic jack, the small input piston must move a greater distance than the large output piston because:

- A. The fluid expands during the lift
- B. The total fluid volume must be conserved
- C. The output piston has a smaller area than the input
- D. The hydraulic system loses energy to friction

88. A 5-inch motor pulley rotates at 1,200 RPM and is connected by a belt to a 8-inch fan pulley. The fan rotates at:

- A. 750 RPM
- B. 900 RPM
- C. 1,920 RPM
- D. 2,000 RPM

89. The boiling temperature of water:

- A. Is fixed at 212°F regardless of conditions
- B. Depends only on the volume of water
- C. Decreases as pressure above the water increases
- D. Depends on the pressure above the water surface

90. Pressure loss in a long section of pipe carrying flowing fluid:

- A. Decreases with longer pipe length
- B. Is unaffected by pipe diameter
- C. Increases with longer length, smaller diameter, and rougher interior
- D. Depends only on fluid temperature

SUBTEST 3 — READING COMPREHENSION

36 questions | 30 minutes | 5 passages

Passage 1

Emergency diesel generators are critical reserve power sources in nuclear and conventional power plants alike. They provide an alternative source of electrical power if the normal power supply from the grid or from in-house generation is lost. The diesel generators are sized to carry the most essential plant loads, including reactor cooling pumps in nuclear facilities, instrumentation and control systems, emergency lighting, and certain communication equipment. Each generator is housed in a dedicated, environmentally protected building with its own fuel supply, cooling system, lubrication system, and starting system. The starting system typically uses compressed air or electric starting motors and is designed to bring the generator from cold-shutdown condition to full electrical output within a specified time, often less than ten seconds. Once started, the generator must be capable of accepting and supplying its rated electrical load reliably for an extended period. Periodic testing verifies that the generator will start and load properly when called upon. The fuel supply is sized to support extended operation without external fuel deliveries, with typical fuel reserves providing several days of continuous operation at full load. Maintenance of emergency diesel generators is rigorously controlled because the consequences of failure during a real emergency could be severe.

91. According to the passage, the primary purpose of emergency diesel generators is to:

- A. Provide power for routine plant operations during peak hours
- B. Replace the plant's main turbines during scheduled maintenance
- C. Generate income through grid-supply contracts

D. Provide alternative power if the normal supply is lost

92. The passage states that emergency diesel generators are sized to carry:

- A. The most essential plant loads
- B. Only emergency lighting requirements
- C. Maximum plant production loads
- D. Only computer system requirements

93. According to the passage, each generator is housed in:

- A. The main turbine building near the boiler
- B. An open outdoor pad near the switchyard
- C. A dedicated, environmentally protected building
- D. The main control room with the operator consoles

94. As used in the passage, the word "essential" most nearly means:

- A. Optional but recommended
- B. Necessary or critical
- C. Decorative or supplementary
- D. Quickly disposable

95. What can be inferred from the passage about the starting time of emergency diesel generators?

- A. They must reach full electrical output within a very short time, often less than ten seconds
- B. They typically take several hours to reach full electrical output

- C. They must operate continuously and never shut down
- D. They are started only by remote utility dispatchers

96. The author's primary purpose in this passage is to:

- A. Argue that emergency generators should be replaced with batteries
- B. Compare the costs of various diesel generator manufacturers
- C. Critique current testing procedures for emergency generators
- D. Describe the function and importance of emergency diesel generators

97. According to the passage, fuel reserves for emergency diesel generators typically provide:

- A. Less than one day of operation
- B. Several days of continuous operation at full load
- C. Indefinite operation without any fuel needed
- D. Operation only during business hours

Passage 2

Plant noise control measures protect workers from the hearing damage that can result from prolonged exposure to high-noise environments. Power plants contain many sources of high-decibel noise, including turbines, generators, large motors, fans, blowers, compressors, and the steam discharge from various plant systems. Without effective noise control, sustained exposure can lead to permanent hearing loss in operators and other workers. Noise control approaches fall into three categories. Engineering controls reduce noise at the source through equipment design, vibration isolation, sound enclosures, and acoustic barriers. Administrative controls limit worker exposure by restricting time spent in noisy areas, rotating personnel through high-noise assignments, and scheduling certain noisy activities for low-occupancy periods. Personal protective equipment — including foam earplugs, molded earplugs, and over-the-ear muffs — provides the third layer of protection by reducing the sound level reaching the worker's ear. Workers in plant areas with noise above regulatory thresholds must wear approved hearing protection at all times. Workplace hearing conservation programs include periodic audiometric testing of workers to detect any hearing changes and to identify problems before they become permanent.

98. According to the passage, the primary purpose of plant noise control measures is to:

- A. Improve the speed of plant equipment
- B. Reduce the energy consumption of motors
- C. Protect workers from hearing damage
- D. Comply with utility insurance requirements

99. The passage states that high-noise sources in power plants include:

- A. Turbines, generators, motors, fans, and steam discharge
- B. Office equipment and break room appliances
- C. Roof-mounted lighting fixtures
- D. The plant security system

100. According to the passage, engineering controls reduce noise:

- A. By rotating workers through high-noise areas
- B. At the source through equipment design and isolation
- C. Only through individual personal protective equipment
- D. By eliminating all noisy equipment from operation

101. As used in the passage, the word "sustained" most nearly means:

- A. Sudden and brief
- B. Easily reversible
- C. Suddenly intense
- D. Continued over time

102. What can be inferred from the passage about workers in noisy plant areas?

- A. They must wear approved hearing protection at all times
- B. They are exempt from noise regulations
- C. They are paid extra for noise exposure risk
- D. They work only during off-peak hours

103. The author's tone in this passage is best described as:

- A. Argumentative and persuasive
- B. Casual and personal
- C. Informative and authoritative
- D. Critical and skeptical

104. According to the passage, workplace hearing conservation programs include:

- A. Replacing all noisy equipment annually
- B. Periodic audiometric testing of workers
- C. Eliminating worker exposure to noise entirely
- D. Mandatory shift rotations every two weeks

Passage 3

Instrument air systems supply clean, dry compressed air to plant instrumentation and pneumatic control devices. Unlike service air systems used for general utility purposes, instrument air must meet stringent specifications for cleanliness, dryness, and pressure stability because the precision instruments and control valves it operates are sensitive to contamination. The instrument air supply originates from dedicated compressors that take in atmospheric air and compress it to the system pressure, typically around 100 PSI. The compressed air then passes through filters that remove particulates and oil mist from the compressor lubrication, followed by air dryers that reduce the moisture content to specified dewpoint

levels. Refrigerated dryers cool the air to condense moisture, while desiccant dryers use absorbent material to remove moisture chemically. After drying, the air is distributed throughout the plant through dedicated piping that is kept separate from service air piping to prevent contamination. Loss of instrument air pressure can cause critical control valves to fail to predetermined safe positions, which is why the instrument air system is treated as essential equipment requiring redundant compressors and continuous monitoring of pressure, dewpoint, and contamination levels.

105. According to the passage, the primary purpose of instrument air systems is to:

- A. Supply clean, dry compressed air to plant instrumentation and pneumatic control devices
- B. Provide breathing air for confined-space entries
- C. Cool electrical switchgear in the plant
- D. Operate the plant's main steam control valves

106. The passage states that instrument air must meet stringent specifications because:

- A. It is shared with the plant's drinking water system
- B. It is used for routine cleaning of plant equipment
- C. It must be safe for direct breathing
- D. The instruments and control valves it operates are sensitive to contamination

107. According to the passage, instrument air pressure is typically:

- A. Around 50 PSI
- B. Around 100 PSI
- C. Around 200 PSI
- D. Around 500 PSI

108. As used in the passage, the word "stringent" most nearly means:

- A. Loose or flexible
- B. Easy to meet
- C. Strict or demanding
- D. Optional or recommended

109. What can be inferred from the passage about loss of instrument air pressure?

- A. It can cause critical control valves to fail to predetermined safe positions
- B. It has no effect on plant operations
- C. It is automatically corrected by the service air system
- D. It is desired during routine maintenance

110. The author's primary purpose in this passage is to:

- A. Argue for replacing pneumatic controls with electronic alternatives
- B. Critique current instrument air maintenance practices
- C. Describe the function and importance of instrument air systems
- D. Compare the costs of different compressor designs

111. According to the passage, the two types of dryers used in instrument air systems are:

- A. Heat exchangers and centrifugal separators
- B. Cyclonic separators and electrostatic precipitators
- C. Demineralizers and ion exchangers
- D. Refrigerated dryers and desiccant dryers

Passage 4

Water hammer is a transient pressure surge that can occur in piping systems when fluid flow is suddenly accelerated, decelerated, or redirected. The phenomenon takes its name from the loud knocking sound it produces, which can be loud enough to startle nearby personnel even when the underlying pressure surge is not immediately destructive. Water hammer typically results from rapid valve closures, sudden pump starts or stops, or steam condensing rapidly in a piping system. The pressure spike from a water hammer event can reach many times the normal operating pressure of the system, potentially damaging valves, pipe supports, instrumentation, and even the piping itself in severe cases. Operators take specific precautions to prevent water hammer, including opening and closing valves slowly, properly draining piping before introducing steam to cold lines, and ensuring that pipe supports are properly designed and maintained. Some plant systems include surge arresters or air chambers that absorb pressure spikes before they cause damage. Despite these precautions, water hammer events still occur occasionally and represent a significant cause of piping system damage, particularly in steam systems where rapid condensation can produce especially severe pressure transients.

112. According to the passage, water hammer is:

- A. A continuous low-pressure condition in piping systems
- B. A transient pressure surge in piping systems
- C. The normal sound of fluid moving through pipes
- D. A type of mechanical valve actuator

113. The passage states that water hammer typically results from:

- A. Rapid valve closures, sudden pump starts or stops, or steam condensing rapidly
- B. Routine plant operation under normal conditions
- C. Operator error during scheduled maintenance only
- D. Atmospheric pressure changes outside the plant

114. According to the passage, the pressure spike from water hammer can:

- A. Improve the performance of piping systems
- B. Always be safely contained by relief valves
- C. Be eliminated by adding more pumps to the system
- D. Reach many times the normal operating pressure

115. As used in the passage, the word "transients" most nearly means:

- A. Permanent operating conditions
- B. Steady-state pressure values
- C. Brief, temporary events
- D. External weather effects

116. What can be inferred from the passage about water hammer prevention?

- A. Specific operational practices and engineering features can reduce its occurrence
- B. It is impossible to prevent under any circumstances
- C. It only requires personal protective equipment
- D. It is unimportant in modern plant design

117. The author's tone in this passage is best described as:

- A. Casual and conversational
- B. Informative and authoritative
- C. Argumentative and persuasive
- D. Critical and dismissive

118. According to the passage, some plant systems include what equipment to absorb pressure spikes?

- A. Pressure-reducing valves
- B. Mechanical isolation valves
- C. Surge arresters or air chambers
- D. Bypass piping arrangements

Passage 5

Incident reporting culture refers to the organizational mindset that encourages plant personnel to report safety events, near-misses, equipment problems, and procedural concerns openly and without fear of unfair punishment. A strong incident reporting culture is widely recognized as one of the most important factors in achieving high levels of plant safety and reliability. When workers feel safe reporting problems, the organization receives early warnings about developing issues, can identify systemic weaknesses, and can implement corrective actions before serious incidents occur. Conversely, when workers fear that reporting problems will lead to blame or punishment, problems go unreported, hazards persist, and the organization loses the opportunity to learn and improve. Effective incident reporting programs include clear reporting procedures, prompt and thorough investigations, transparent communication about findings and corrective actions, and a fair handling of any individual accountability that may be appropriate. The investigations focus on understanding why an event occurred — including any contributing organizational, procedural, or design factors — rather than simply identifying who was involved. This learning-focused approach builds the trust needed to sustain a strong reporting culture over time.

119. According to the passage, incident reporting culture refers to:

- A. Government regulations that require event reporting
- B. The organizational mindset that encourages reporting safety events without fear of unfair punishment
- C. The plant's annual safety performance metrics
- D. The technical equipment used to report incidents

120. The passage states that a strong incident reporting culture is widely recognized as:

- A. A regulatory requirement that adds cost
- B. An optional supplementary safety measure
- C. A barrier to operational efficiency
- D. One of the most important factors in plant safety and reliability

121. According to the passage, when workers feel safe reporting problems, the organization:

- A. Receives early warnings and can identify systemic weaknesses
- B. Has more disciplinary actions to take against workers
- C. Reduces the need for employee training programs
- D. Eliminates the need for routine inspections

122. As used in the passage, the word "systemic" most nearly means:

- A. Limited to a single individual
- B. Caused by external factors only
- C. Affecting an entire system or organization
- D. Rare and unique to one event

123. What can be inferred from the passage about effective incident investigations?

- A. They focus on punishing those involved in the incident
- B. They focus on understanding why the event occurred, including contributing factors
- C. They are conducted only by external regulatory inspectors
- D. They are kept confidential from plant workers

124. The author's tone in this passage is best described as:

- A. Informative and authoritative
- B. Argumentative and persuasive
- C. Casual and personal
- D. Critical and dismissive

125. According to the passage, what is essential to sustaining a strong reporting culture over time?

- A. Strict punishment of any worker involved in incidents
- B. Eliminating all individual accountability completely
- C. Focusing solely on technical equipment problems
- D. Building trust through learning-focused investigations

126. The passage indicates that ineffective reporting culture leads to:

- A. Increased operating efficiency through reduced bureaucracy
- B. Better individual worker accountability
- C. Problems going unreported and hazards persisting
- D. Reduced regulatory oversight requirements

SUBTEST 4 — FIGURAL REASONING

20 questions | 10 minutes | Visual pattern recognition

127. A sequence shows a triangle that combines rotation with color shift. Frame 1: white triangle pointing up. Frame 2: gray triangle pointing right (rotated 90° clockwise). Frame 3: dark gray triangle pointing down (rotated 90° more). Frame 4: nearly black triangle pointing left (rotated 90° more). What should Frame 5 show?

- A. White triangle pointing up
- B. Gray triangle pointing right
- C. Black triangle pointing up
- D. Black triangle pointing down

128. A 2×2 grid shows: top-left = small filled circle, top-right = small empty circle, bottom-left = large filled circle, bottom-right = ? What should appear in the bottom-right?

- A. Large empty circle
- B. Small filled circle
- C. Large filled circle
- D. Small empty circle

129. A 3×3 dot matrix shows dots at positions (1,1), (1,2), (1,3) in the top row. The middle row has dots at (2,2), (2,3). The bottom row has a dot at (3,3) and the missing position. What dots belong in the bottom row?

- A. Just (3,1)
- B. Dots at (3,1) and (3,2)
- C. Dot at (3,2) only
- D. No dots — the bottom-right position is empty

130. A sequence shows a rectangle that gains one diagonal line per frame. Frame 1: 0 lines. Frame 2: 1 line. Frame 3: 2 lines. Frame 4: 3 lines. How many diagonal lines should Frame 5 show?

- A. 3 lines
- B. 4 lines
- C. 5 lines
- D. 6 lines

131. A 2×2 grid shows: top-left = single horizontal arrow pointing right, top-right = double-headed arrow (pointing both right and left), bottom-left = single vertical arrow pointing up, bottom-right = ? What should appear in the bottom-right?

- A. Vertical arrow pointing down
- B. Single horizontal arrow
- C. Double-headed vertical arrow (pointing both up and down)
- D. Diagonal arrow

132. A sequence shows a circle that rotates 45° clockwise per frame, with one segment marked. Frame 1: marked at top (12 o'clock). Frame 2: marked at upper-right (1:30). Frame 3: marked at right (3:00). Frame 4: marked at lower-right (4:30). Where should the mark be in Frame 5?

- A. At top (12 o'clock)
- B. At bottom (6:00)
- C. At lower-left (7:30)
- D. At upper-right (1:30)

133. A 3×3 grid shows shapes that decrease in size from left to right within each row. The bottom row begins with a large octagon and a medium octagon. What belongs in the missing third cell?

- A. A large octagon
- B. A medium octagon
- C. A square
- D. A small octagon

134. A sequence shows a star whose color cycles in a fixed pattern: white, gray, black, white, gray. What color should Frame 6 be?

- A. Black
- B. White
- C. Gray
- D. Striped

135. A 2×2 grid shows: top-left = empty diamond, top-right = empty pentagon, bottom-left = filled diamond, bottom-right = ? What should appear in the bottom-right?

- A. Empty hexagon
- B. Empty pentagon
- C. Filled pentagon
- D. Filled diamond

136. A sequence shows a shape that loses one internal line per frame. Frame 1: 4 internal lines. Frame 2: 3 lines. Frame 3: 2 lines. Frame 4: 1 line. How many internal lines should Frame 5 show?

- A. 1 line

- B. 0 lines (still empty)
- C. 2 lines
- D. 3 lines

137. A 2×2 grid shows: top-left = single circle, top-right = circle with a horizontal line through it, bottom-left = single square, bottom-right = ? What should appear in the bottom-right?

- A. Square with a horizontal line through it
- B. Square with a vertical line through it
- C. Two squares
- D. Circle with a square inside

138. A sequence shows a shape that combines a 90° clockwise rotation with addition of one element per frame. Frame 1: triangle pointing up with 1 dot inside. Frame 2: triangle pointing right with 2 dots. Frame 3: triangle pointing down with 3 dots. Frame 4: triangle pointing left with 4 dots. What should Frame 5 show?

- A. Triangle pointing up with 4 dots
- B. Triangle pointing left with 5 dots
- C. Triangle pointing up with 5 dots
- D. Triangle pointing right with 5 dots

139. A 3×3 grid shows colors that shift one position per row: top row = white, gray, black. Middle row = gray, black, white. Bottom row = black, white, ? What color belongs in the missing cell?

- A. White
- B. Gray
- C. Black
- D. Striped

140. A sequence shows a square mirrored across its horizontal axis in alternating frames. Frame 1: small mark on top edge. Frame 2: mirror — mark on bottom edge. Frame 3: mark on top edge. Frame 4: mark on bottom edge. Where should the mark be in Frame 5?

- A. On the bottom edge
- B. On the right edge
- C. On the left edge
- D. On the top edge

141. A 2×2 grid shows: top-left = a 4-cornered square, top-right = a 6-cornered hexagon, bottom-left = a 4-cornered diamond, bottom-right = ? What should appear in the bottom-right?

- A. A 6-cornered shape oriented like a diamond
- B. A 4-cornered diamond
- C. A 5-cornered pentagon
- D. A 3-cornered triangle

142. A sequence shows a circle progressively divided by lines through the center. Frame 1: 1 line dividing into 2 segments. Frame 2: 2 lines dividing into 4 segments. Frame 3: 3 lines dividing into 6 segments. Frame 4: 4 lines dividing into 8 segments. How many segments should Frame 5 contain?

- A. 6 segments
- B. 8 segments
- C. 9 segments
- D. 10 segments

143. A 2×2 grid shows: top-left = single dot positioned in upper-left of cell, top-right = single dot in upper-right of cell, bottom-left = single dot in lower-left of cell, bottom-right = ? What should appear in the bottom-right?

- A. Dot in the center of the cell
- B. Dot in the lower-right of cell
- C. Dot in the upper-right of cell
- D. No dot at all

144. A sequence shows a hexagon with progressive shading. Frame 1: empty (0% shaded). Frame 2: $\frac{1}{3}$ shaded. Frame 3: $\frac{2}{3}$ shaded. Frame 4: fully shaded (100%). What should Frame 5 show?

- A. Empty hexagon (0% shaded again, restarting cycle)
- B. Half-shaded hexagon
- C. Fully shaded hexagon
- D. Striped hexagon

145. A 3×3 grid shows shapes that gain one element from left to right within each row. The bottom row shows: 1 small square, 2 small squares, ? How many small squares belong in the missing cell?

- A. 4 squares
- B. 5 squares
- C. 3 squares
- D. 6 squares

146. A sequence shows a star whose number of points increases by 1 each frame. Frame 1: 4 points. Frame 2: 5 points. Frame 3: 6 points. Frame 4: 7 points. How many points should Frame 5 show?

A. 7 points

B. 6 points

C. 9 points

D. 8 points

PRACTICE EXAM 7 — ANSWER KEY

AND FULL EXPLANATIONS

SUBTEST 1 — MATHEMATICAL USAGE (Questions 1–46)

1. **A** — 2,025. Use the squaring shortcut for numbers ending in 5: take the leading digit (4), multiply by the next integer (5) to get 20, then append 25. Result: 2,025. This trick works for every number ending in 5.
2. **C** — 1,050 gallons. Set up the proportion: $420/14 = x/35$. Cross-multiply: $14x = 14,700$, so $x = 1,050$ gallons. Direct proportional reasoning handles steady-rate flow problems reliably.
3. **D** — 63. Use the 10% anchor: 10% of 70 = 7, so 90% = $70 - 7 = 63$. The anchor method is the fastest mental approach for percentage calculations.
4. **B** — 7. Add 12 to both sides: $9x = 63$. Divide by 9: $x = 7$. The standard two-step pattern handles every linear equation: undo addition first, then undo multiplication.
5. **A** — 385 minutes. Convert 6 hours to 360 minutes, then add 25 minutes: $360 + 25 = 385$ minutes. Mixed time-unit conversions must be handled by converting to a common unit first.
6. **C** — 21 feet. Divide 252 inches by 12 inches per foot = 21 feet. The conversion factor of 12 inches per foot should be at the level of automatic recall.
7. **D** — $11/8$. Find a common denominator of 8: $3/4 = 6/8$ and $5/8 = 5/8$. Add: $6/8 + 5/8 = 11/8$. The fraction is improper and cannot be reduced further.
8. **B** — 450. Convert 1,500 RPM to revolutions per second: $1,500 / 60 = 25$ revolutions per second. In 18 seconds: $25 \times 18 = 450$ revolutions. Recognizing the unit conversion embedded in the problem is the key step.
9. **A** — 10 days. This is an inverse proportion: workers \times days = constant. So $15 \times 14 = 21 \times x$, giving $210 = 21x$ and $x = 10$ days. More workers means less time, which is the inverse-proportion signature.
10. **C** — 0.26. Multiply $0.65 \times 0.4 = 0.260$. Count two decimal places in the original numbers and place the decimal point that many places from the right in the answer.
11. **B** — 149.5 gallons. Multiply 23 gallons per hour \times 6.5 hours = 149.5 gallons. Use decomposition: $23 \times 6 = 138$, then $23 \times 0.5 = 11.5$, giving 149.5 total.

12. **A** — $1/8$. The decimal 0.125 equals $125/1000$, which simplifies to $1/8$ by dividing both by 125. This is one of the common decimal-fraction equivalences that should be at the level of automatic recall.
13. **C** — \$988. Multiply $\$26 \times 38$ hours = \$988. Use decomposition: $26 \times 38 = 26 \times (40 - 2) = 1,040 - 52 = 988$. The round-and-adjust method is fast for multiplication near round numbers.
14. **A** — 900. Use the $\times 25$ shortcut: multiply by 100 and divide by 4. So $36 \times 25 = 3,600 / 4 = 900$. The $\times 25$ mental math shortcut is one of the highest-leverage patterns to internalize.
15. **B** — 219.45 feet. Multiply $95 \text{ PSI} \times 2.31$ feet of water per PSI = 219.45 feet. The pressure-to-water-column conversion factor is a core plant operations equivalence used frequently in hydrostatic calculations.
16. **D** — 8. Subtract $6n$ from both sides: $2n + 9 = 25$. Subtract 9: $2n = 16$. Divide: $n = 8$. Equations with variables on both sides require collecting variables before applying the standard pattern.
17. **C** — 34. Add the five numbers: $18 + 24 + 30 + 42 + 56 = 170$. Divide by $5 = 34$. Average problems require summing all values and dividing by the count.
18. **A** — 9,000 gallons. Convert 1 hour 12 minutes to 72 minutes total. Multiply 125 gallons per minute $\times 72$ minutes = 9,000 gallons. Always convert mixed time units before applying the rate.
19. **B** — 13. The square root of 169 is 13 because $13 \times 13 = 169$. Memorization of perfect squares from 1 to 20 enables instant recognition.
20. **D** — 4.5 hours. Use $T = D / R = 360 / 80 = 4.5$ hours. The DRT formula handles every distance-rate-time problem reliably regardless of which variable is the unknown.
21. **A** — 49. Multiply $7/12 \times 84 = (7 \times 84) / 12 = 588 / 12 = 49$. Recognizing that $84 / 12 = 7$, the calculation simplifies to $7 \times 7 = 49$.
22. **C** — 1,260 gallons. Multiply $0.70 \times 1,800 = 1,260$ gallons. Use the 10% anchor: 10% of 1,800 = 180, so $70\% = 1,260$. The "of" in percentage problems always signals multiplication.
23. **D** — 4 gallons. Divide 32 pints by 8 pints per gallon = 4 gallons. The 8-pints-per-gallon conversion is a memorized volume equivalence used frequently in fluid system calculations.
24. **B** — 13. Recognize that $18 \times 13 = 234$, so $234 / 18 = 13$. Memorization of multiplication tables allows for instant division recognition.
25. **D** — 880 cubic feet. Volume = length \times width \times height = $16 \times 11 \times 5 = 880$ cubic feet. Compute by stages: $16 \times 11 = 176$, then $176 \times 5 = 880$.
26. **B** — 120. If x decreased by 25% equals 90, then $0.75x = 90$, so $x = 90 / 0.75 = 120$. Always identify the original quantity before applying the percentage decrease relationship.

27. **A** — 46. Move the decimal points: $27.6 / 0.6 = 276 / 6 = 46$. Decimal division is simplified by shifting decimal points equally to make the divisor a whole number.
28. **C** — 48 gallons. Set up the proportion: 9 water / 4 chemical = 108 / x. Cross-multiply: $9x = 432$, so $x = 48$ gallons. Cross-multiplication is the universal solving technique for ratio problems.
29. **A** — $7/4$. Divide fractions by inverting and multiplying: $7/8 \div 1/2 = 7/8 \times 2/1 = 14/8 = 7/4$. Fraction division uses the "invert and multiply" rule.
30. **D** — 1,950 RPM. A 22% decrease means the new speed is 78% of the original: $2,500 \times 0.78 = 1,950$ RPM. Always apply the percentage change to the original value.
31. **C** — 9. Distribute first: $6y - 24 = 30$. Add 24: $6y = 54$. Divide: $y = 9$. Equations with parentheses require distribution before applying the standard two-step solving pattern.
32. **B** — 56. Use the 10% anchor: 10% of 200 = 20, so 20% = 40 and 8% = 16. Add: $40 + 16 = 56$. The anchor method handles uncommon percentages by combining or subtracting from familiar ones.
33. **A** — 2,640 minutes. 11 hours per day \times 60 minutes per hour = 660 minutes per day. Over 4 days: $660 \times 4 = 2,640$ minutes. Multi-step conversions can be combined efficiently.
34. **D** — 64. Compute $4 \times 4 \times 4 = 16 \times 4 = 64$. The cube of 4 is a foundational fact that should be at the level of automatic recall.
35. **B** — 150. If $84 = 0.56 \times x$, then $x = 84 / 0.56 = 150$. The setup "Whole = Part / Percentage" handles this category of percentage question reliably.
36. **D** — 50 gallons per hour. Calculate the change: $2,500 - 1,900 = 600$ gallons consumed. Divide by time: $600 / 12 = 50$ gallons per hour. Average rate is total change divided by total time.
37. **A** — $7/6$. Find a common denominator of 12: $11/12 + 3/12 = 14/12$. Simplify by dividing by 2: $7/6$. Always reduce the final fraction to its lowest terms.
38. **B** — \$1,960. Regular pay: $40 \times \$40 = \$1,600$. Overtime hours: $46 - 40 = 6$. Overtime pay: $6 \times \$60 = \360 . Total: $\$1,600 + \$360 = \$1,960$. Multi-step word problems require careful sequential execution.
39. **C** — 88 feet. Perimeter of a rectangle = $2 \times (\text{length} + \text{width}) = 2 \times (26 + 18) = 2 \times 44 = 88$ feet. Doubling the sum of length and width is faster than adding all four sides individually.
40. **D** — 200.96 square inches. Area of a circle = $\pi \times r^2$. Radius = $16 / 2 = 8$ inches. Area = $3.14 \times 64 = 200.96$ square inches. The diameter must be halved to find the radius before applying the area formula.
41. **A** — $1/8$. The decimal 0.125 equals 125/1000, which simplifies to $1/8$ by dividing both by 125. This is one of the most common decimal-fraction equivalences and should be recognized instantly.

42. **C** — 165°F. Subtract: $245 - 80 = 165^\circ\text{F}$. Temperature change is the difference between final and initial temperatures, with units staying the same.
43. **D** — 25 minutes. Combined flow rate: $35 + 65 = 100$ gallons per minute. Time to fill: $2,500 / 100 = 25$ minutes. Pump rates add when pumps work together to produce combined output.
44. **B** — 28. Use the 10% anchor: 10% of 400 = 40. Then 1% = 4, so 7% = 28. The anchor method handles uncommon percentages efficiently.
45. **C** — 24 sections. Divide $288 / 12 = 24$ sections. Word problems involving cutting or partitioning into equal pieces always reduce to simple division.
46. **A** — 42. Substitute $x = 5$ and $y = 3$: $2(25) - 3(3) + 1 = 50 - 9 + 1 = 42$. Apply the order of operations strictly — exponents first, then multiplication, then addition and subtraction.

SUBTEST 2 — MECHANICAL CONCEPTS (Questions 47–90)

47. **C** — 360 pounds. Apply the law of the lever: $\text{Effort} \times \text{Effort Arm} = \text{Load} \times \text{Load Arm}$. So $\text{Effort} \times 9 = 540 \times 6$, giving $\text{Effort} = 3,240 / 9 = 360$ pounds. The mechanical advantage of 1.5 reduces the required force.
48. **A** — Counterclockwise at 200 RPM. Meshing gears always rotate in opposite directions. The gear ratio is $25/75 = 1/3$, so the larger gear rotates at one-third the driver speed: $600 / 3 = 200$ RPM, in the counterclockwise direction.
49. **D** — 1,750 pounds. Calculate the pressure: $P = F/A = 70/4 = 17.5$ PSI. Apply this pressure to the output piston: $F = P \times A = 17.5 \times 100 = 1,750$ pounds. Hydraulic mechanical advantage equals the ratio of piston areas ($100/4 = 25 \times$ force multiplier).
50. **B** — 400 pounds. The mechanical advantage of a block-and-tackle equals the number of rope segments supporting the load: $MA = 9$. Force required = $\text{Load} / MA = 3,600 / 9 = 400$ pounds. Each rope segment shares an equal portion of the load.
51. **C** — 12 feet per second. Apply the continuity equation: $A_1V_1 = A_2V_2$, so $36 \times 3 = 9 \times V_2$, giving $V_2 = 12$ feet per second. Fluid speeds up when pipe area decreases because the same volume must pass through the smaller cross-section.
52. **A** — 8. Mechanical advantage of a wheel-and-axle = $\text{Wheel Radius} / \text{Axle Radius} = 32 / 4 = 8$. A force applied at the rim of the larger wheel is multiplied at the rim of the smaller axle by the radius ratio.
53. **D** — Pressure is transmitted equally in all directions. This is Pascal's law, the foundational principle of all hydraulic systems. Pressure exists at every point in the connected fluid simultaneously, regardless of distance or path direction.

54. **B** — 500 RPM. Driven RPM = (Driver Diameter / Driven Diameter) × Driver RPM = (4/12) × 1,500 = (1/3) × 1,500 = 500 RPM. A larger driven pulley turns more slowly than a smaller driver by the same ratio as the diameters.
55. **A** — 5. Mechanical advantage of a wedge = Length / Thickness = 20 / 4 = 5. Long, thin wedges have higher mechanical advantage than short, thick wedges and require less driving force.
56. **C** — Throttling and partial flow control. Globe valves use a movable disk against a stationary seat that can be set to any partial opening reliably, making them the standard choice for throttling. The S-shaped flow path produces high pressure drop but excellent flow control.
57. **B** — 200 PSI. Apply Boyle's law: $P_1V_1 = P_2V_2$, so $50 \times 24 = P_2 \times 6$, giving $1,200 = 6P_2$ and $P_2 = 200$ PSI. Compressing a gas to one-quarter of its original volume quadruples its pressure at constant temperature.
58. **D** — 6. Mechanical advantage of a ramp = Length / Height = 36 / 6 = 6. A long, gradual ramp produces high mechanical advantage; a short, steep ramp produces low mechanical advantage.
59. **B** — Meshing gears rotate in opposite directions; belt drives rotate in the same direction. This direction-of-rotation difference is one of the most reliably testable principles distinguishing the two power transmission methods.
60. **A** — The height of the column and the fluid density. Hydrostatic pressure at any depth equals density × gravity × height. The width of the column, container shape, and fluid temperature have no direct effect on the hydrostatic pressure produced.
61. **D** — Flow rate decreases toward zero. The pump curve of a centrifugal pump shows an inverse relationship between pressure and flow. As back pressure rises toward the shutoff head, the flow rate drops progressively toward zero.
62. **B** — Always greater than 1. Second-class levers (load between fulcrum and effort) always produce mechanical advantage greater than 1, meaning they multiply the input force. A wheelbarrow is the classic example.
63. **C** — 47.6 PSI. Use the conversion 1 foot of water ≈ 0.433 PSI. Multiply $110 \times 0.433 = 47.63$ PSI ≈ 47.6 PSI. The hydrostatic pressure depends on the height of the column, not on the volume or shape of the container.
64. **A** — Force equals mass times acceleration. Newton's second law states $F = m \times a$. The same force produces less acceleration on a more massive object than on a less massive one.
65. **D** — Prevent reverse flow when the pump stops. Check valves allow fluid to flow in only one direction and close automatically when flow reverses. Without a check valve, fluid would flow backward through a stopped pump and could damage the impeller and drive system.

66. **C** — 300 RPM. The gear ratio is $90/30 = 3$, meaning the driven gear rotates at three times the speed of the driver. So $100 \times 3 = 300$ RPM. The driven gear with fewer teeth always rotates faster than the driver gear.
67. **A** — Work (force \times distance) is conserved across input and output. Every simple machine obeys this conservation principle. Mechanical advantage trades force for distance — you can multiply force, or you can multiply distance, but never both simultaneously.
68. **B** — 90 pounds. Mechanical advantage of the ramp = $18 / 3 = 6$. Required force = Load / MA = $540 / 6 = 90$ pounds. The ramp reduces the required force by a factor equal to its mechanical advantage.
69. **B** — Mass and the acceleration due to gravity. In the formula $W = m \times g$, weight equals mass multiplied by gravitational acceleration (approximately 9.8 m/s^2 or 32.2 ft/s^2 on Earth's surface). This is the fundamental relationship between mass and weight.
70. **C** — Produce maximum pressure but zero flow with rapid fluid heating. When a centrifugal pump runs against a closed valve, it produces shutoff head pressure but zero flow. The impeller continues adding energy to the trapped fluid, causing rapid temperature rise that can damage seals.
71. **A** — Always opposes the direction of motion. Friction acts in the opposite direction of attempted or actual movement, regardless of the type of motion or the surfaces involved. This is a defining characteristic of friction.
72. **D** — 1. A single fixed pulley changes the direction of force but does not multiply it — the input and output forces are equal. The mechanical advantage of 1 means you must pull with the same force as the load weight.
73. **A** — The driven gear rotates faster than the driver. When the driven gear has fewer teeth than the driver, the gear ratio is less than 1 and the driven gear rotates faster while producing less torque. Speed and torque are inversely related in any gear system.
74. **B** — The pipe expands in length and requires expansion provisions. Most materials, including steel, expand when heated. Plant piping systems incorporate expansion loops, expansion joints, and slip fittings to safely accommodate this thermal expansion without buckling or rupturing.
75. **C** — Newton's first law (inertia). Newton's first law states that an object at rest stays at rest and an object in motion stays in motion at constant velocity unless acted on by an external force. This is the principle of inertia.
76. **B** — 8. Mechanical advantage = Output Force / Input Force = $280 / 35 = 8$. The lever multiplies the input force by a factor of 8, with a corresponding cost in distance.
77. **D** — Support axial loads along the shaft. Thrust bearings are specifically designed to support loads along the axis of the shaft, distinguishing them from radial bearings that support loads perpendicular to the shaft.

78. **C** — The same pressure acts across a much larger output piston area. Hydraulic systems multiply force by applying pressure (force per unit area) generated at a small piston to a much larger output piston. The same pressure across a larger area produces a larger force.
79. **A** — The fluid speeds up. By the continuity equation, when pipe area decreases at a constant flow rate, the fluid velocity must increase proportionally. The same volume must pass through the smaller cross-section in the same time.
80. **A** — The wedging action increases friction and grip. The trapezoidal cross-section of a V-belt wedges into matching V-shaped pulley grooves, creating significantly more friction and contact force than a flat belt could produce.
81. **D** — Convection. Heat transfer through the bulk movement of a fluid is convection. Conduction requires direct contact through solid materials, and radiation involves electromagnetic waves through space.
82. **B** — 200 RPM. Driven sprocket RPM = (Driver Teeth / Driven Teeth) × Driver RPM = (30/90) × 600 = (1/3) × 600 = 200 RPM. Larger sprockets rotate more slowly than smaller ones connected by the same chain.
83. **C** — The result of inertia attempting to maintain straight-line motion. The apparent outward force on a rotating object is the result of inertia — the object's natural tendency to travel in a straight line is constrained by the centripetal force pulling it toward the center.
84. **D** — Some shaft misalignment is anticipated during operation. Flexible couplings tolerate small shaft misalignments without damaging bearings or transmitting harmful vibrations. Rigid couplings require precise alignment but transmit motion without flexibility.
85. **A** — Latent heat of vaporization. Energy released when steam condenses to water (or absorbed when water vaporizes to steam) without temperature change is the latent heat of vaporization. The condensation phase change releases the same energy that vaporization absorbs.
86. **C** — Catastrophic failure of the pressurized equipment. A failed relief valve allows pressure to continue rising past the safety setpoint, potentially causing rupture, explosion, or other catastrophic equipment failure. This is why relief valves are required on every pressurized system.
87. **B** — The total fluid volume must be conserved. The fluid is incompressible, so the volume displaced from the small piston must equal the volume filling the large piston. Since the large piston has more area, the small piston must move farther for the same fluid volume.
88. **A** — 750 RPM. Fan RPM = (Motor Pulley Diameter / Fan Pulley Diameter) × Motor RPM = (5/8) × 1,200 = 750 RPM. A larger driven pulley rotates more slowly than a smaller driver pulley.
89. **D** — Depends on the pressure above the water surface. Water boils at 212°F at sea-level atmospheric pressure, but at higher pressures the boiling point rises significantly. Power plant boilers exploit this principle to heat water to 545°F or higher without flashing into vapor.

90. **C** — Increases with longer length, smaller diameter, and rougher interior. Friction loss in piping increases with these factors plus higher flow rates. These variables determine the pressure drop a pump must overcome to move fluid through the system.

SUBTEST 3 — READING COMPREHENSION (Questions 91–126)

91. **D** — Provide alternative power if the normal supply is lost. The opening sentences state this directly: emergency diesel generators "provide an alternative source of electrical power if the normal power supply from the grid or from in-house generation is lost."
92. **A** — The most essential plant loads. The passage states that "the diesel generators are sized to carry the most essential plant loads, including reactor cooling pumps in nuclear facilities, instrumentation and control systems, emergency lighting, and certain communication equipment."
93. **C** — A dedicated, environmentally protected building. The passage states that "each generator is housed in a dedicated, environmentally protected building with its own fuel supply, cooling system, lubrication system, and starting system."
94. **B** — Necessary or critical. In the context of "the most essential plant loads," the word means necessary or critical — these are the loads that absolutely must be supported during emergency conditions.
95. **A** — They must reach full electrical output within a very short time, often less than ten seconds. The passage states explicitly that the starting system "is designed to bring the generator from cold-shutdown condition to full electrical output within a specified time, often less than ten seconds."
96. **D** — Describe the function and importance of emergency diesel generators. The passage describes generator function, components, and maintenance without arguing for changes or comparing manufacturers. It is a descriptive overview.
97. **B** — Several days of continuous operation at full load. The passage states that "fuel reserves providing several days of continuous operation at full load."
98. **C** — Protect workers from hearing damage. The opening sentence states this directly: noise control measures "protect workers from the hearing damage that can result from prolonged exposure to high-noise environments."
99. **A** — Turbines, generators, motors, fans, and steam discharge. The passage lists "turbines, generators, large motors, fans, blowers, compressors, and the steam discharge from various plant systems" as high-noise sources.
100. **B** — At the source through equipment design and isolation. The passage states that "engineering controls reduce noise at the source through equipment design, vibration isolation, sound enclosures, and acoustic barriers."

101. **D** — Continued over time. In the context of "sustained exposure can lead to permanent hearing loss," the word means continuous or prolonged over time, distinguishing it from brief or intermittent exposures.
102. **A** — They must wear approved hearing protection at all times. The passage states that "workers in plant areas with noise above regulatory thresholds must wear approved hearing protection at all times."
103. **C** — Informative and authoritative. The passage describes noise control measures in a neutral, prescriptive manner using language characteristic of training and safety documentation.
104. **B** — Periodic audiometric testing of workers. The passage states that "workplace hearing conservation programs include periodic audiometric testing of workers to detect any hearing changes."
105. **A** — Supply clean, dry compressed air to plant instrumentation and pneumatic control devices. The opening sentence states this directly: instrument air systems "supply clean, dry compressed air to plant instrumentation and pneumatic control devices."
106. **D** — The instruments and control valves it operates are sensitive to contamination. The passage states that "instrument air must meet stringent specifications... because the precision instruments and control valves it operates are sensitive to contamination."
107. **B** — Around 100 PSI. The passage states explicitly that compressors "compress it to the system pressure, typically around 100 PSI."
108. **C** — Strict or demanding. In the context of "stringent specifications for cleanliness, dryness, and pressure stability," the word means strict or demanding requirements that must be carefully met.
109. **A** — It can cause critical control valves to fail to predetermined safe positions. The passage states that "loss of instrument air pressure can cause critical control valves to fail to predetermined safe positions."
110. **C** — Describe the function and importance of instrument air systems. The passage describes instrument air system function, components, and importance without arguing or comparing alternatives. It is a descriptive overview.
111. **D** — Refrigerated dryers and desiccant dryers. The passage states that "refrigerated dryers cool the air to condense moisture, while desiccant dryers use absorbent material to remove moisture chemically."
112. **B** — A transient pressure surge in piping systems. The opening sentence states this: water hammer is "a transient pressure surge that can occur in piping systems when fluid flow is suddenly accelerated, decelerated, or redirected."

113. **A** — Rapid valve closures, sudden pump starts or stops, or steam condensing rapidly. The passage states that water hammer "typically results from rapid valve closures, sudden pump starts or stops, or steam condensing rapidly in a piping system."
114. **D** — Reach many times the normal operating pressure. The passage states that "the pressure spike from a water hammer event can reach many times the normal operating pressure of the system."
115. **C** — Brief, temporary events. In the context of "pressure transients," the word means brief, temporary occurrences distinct from steady-state conditions.
116. **A** — Specific operational practices and engineering features can reduce its occurrence. The passage states that "operators take specific precautions to prevent water hammer" and that "some plant systems include surge arresters or air chambers."
117. **B** — Informative and authoritative. The passage describes water hammer phenomena and prevention measures in a neutral, factual manner, characteristic of training documentation.
118. **C** — Surge arresters or air chambers. The passage states that "some plant systems include surge arresters or air chambers that absorb pressure spikes before they cause damage."
119. **B** — The organizational mindset that encourages reporting safety events without fear of unfair punishment. The opening sentence states this: incident reporting culture "refers to the organizational mindset that encourages plant personnel to report safety events, near-misses, equipment problems, and procedural concerns openly and without fear of unfair punishment."
120. **D** — One of the most important factors in plant safety and reliability. The passage states that "a strong incident reporting culture is widely recognized as one of the most important factors in achieving high levels of plant safety and reliability."
121. **A** — Receives early warnings and can identify systemic weaknesses. The passage states that when workers feel safe reporting, "the organization receives early warnings about developing issues, can identify systemic weaknesses, and can implement corrective actions."
122. **C** — Affecting an entire system or organization. In the context of "systemic weaknesses," the word means affecting the broader organization or system rather than being isolated to a single individual or event.
123. **B** — They focus on understanding why the event occurred, including contributing factors. The passage states that investigations "focus on understanding why an event occurred — including any contributing organizational, procedural, or design factors — rather than simply identifying who was involved."
124. **A** — Informative and authoritative. The passage describes incident reporting culture in a neutral, prescriptive manner using language characteristic of safety and operational documentation.

125. **D** — Building trust through learning-focused investigations. The passage states that "this learning-focused approach builds the trust needed to sustain a strong reporting culture over time."
126. **C** — Problems going unreported and hazards persisting. The passage states that "when workers fear that reporting problems will lead to blame or punishment, problems go unreported, hazards persist, and the organization loses the opportunity to learn and improve."

SUBTEST 4 — FIGURAL REASONING (Questions 127–146)

127. **C** — Black triangle pointing up. The pattern combines two transformations: rotation of 90° clockwise per frame (up \rightarrow right \rightarrow down \rightarrow left \rightarrow up) and progressive darkening from white to black. Frame 5 reaches fully black at the up-pointing position, completing one full rotation cycle.
128. **A** — Large empty circle. The transformation in the top row is "filled to empty" (color change). The transformation in the left column is "small to large" (size change). Combining both, the bottom-right must be a large empty circle.
129. **D** — No dots — the bottom-right position is empty. The grid pattern shows dots filling positions in a specific way, with the bottom-right position being the missing pattern position. The triangular dot pattern progresses but does not require a dot at this position to maintain the pattern.
130. **B** — 4 lines. The pattern adds one diagonal line per frame: 0, 1, 2, 3, then 4. Each successive frame adds exactly one more line, making the addition rule consistent.
131. **C** — Double-headed vertical arrow (pointing both up and down). The transformation in the top row is "single-headed becomes double-headed" (one-direction becomes two-direction). Applying the same transformation to the bottom row, the single up-arrow becomes a double-headed up-and-down arrow.
132. **B** — At bottom (6:00). The mark advances 45° clockwise per frame: 12:00, 1:30, 3:00, 4:30, then 6:00. Each successive frame adds 45° to the cumulative rotation.
133. **D** — A small octagon. The pattern within each row shows the same shape with decreasing size from left to right (large, medium, small). The bottom row continues the progression with a small octagon as the third element.
134. **A** — Black. The cycle is white, gray, black, white, gray, then black (Frame 6). Each color cycles through the three-color sequence repeatedly.
135. **C** — Filled pentagon. The transformation in the top row is "diamond becomes pentagon" (shape change). The transformation in the left column is "empty becomes filled" (color change). Combining both, the bottom-right must be a filled pentagon.
136. **B** — 0 lines (still empty). The pattern subtracts one internal line per frame: 4, 3, 2, 1, then 0. Frame 5 reaches zero internal lines and stays empty.

137. **A** — Square with a horizontal line through it. The transformation in the top row is "single shape becomes shape with horizontal line through it." Applying the same transformation to the bottom row, the single square becomes a square with a horizontal line through it.
138. **C** — Triangle pointing up with 5 dots. The pattern combines a 90° clockwise rotation per frame (up, right, down, left, up after one full cycle) with addition of one dot per frame (1, 2, 3, 4, 5). Frame 5 returns to up-pointing with 5 dots.
139. **B** — Gray. The pattern shifts colors leftward by one position in each row: top row (white, gray, black), middle row (gray, black, white), bottom row (black, white, gray). The missing cell continues the leftward shift with gray.
140. **D** — On the top edge. The pattern alternates between top and bottom edges across frames: top, bottom, top, bottom, then top. Frame 5 follows the alternation by returning to the top edge.
141. **A** — A 6-cornered shape oriented like a diamond. The transformation in the top row is "4-cornered shape becomes 6-cornered shape" (corner count increases by 2). Applying the same transformation to the bottom row, the 4-cornered diamond becomes a 6-cornered shape oriented like a diamond.
142. **D** — 10 segments. The pattern adds 2 segments per frame: 2, 4, 6, 8, then 10. The arithmetic progression of +2 per frame makes Frame 5 contain 10 segments.
143. **B** — Dot in the lower-right of cell. The pattern places dots in the four corner positions of the cells in a clockwise progression. The missing cell completes the pattern with a dot in the lower-right corner.
144. **A** — Empty hexagon (0% shaded again, restarting cycle). The pattern increases shading by 1/3 per frame: 0%, 1/3, 2/3, 100%, then 0% (cycle restarts). Frame 5 begins a new cycle with the empty state.
145. **C** — 3 squares. The pattern within each row adds one element per cell from left to right: 1, 2, then 3. The bottom row continues the progression to 3 squares in the third cell.
146. **D** — 8 points. The pattern adds one point per frame: 4, 5, 6, 7, then 8. Each successive frame contains one more star point than the previous frame.