

PRACTICE EXAM 15: RED SEAL STEAMFITTER/PIPEFITTER SIMULATION (130 QUESTIONS)

1. Four controls are proposed for the same airborne hazard. Which one is the LEAST effective according to the hierarchy of controls?

- A. Substituting a less hazardous material
- B. Installing local exhaust ventilation
- C. Eliminating the process that creates it
- D. Issuing respirators to exposed workers

2. Which statement about confined-space atmospheric testing is correct?

- A. Oxygen is tested before flammables and toxics
- B. Toxics are always tested first of the three
- C. A single reading at the entrance is sufficient
- D. Testing is unnecessary if the space is ventilated

3. A worker lists the lockout steps. Which ordering is correct?

- A. Notify, shut down, isolate, lock, dissipate, verify
- B. Lock, isolate, shut down, notify, verify, dissipate
- C. Verify, lock, isolate, dissipate, shut down, notify
- D. Isolate, notify, verify, lock, shut down, dissipate

4. Which statement about PPE is correct?

- A. PPE is the most effective control available

- B. PPE eliminates the hazard at its source
- C. PPE is the last line of defence against a hazard
- D. PPE protects every worker in the area at once

5. A fire watch is posted for hot work. Which practice is correct?

- A. The watch continues for a period after work ends
- B. The watch leaves as soon as the torch is shut off
- C. The watch operates the welding equipment too
- D. No watch is needed if an extinguisher is nearby

6. Which of the following correctly identifies an oxygen-deficient atmosphere?

- A. Any level above 23.0% oxygen
- B. Any level below 19.5% oxygen
- C. A level of exactly 20.9% oxygen
- D. A level between 21% and 23% oxygen

7. Which tool use is INCORRECT for a steamfitter/pipefitter?

- A. Using a straight pipe wrench on threaded pipe
- B. Using a pipe wrench on a finished hex nut
- C. Using a level to set grade on a drain line
- D. Using a reamer to clear an internal burr

8. Which statement about cutting oil when threading steel pipe is correct?

- A. It cools the die and flushes away chips

- B. It is only needed on stainless steel pipe
- C. It increases the taper angle of the thread
- D. It permanently seals the finished joint

9. A worker compares two documents that disagree. Which action is correct when a drawing and specification conflict?

- A. Seek written clarification before proceeding
- B. Always follow the drawing over the spec
- C. Always follow the spec over the drawing
- D. Proceed on the installer's best judgment

10. Which statement about a group lockout is correct?

- A. Each worker applies their own personal lock
- B. One shared lock covers the whole crew
- C. The supervisor holds all the workers' locks
- D. Tags alone replace the need for locks

11. Which step is most often skipped in real lockout incidents, leading to injury?

- A. Dissipating stored energy before work
- B. Notifying affected workers of the lockout
- C. Shutting the equipment down normally
- D. Identifying the correct isolation points

12. A material take-off is being prepared. Which statement about it is correct?

- A. It records completed pressure-test results

- B. It is a drawing of the system flow path
- C. It removes scrap material from the site
- D. It is an itemized count of required materials

13. Which communication method is best for conveying a complex pipe routing on a noisy site?

- A. A quick isometric sketch of the routing
- B. Shouting the dimensions across the room
- C. A message relayed through a third worker
- D. A verbal description given at shift end

14. Which statement about a Safety Data Sheet (SDS) is correct?

- A. It provides hazard and safe-handling data
- B. It lists the lockout steps for a machine
- C. It states the pressure rating of a pipe
- D. It certifies a welder's qualifications

15. A condensate line must fall 1/4 inch per foot over 16 feet. Which total drop is correct?

- A. 2 inches over the run
- B. 8 inches over the run
- C. 4 inches over the run
- D. 16 inches over the run

16. Which statement about mentoring an apprentice is correct?

- A. Only the steps matter, never the reasoning

- B. Explaining the reasoning builds true competence
- C. Mentoring mainly reduces the crew's tool costs
- D. Apprentices learn best with no feedback given

17. Which statement about isometric drawings is correct?

- A. They are drawn precisely to a stated scale
- B. They show only system function and flow
- C. They show a 3-D run with figured dimensions
- D. They are cross-sections through one fitting

18. On a drawing, which dimension governs when a printed value and a scaled value disagree?

- A. The scaled value, since rulers are exact
- B. The average of the two conflicting values
- C. The printed (figured) value always governs
- D. Whichever value is larger of the two

19. A 45° offset must shift a line 500 mm. Which centre-to-centre travel is correct?

- A. 354 mm of travel
- B. 707 mm of travel
- C. 1,000 mm of travel
- D. 250 mm of travel

20. Which statement about pipe schedule is correct for a given Nominal Pipe Size?

- A. Higher schedule means thicker wall, smaller bore

- B. Higher schedule means a larger outside diameter
- C. Higher schedule means a lower pressure rating
- D. Schedule has no effect on the wall thickness

21. Which reducer and orientation prevents a condensate pocket in a horizontal drainage line?

- A. A concentric reducer centred on the line
- B. A concentric reducer with the taper up
- C. An eccentric reducer with the flat side up
- D. An eccentric reducer with the flat side down

22. Which statement about brazing versus soldering is correct?

- A. Soldering filler melts above 450°C (840°F)
- B. Brazing filler melts above 450°C (840°F)
- C. Both melt at exactly the same temperature
- D. Brazing always melts below 200°C (392°F)

23. Which sequence correctly describes preparing and making a threaded steel pipe joint?

- A. Thread, apply dope, cut, ream, assemble
- B. Apply dope, cut, thread, assemble, ream
- C. Cut, ream, thread, apply sealant, assemble
- D. Assemble, cut, thread, ream, apply dope

24. Which copper tube type has the thickest wall?

- A. Type K copper tube

- B. Type L copper tube
- C. Type M copper tube
- D. Type DWV copper tube

25. Which statement about a 45° pipe offset is correct?

- A. The run equals the set in a 45° offset
- B. The run is twice the set in a 45° offset
- C. The travel equals the set in a 45° offset
- D. The set is 1.414 times the travel

26. Which weld defect describes the base metal melted away at the toe of the weld?

- A. Incomplete root penetration
- B. Internal gas porosity
- C. Excess weld reinforcement
- D. Undercut at the weld toe

27. Which statement about a root gap in a butt weld is correct?

- A. A larger gap always improves the weld
- B. The gap is unnecessary on pressure pipe
- C. No gap is needed if the bevel is steep
- D. The gap allows the root pass to penetrate

28. Which joining method is correct for HDPE pipe?

- A. Soldering with a tin-based filler

- B. Threading with tapered NPT threads
- C. Heat fusion of the pipe ends
- D. Solvent cementing the joint

29. Which statement about thermal expansion of a hot pipe run is correct?

- A. Hot pipe should be rigidly anchored at both ends
- B. Pipe does not change length when heated
- C. Expansion is unrelated to the run length
- D. Loops or offsets must absorb the growth

30. Which component allows two pipes to be disconnected without cutting?

- A. A welded coupling
- B. A union
- C. A 90° elbow
- D. A reducing tee

31. Which statement about PTFE thread tape is correct?

- A. Wrap a few neat turns in the thread direction
- B. Wrap many layers against the thread direction
- C. Apply it only to the female fitting threads
- D. Tape replaces the need for clean threads

32. Which welding process is most commonly used for the root pass on critical pressure pipe?

- A. Oxy-acetylene gas welding

- B. Flux-cored arc welding (FCAW)
- C. Gas tungsten arc welding (GTAW)
- D. Submerged arc welding (SAW)

33. Which statement about a blind flange is correct?

- A. It connects two pipes at a 90° turn
- B. It reduces the pipe size in a run
- C. It supports the weight of a valve
- D. It positively closes off or isolates a line

34. Which is the correct total included angle for a typical pipe weld bevel?

- A. 30° included angle
- B. 45° included angle
- C. 90° included angle
- D. 75° included angle

35. Which statement about supporting steel versus copper pipe of the same size is correct?

- A. Copper can span farther than steel
- B. Both require identical support spacing
- C. Steel can span farther because it is stiffer
- D. Steel needs the closest support spacing

36. Which spool-related statement is correct?

- A. A spool is fabricated only in the field

- B. A spool is a prefabricated pipe assembly
- C. A spool drawing shows system flow only
- D. A spool is always a single straight pipe

37. A 30° offset shifts a line 400 mm using a 30° constant of 2.000. Which travel is correct?

- A. 283 mm of travel
- B. 566 mm of travel
- C. 200 mm of travel
- D. 800 mm of travel

38. Which statement about reaming a freshly threaded pipe is correct?

- A. It increases the pipe outside diameter
- B. It applies sealant to the threads
- C. It bevels the end for welding
- D. It removes the internal burr restricting flow

39. Which statement correctly distinguishes a schematic from an isometric drawing?

- A. A schematic shows function; an iso shows the 3-D run
- B. A schematic is drawn to exact scale; an iso is not
- C. An iso shows only flow; a schematic shows the run
- D. Both show the same information in different colours

40. Which thread type is standard for joining threaded steel pipe?

- A. Straight machine thread

- B. Acme square thread
- C. Buttress thread
- D. Tapered NPT thread

41. Which statement about medical gas brazing is correct?

- A. No purge is needed if the tube is clean
- B. Flux must always be packed into the joint
- C. An oil-free nitrogen purge prevents oxide scale
- D. Soldering is preferred over brazing for strength

42. Which statement about a "high-low" weld condition is correct?

- A. It is misalignment of the two pipe ends
- B. It is an excessive number of weld passes
- C. It is the bevel angle being too steep
- D. It is porosity within the finished bead

43. Which fitting choice prevents air or condensate pockets in a horizontal steam line?

- A. A concentric reducer centred on the line
- B. A union installed at the size change
- C. A coupling with no size change at all
- D. An eccentric reducer keeping one side flat

44. Which statement about the 45° offset travel constant is correct?

- A. The constant is 2.000 for a 45° offset

- B. The constant is 1.155 for a 45° offset
- C. The constant is 0.707 for a 45° offset
- D. The constant is 1.414 for a 45° offset

45. Which statement about cutting oil and thread quality is correct?

- A. Dry threading dulls the die and tears threads
- B. Cutting oil makes threads leak more often
- C. Oil is only used after the thread is cut
- D. Threads cut dry are always stronger

46. Which statement about sling angle and leg tension is correct?

- A. Lower angles reduce the tension in each leg
- B. Angle has no effect on the leg tension
- C. Higher angles raise the tension in each leg
- D. Lower angles raise the tension in each leg

47. Which is the correct action for a sling found with no legible capacity tag?

- A. Use it for light loads with supervision
- B. Estimate its capacity from a similar sling
- C. Derate it to half and use it cautiously
- D. Remove it from service immediately

48. Which statement about lifting a load level is correct?

- A. The hook goes over the heaviest end

- B. The hook goes over the lightest end
- C. The hook goes over the centre of gravity
- D. The hook goes at the geometric midpoint

49. Which sequence correctly describes a routine lift?

- A. Lift fully, inspect rigging, then trial lift
- B. Attach, lift fully, then check balance in air
- C. Inspect, attach, trial lift, then lift smoothly
- D. Trial lift, ride the load, then inspect rigging

50. Which statement about crane capacity and radius is correct?

- A. Capacity decreases as the radius increases
- B. Capacity increases as the radius increases
- C. Capacity is constant at every radius
- D. Capacity depends only on the boom colour

51. Which sling type best resists heat and harsh conditions?

- A. A chain sling
- B. A nylon web sling
- C. A polyester round sling
- D. A natural-fibre sling

52. Which statement about the emergency stop signal is correct?

- A. Only the designated signaller may give it

- B. Anyone who sees a hazard may give it
- C. Only the crane operator may give it
- D. Only the lift supervisor may give it

53. Which statement about a tandem (multi-crane) lift is correct?

- A. Each crane is de-rated to about 75% of capacity
- B. Each crane uses its full chart capacity
- C. Each crane is loaded to exactly half capacity
- D. No engineered lift plan is required

54. Which statement about crane outriggers is correct?

- A. They must be fully extended and supported
- B. They may be partially set on soft ground
- C. They reduce the crane's rated capacity
- D. They are only needed for travel, not lifting

55. Which wire rope condition requires removal from service?

- A. A light coating of manufacturer's lubricant
- B. A clean, properly seated thimble eye
- C. Broken wires, kinks, or birdcaging
- D. A legible, attached capacity tag

56. Which statement about controlling a suspended load is correct?

- A. Steady it by hand at the landing point

- B. Ride the load down to guide it precisely
- C. Swing it quickly into the landing area
- D. Use tag lines from a safe distance

57. Which lift would be classified as a critical lift?

- A. A light load on firm, level ground
- B. A routine lift well within capacity
- C. A load lifted by two cranes together
- D. A lift in clear view of the operator

58. Which statement about the designated signaller is correct?

- A. Several signallers direct the operator at once
- B. Only one signaller directs the operator at a time
- C. No signaller is needed when radios are used
- D. The operator chooses among multiple signallers

59. A two-leg sling shares a 1,200 kg load near vertical. Which per-leg load is correct?

- A. About 1,200 kg per leg
- B. About 300 kg per leg
- C. About 1,414 kg per leg
- D. About 600 kg per leg

60. Which statement about working near energized overhead power lines is correct?

- A. Touch the line first to confirm it is dead

- B. Use a metal tag line for better control
- C. Work faster to reduce time near the line
- D. Maintain the required minimum clearance distance

Major Work Activity D — Steam and Condensate Systems (Questions 61–84)

61. Which statement about how steam delivers heat is correct?

- A. It delivers heat by raising its own temperature
- B. It delivers heat by releasing latent heat as it condenses
- C. It delivers heat by increasing its pressure
- D. It delivers heat only through radiant transfer

62. Which statement about saturated steam is correct?

- A. Its temperature is fixed by its pressure
- B. Its temperature is set by the pipe diameter
- C. Its temperature is independent of pressure
- D. Higher pressure lowers its temperature

63. Which pressure correctly marks the upper limit of a low-pressure steam system?

- A. 5 psi is the upper limit
- B. 10 psi is the upper limit
- C. 15 psi is the upper limit
- D. 50 psi is the upper limit

64. Which statement about a steam trap's job is correct?

- A. It raises the pressure of the steam
- B. It filters solids from the steam
- C. It reduces the steam temperature
- D. It discharges condensate while holding back steam

65. Which symptoms indicate a steam trap that has failed OPEN?

- A. A cold exchanger flooded with condensate
- B. Rising boiler pressure and faster heating
- C. No flow through the trap at all
- D. Live steam blowing through to the return

66. Which statement about steam main pitch is correct?

- A. Pitch increases the steam velocity
- B. Pitch reduces the cost of the piping
- C. Pitch lets condensate drain and not pool
- D. Pitch is only needed on vertical risers

67. Which statement about a drip leg is correct?

- A. It vents building air into the main
- B. It increases the steam pressure
- C. It supports the weight of the main
- D. It collects condensate for a trap to remove

68. Which symptoms indicate a steam trap that has failed CLOSED?

- A. Live steam blowing freely to the return
- B. A cold exchanger with water hammer
- C. Faster heating and lower fuel use
- D. A rise in the boiler operating pressure

69. Which statement about boiler water level is correct?

- A. High water level is the most dangerous condition
- B. Water level has no effect on safety
- C. The gauge glass need not be readable
- D. Low water level is the most dangerous condition

70. Which statement about a PRV station is correct?

- A. It needs no relief device of any kind
- B. A strainer downstream is its only protection
- C. A second gauge replaces the relief valve
- D. It needs a downstream safety relief valve

71. Which statement correctly distinguishes the two boiler types?

- A. A water-tube boiler runs gases through the tubes
- B. A fire-tube boiler runs hot gases through the tubes
- C. A fire-tube boiler runs water through the tubes
- D. Both run combustion gases through the water

72. Which statement about warming up a cold steam line is correct?

- A. Warm it slowly to drain condensate and vent air
- B. Snap the main valve fully open at once
- C. Pressurize it above the boiler rating first
- D. Keep it isolated and cold until first use

73. Which statement about a steam separator is correct?

- A. It reduces the pressure of the steam
- B. It adds moisture to dry steam
- C. It removes entrained water from steam
- D. It raises the steam temperature

74. Which statement about a two-pipe steam system is correct?

- A. Steam and condensate share one pipe
- B. A trap is installed at each radiator outlet
- C. No traps are used anywhere in the system
- D. The supply and return are the same line

75. Which statement about superheated steam is correct?

- A. It condenses more readily than saturated steam
- B. It carries extra sensible heat above saturation
- C. It always carries more entrained water
- D. It exists only below atmospheric pressure

76. Which symptom set points to an air-bound steam radiator?

- A. Continuous live steam at the return line
- B. A rise in the boiler operating pressure
- C. Rapid, even heating across the radiator
- D. A partly cold radiator with a stuck air vent

77. Which statement about a gravity condensate return is correct?

- A. It uses a condensate pump and receiver
- B. It relies on injected compressed air
- C. Steam pressure pushes the condensate back
- D. It relies on proper pitch and gravity

78. Which statement about recovering condensate to the boiler is correct?

- A. It conserves hot, treated water and energy
- B. It adds raw, untreated cold water
- C. It cools the boiler and lowers efficiency
- D. It raises the stack temperature for draft

79. Which trap operating principle matches a thermostatic steam trap?

- A. The density difference of steam and water
- B. The velocity of flash steam across a disc
- C. The temperature difference of the condensate
- D. The electrical conductivity of the condensate

80. Which joining method should high-pressure steam systems use?

- A. Solvent-cemented plastic joints
- B. Compression tubing fittings
- C. Welded steel joints for integrity
- D. Bell-and-spigot gasketed joints

81. Which statement about water hammer is correct?

- A. A condensate slug struck by high-velocity steam
- B. The normal sound of steam flowing smoothly
- C. A gradual, harmless loss of pressure
- D. A slow drip at a threaded joint

82. Which trap operating principle matches an inverted bucket trap?

- A. The temperature difference of the condensate
- B. The velocity of flash steam across a disc
- C. The density difference of steam and water
- D. The electrical conductivity of the condensate

83. Which statement about servicing a steam component is correct?

- A. Raise the pressure to test it first
- B. Open the nearest trap fully and proceed
- C. Isolate, depressurize, and let it cool first
- D. Record the gauge glass and then proceed

84. Which statement about venting air from a steam heating system is correct?

- A. Air raises the steam saturation temperature
- B. Air makes the condensate corrosive instantly
- C. Air increases the system pressure too much
- D. Trapped air blocks heat transfer at the emitter

85. Using $\text{Btuh} = \text{gpm} \times 500 \times \Delta T$, which flow delivers 50,000 Btuh at a 20°F ΔT ?

- A. 10 gpm of flow
- B. 5 gpm of flow
- C. 2.5 gpm of flow
- D. 50 gpm of flow

86. Which statement about a closed hydronic system is correct?

- A. It needs neither an expansion tank nor air removal
- B. It needs an expansion tank and air removal
- C. It needs only a pump and nothing else
- D. It runs on steam rather than water

87. Which statement about an air-bound hydronic circuit is correct?

- A. Air improves the heat output of the emitter
- B. Air raises the pump's efficiency
- C. Trapped air blocks circulation and heating
- D. Air lowers the system pressure safely

88. Which statement about hydraulic and pneumatic fluids is correct?

- A. Both liquids and gases are incompressible
- B. Liquids are incompressible; gases are compressible
- C. Both liquids and gases are compressible
- D. Liquids are compressible; gases are not

89. Which statement about the FRL unit on a compressed-air system is correct?

- A. It generates and stores the compressed air
- B. It filters, regulates, and lubricates the air
- C. It measures total air consumption only
- D. It cools the compressor motor directly

90. Which statement about refrigerant piping joints is correct?

- A. They are brazed under a nitrogen purge
- B. They are solvent-cemented like PVC
- C. They are made with soft solder only
- D. They use threaded NPT connections

91. Which statement about evacuating a refrigeration system is correct?

- A. Evacuation increases the refrigerant pressure
- B. Evacuation adds lubricating oil to the lines
- C. Evacuation removes moisture and non-condensables
- D. Evacuation tests the strength of the joints

92. Which statement about a hydraulic fluid injection injury is correct?

- A. It is a minor scratch needing no care
- B. It is a serious surgical emergency
- C. It is a simple bruise to watch at home
- D. It needs no medical attention at all

93. Which statement about process-line identification is correct?

- A. It is purely decorative on the pipe
- B. It increases the flow rate in the line
- C. It reduces the weight of the piping
- D. It prevents dangerous mix-ups of fluids

94. Which statement about untreated boiler feedwater is correct?

- A. It increases the steam pressure
- B. It speeds up the condensate return
- C. It lowers the fuel consumption
- D. It causes scale and corrosion in the boiler

95. Which method is correct for searching for a high-pressure hydraulic leak?

- A. Run a bare hand along the suspect line
- B. Use cardboard with the system depressurized
- C. Hold a lit torch near the suspect joint
- D. Taste any fluid found on the floor

96. Which statement about a solar thermal system in a freezing climate is correct?

- A. It must be indirect closed-loop with antifreeze
- B. It must be a direct open-loop potable system
- C. It must be a gravity single-pipe system
- D. It must circulate potable water through the collector

97. Which statement about a heat exchanger is correct?

- A. It transfers heat between fluids without mixing them
- B. It mixes two fluids into a single stream
- C. It generates new heat by combustion
- D. It stores fluid under high pressure

98. Which statement about a hydronic system's medium is correct?

- A. It circulates high-pressure steam
- B. It circulates water or a water/glycol mix
- C. It circulates compressed air
- D. It circulates refrigerant vapour

99. Which statement about medical gas joining is correct?

- A. Brazing gives stronger, higher-integrity joints
- B. Soldering is preferred for its higher strength
- C. Threaded joints are standard in the gas stream
- D. No cleaning of the tube is required

100. Which statement about medical gas cross-connection testing is correct?

- A. It checks the insulation thickness
- B. It measures the pipe sizes only
- C. It confirms each outlet delivers the correct gas
- D. It speeds up the installation schedule

101. Which statement about hydraulic system cleanliness is correct?

- A. Dirt improves the lubrication of pumps
- B. Clean oil increases the system pressure
- C. Contamination is the leading cause of failure
- D. Cleanliness lowers the oil temperature

102. Which collector performs better in cold, cloudy conditions, and why?

- A. Flat-plate, because it is simpler in design
- B. Evacuated-tube, because the vacuum cuts heat loss
- C. An unglazed mat, because it is cheapest
- D. A pool collector, because it is open to air

103. Which statement about a balancing valve is correct?

- A. It relieves excess system pressure
- B. It removes air from the loop
- C. It sets the design flow to each circuit
- D. It absorbs thermal expansion

104. Which by-product of compressing air must be managed in a pneumatic system?

- A. Combustible methane gas
- B. Refrigerant vapour
- C. Condensed water (moisture)
- D. Hydraulic oil mist

105. Which statement about oxygen-service medical gas tube is correct?

- A. Oils improve the brazing flow
- B. Contaminants raise the gas pressure
- C. Oil makes the tube easier to bend
- D. Oils can ignite in oxygen-rich lines

106. Which statement about a chilled-water cooling system is correct?

- A. It circulates cool water to absorb space heat
- B. It burns fuel to absorb the heat
- C. It vents steam to cool the space
- D. It compresses air to cool the room

107. Which code most commonly governs process piping design and construction?

- A. The residential plumbing bylaw
- B. ASME B31.3 for process piping
- C. The elevator safety standard
- D. The fire-alarm wiring code

108. Which statement about keeping refrigerant lines clean and dry is correct?

- A. Moisture has no effect on a refrigeration system
- B. Moisture forms acids and ice in the system
- C. Cleanliness increases the line pressure
- D. Dryness raises the refrigerant temperature

109. Which statement about a heat recovery system is correct?

- A. It reclaims heat from a waste stream
- B. It generates new heat by combustion
- C. It increases the building's fuel use
- D. It vents all waste heat outdoors

110. Which heat-exchanger flow arrangement transfers the most heat?

- A. Both streams flowing the same direction
- B. The two streams in counterflow
- C. Both streams held stagnant and still
- D. The two streams mixed fully together

111. Which statement about refrigerant line brazing is correct?

- A. It is done with no purge to save time
- B. It is done with soft solder for flexibility
- C. It is done under a nitrogen purge
- D. It is done after the system is charged

112. Which statement about a ground-source heat pump is correct?

- A. It exchanges heat with the outdoor air only
- B. It exchanges heat with the ground or groundwater
- C. It burns fuel in a combustion chamber
- D. It exchanges heat with the exhaust air only

113. Why is a ground-source heat pump more efficient than an air-source unit in cold climates?

- A. It burns fuel more completely in winter
- B. Ground temperature is far more stable
- C. It uses no electricity at all to run
- D. It requires no circulating pump

114. Which pipe and joining method is correct for a closed-loop geo-exchange field?

- A. Copper joined by soldering
- B. PVC joined by solvent cement
- C. HDPE joined by heat fusion
- D. Steel joined by threading

115. Which loop configuration suits a site with very limited land area?

- A. A wide horizontal loop in trenches
- B. An open loop drawing from a pond
- C. A surface loop laid on the soil
- D. A vertical closed loop in boreholes

116. Which statement about solar collector stagnation is correct?

- A. It is the collector freezing in cold weather
- B. It is the collector overheating with no heat drawn off
- C. It is the pump running all night long
- D. It is antifreeze leaking from the loop

117. Which streams does a heat recovery ventilator (HRV) exchange heat between?

- A. Two separate hydronic water loops
- B. Boiler flue gas and the feedwater
- C. Outgoing exhaust air and incoming fresh air
- D. Refrigerant vapour and liquid

118. Which statement about an indirect solar thermal system is correct?

- A. The potable water flows through the collector
- B. The antifreeze mixes directly with the water
- C. A heat exchanger keeps the fluids separate
- D. Steam is vented into the storage tank

119. Which factor is most critical to an open-loop geo-exchange system?

- A. A large amount of available land
- B. A clean, suitable water source
- C. A south-facing roof orientation
- D. A constant compressed-air supply

120. Which statement about hydrostatic versus pneumatic testing is correct?

- A. Pneumatic is preferred because leaks are easier to hear
- B. Both store the same amount of energy under test
- C. Hydrostatic is preferred because water stores little energy
- D. Pneumatic is preferred because air is cheaper

121. Which medium is used in a hydrostatic pressure test?

- A. Compressed air
- B. Inert nitrogen gas
- C. Water
- D. Live steam

122. Which statement about cleaning and flushing before service is correct?

- A. It raises the system operating pressure
- B. It removes debris that fouls components
- C. It increases the flow velocity in the line
- D. It reduces the insulation required

123. Which statement about safety relief valves at commissioning is correct?

- A. They should be gagged shut during the test
- B. They must be correctly set and proven functional
- C. They should be removed before start-up
- D. They only need to be painted to match the line

124. Which statement best describes commissioning a system?

- A. A gradual, sequential start-up and verification
- B. A single switch thrown to full operation
- C. A test performed only after a failure occurs
- D. A paperwork exercise done off site

125. Which statement about as-built drawings is correct?

- A. They show only the original design intent
- B. They reflect what was actually installed
- C. They are used only to order more material
- D. They list the names of the installers

126. Which statement about a pneumatic pressure test's hazard is correct?

- A. The danger is water freezing in the pipe
- B. The danger is the slow speed of the test
- C. The danger is the large stored energy in the gas
- D. The danger is the high cost of the air

127. Which set of documents belongs in a turnover package?

- A. Only the installer's daily time sheets
- B. Only photographs of the finished work
- C. Test reports, manuals, and as-built drawings
- D. Only the original material purchase orders

128. During controlled start-up, how should steam lines be brought up to temperature?

- A. Warmed slowly, draining condensate as they heat
- B. Pressurized fully in a single rapid step
- C. Filled with water before admitting steam
- D. Left isolated and cold until first use

129. Which statement about balancing during commissioning is correct?

- A. It raises the test pressure of the system
- B. It removes all the air from the boiler
- C. It verifies the welds with radiography
- D. It sets design flows to each circuit or zone

130. Which statement about owner training at turnover is correct?

- A. It lets the installer skip writing manuals
- B. It shortens the warranty period
- C. It lets the owner run and maintain the system safely
- D. It allows the as-built drawings to be discarded

Practice Exam 16: Answer Key and Explanations

1. D — PPE is the least effective control because it protects only the individual wearing it and only when used correctly, doing nothing to reduce the hazard itself. Elimination, substitution, and engineering controls all rank higher because they reduce the hazard at its source.

2. A — Oxygen is tested first, then flammables, then toxics, because the flammable and toxic readings are only reliable at a normal oxygen level. Testing must also occur at multiple depths since gases stratify, so a single entrance reading is never sufficient.

3. A — The correct order is notify, shut down, isolate, lock, dissipate stored energy, then verify. Verification comes last because it confirms the prior steps achieved a true zero-energy state; dissipating stored energy before verifying is the step most often skipped.

4. C — PPE is the last line of defence, used only when higher controls cannot fully eliminate the risk. It does not remove the hazard or protect everyone in the area, which is why elimination and engineering controls are always preferred.

5. A — The fire watch continues for a period after the work ends, commonly 30 to 60 minutes, because smouldering material can ignite long after the torch is shut off. Leaving when the flame stops removes the safeguard against a delayed fire.

6. B — An atmosphere below 19.5% oxygen is oxygen-deficient and unsafe to enter without supplied air. Normal air is about 20.9%; levels above 23% are oxygen-enriched, so the deficiency threshold is specifically below 19.5%.

7. B — Using a pipe wrench on a finished hex nut is incorrect, because its hardened, toothed jaws bite round stock and will crush hex corners. A flat-jaw wrench is used on nuts and fittings, while the pipe wrench is reserved for round pipe.

8. A — Cutting oil cools the die and flushes away chips while lubricating the cut, producing clean, full threads. It is required on steel, not just stainless, and dry threading overheats the die and tears the threads.

9. A — When a drawing and specification conflict, the correct action is to seek written clarification before proceeding. Guessing or defaulting to one document risks installing an underrated or wrong component, so an RFI resolves the discrepancy first.

10. A — Each worker applies their own personal lock so no one else can re-energize the equipment while they are exposed. The system stays isolated until every individual removes their own lock, which a single shared lock or tags alone cannot guarantee.

11. A — Dissipating stored energy before work is the step most often skipped in real incidents. Workers isolate the energy source but forget the energy already stored in a charged line or suspended load, which then releases unexpectedly.

12. D — A material take-off is an itemized count of every component a job requires, derived from the drawings. An accurate take-off prevents both shortages that halt work and over-ordering that wastes budget.

13. A — A quick isometric sketch conveys a complex routing most clearly, especially on a noisy site where voice is unreliable. A drawing shows direction, fittings, and dimensions at once, avoiding the errors that shouted or relayed instructions invite.

14. A — A Safety Data Sheet provides hazard identification and safe-handling information for a controlled product. Under WHMIS an SDS must be available for every hazardous product on site so workers know its risks and precautions.

15. C — $16 \text{ ft} \times 1/4 \text{ in./ft} = 4 \text{ inches}$ of total drop. Calculating grade correctly ensures a self-draining line; an error leaves condensate pooling, which causes water hammer.

16. B — Explaining the reasoning builds true competence, because an apprentice who understands why a procedure works can apply it correctly to new situations. Good mentoring transfers judgment, and teaching the why also reflects the journey person's own mastery.

17. C — An isometric shows a three-dimensional pipe run with figured (printed) dimensions, drawn at 30° axes. It is not drawn to scale; the shape shows the routing while the printed numbers give the lengths for fabrication.

18. C — The printed (figured) value always governs when it disagrees with a scaled measurement. Drawings can be distorted in reproduction or plotting, making a ruler reading unreliable, so the printed number is the authority.

19. B — $\text{Travel} = \text{set} \times 1.414 = 500 \times 1.414 \approx 707 \text{ mm}$. The 45° offset constant from the exam formula sheet gives the centre-to-centre travel; fitting take-outs are deducted afterward to find the cut length.

20. A — For a given Nominal Pipe Size, a higher schedule means a thicker wall and a smaller bore, while the outside diameter stays constant. The fixed OD is what allows fittings and threads to be standardized across schedules.

21. D — An eccentric reducer with the flat side down keeps the bottom of a horizontal drainage line continuous so condensate drains and no pocket forms. A concentric reducer would leave a low pocket where liquid collects and causes water hammer.

22. B — Brazing filler melts above 450°C (840°F), which is the defining line separating it from soldering. The higher temperature produces a stronger, higher-temperature joint, which is why refrigeration and medical gas lines are brazed.

23. C — The correct sequence is cut, ream, thread, apply sealant, then assemble. Reaming removes the internal burr after cutting, threading produces the tapered thread, and sealant is applied to the male thread before assembly.

24. A — Type K copper tube has the thickest wall of the common types, suiting it to underground and high-pressure service. Wall thickness decreases from K to L to M, with DWV being thin-wall drainage tube.

25. A — In a 45° offset the run equals the set, because the two legs of the right triangle are equal when the angle is 45°. This is why the same 1.414 constant relates both set-to-travel and run-to-travel.

26. D — Undercut is the defect where base metal is melted away at the toe of the weld, leaving a groove. It reduces the cross-section and creates a stress concentration, making it a recognized rejectable defect.

27. D — A root gap allows the root pass to fully penetrate and fuse the inside of the joint. Too small a gap risks incomplete penetration and too large risks burn-through, so the controlled opening is essential, not optional.

28. C — HDPE pipe is joined by heat fusion, which melts and fuses the ends into a joint as strong as the pipe itself. This leak-proof joint suits buried and outdoor service where access for repair is limited.

29. D — A hot pipe run grows, and loops or offsets must absorb that growth. Rigidly anchoring both ends with no expansion provision generates enormous thermal stress that can buckle pipe or crack fittings.

30. B — A union allows two lengths of pipe to be disconnected without cutting, separating into two halves drawn together by a ring nut. This makes it essential where components must be removed for service.

31. A — PTFE tape is wrapped a few neat turns in the thread direction so it tightens rather than unravels during assembly. Excess tape or backward wrapping shreds and can foul valves and strainers downstream.

32. C — GTAW (TIG) is most commonly used for the root pass on critical pressure pipe because it produces a clean, sound, fully fused root. Fill and cap passes are often completed with SMAW or FCAW for productivity.

33. D — A blind flange positively closes off or isolates a line, providing a solid barrier with no bore. Unlike a closed valve, which can leak or be opened, a blind gives true positive isolation for safe maintenance.

34. D — A typical pipe weld bevel forms a 75° included angle, made up of roughly $37\frac{1}{2}^\circ$ per side. This V-groove preparation provides the access the weld needs to achieve full penetration through the joint.

35. C — Steel can span farther than copper because it is stiffer and sags less between supports. Copper and plastic deflect more readily and therefore need closer support spacing for the same size.

36. B — A spool is a prefabricated pipe assembly, complete with fittings and flanges, built as a unit, usually in a shop. Breaking a system into spools allows controlled shop fabrication and faster, higher-quality field assembly.

37. D — $\text{Travel} = \text{set} \times 2.000 = 400 \times 2.000 = 800 \text{ mm}$. Each offset angle has its own travel constant; for 30° the constant is 2.000, so the centre-to-centre travel is twice the set.

38. D — Reaming removes the internal burr left by cutting, which would otherwise restrict flow and create turbulence. Clearing the burr restores the full bore and proper flow through the pipe.

39. A — A schematic shows system function and flow, while an isometric shows the three-dimensional run for fabrication. The schematic answers how the system works; the iso shows the physical routing and dimensions.

40. D — Tapered NPT (National Pipe Thread) is standard for joining threaded steel pipe; the taper wedges tight to create the seal as the joint is tightened. Straight threads would not seal the same way.

41. C — An oil-free nitrogen purge during medical gas brazing prevents internal copper-oxide scale. That scale can break loose and contaminate the gas delivered to a patient, so purging is a mandatory code requirement.

42. A — High-low is the misalignment of the two pipe ends at the joint, where one side sits higher than the other. The fitter controls high-low through proper fit-up before welding, since it weakens the joint and impedes penetration.

43. D — An eccentric reducer keeping one side flat prevents the air or condensate pocket that a concentric reducer would create in a horizontal steam line. Those pockets trap liquid and cause water hammer.

44. D — The 45° offset travel constant is 1.414, provided on the exam formula sheet. Multiplying the set by 1.414 gives the centre-to-centre travel before fitting take-outs are deducted.

45. A — Dry threading dulls the die and tears the threads, producing rough, leak-prone joints. Cutting oil cools the die, flushes chips, and lubricates the cut, so it must be used during threading, not after.

46. D — As the sling angle decreases (measured from horizontal), the tension in each leg rises sharply even though the load is unchanged. Spreading the legs wider is more dangerous, not gentler, because it multiplies leg tension.

47. D — A sling with no legible capacity tag must be removed from service immediately, because its rating cannot be verified. There is no acceptable way to estimate or derate untagged rigging in the field.

48. C — The hook must be positioned directly above the centre of gravity for a load to hang level and stable. An off-CG lift tilts, swings, or shifts when raised and can slip out of the rigging.

49. C — The correct sequence is inspect the rigging, attach it, make a trial lift to check balance, then lift smoothly. The trial lift catches off-CG loads and slipped slings before the load is high and dangerous.

50. A — A crane's lifting capacity decreases as the load radius increases, because the load acts on a longer lever arm. The operator reads the load chart for the actual radius and never exceeds it.

51. A — A chain sling best resists heat and harsh conditions, suiting it to the heaviest and most rugged lifts. Synthetic and natural-fibre slings are far more vulnerable to heat, cuts, and abrasion.

52. B — Anyone who observes a hazard may give the emergency stop signal, and the operator must obey it immediately. While only the designated signaller gives routine commands, emergency stop authority is universal for safety.

53. A — In a tandem (multi-crane) lift each crane is de-rated to about 75% of its chart capacity. Because the load can shift between cranes as they move, the reduced rating provides margin, and an engineered plan is required.

54. A — Outriggers must be fully extended and properly supported so the crane can achieve its charted capacity, which assumes a firm, level, fully-supported setup. Partial outriggers on soft ground can let the crane tip even within its rated load.

55. C — Wire rope with broken wires, kinks, or birdcaging must be removed from service, since these indicate the rope's structure has failed. Such damage cannot be repaired and risks sudden failure under load.

56. D — A suspended load is controlled with tag lines handled from a safe distance, keeping workers clear of the fall zone. Hands on the load, riding it, or fast swinging all invite a dropped or crushing-load incident.

57. C — A load lifted by two cranes together (a tandem lift) is classified as a critical lift, requiring an engineered plan and added controls. The shared, shifting load and complexity place it well beyond a routine lift.

58. B — Only one designated signaller directs the crane operator at a time, so the operator never receives conflicting commands. That single signaller is clearly identified before the lift begins, even when radios are used.

59. D — A two-leg sling near vertical shares a 1,200 kg load roughly evenly, so each leg carries about 600 kg. As the sling angle decreases, that per-leg tension would climb well above 600 kg.

60. D — Maintaining the required minimum clearance distance from energized overhead lines is essential. Contact between the crane, load, or rigging and a live line is frequently fatal, so the clearance is kept and a metal tag line is never used.

61. B — Steam delivers most of its useful heat by releasing its latent heat of vaporization as it condenses back to water. This large reservoir of energy released at constant temperature is what makes steam an effective heating medium.

62. A — For saturated steam, the temperature is fixed by its pressure; there is exactly one saturation temperature for each pressure. This is why steam pressure is used to control delivery temperature and a pressure gauge indicates steam temperature.

63. C — Low-pressure steam systems operate at or below 15 psi; above that threshold a system is classified as high-pressure with stricter code requirements. This 15 psi dividing line is a basic, frequently tested specification.

64. D — A steam trap's defining job is to discharge condensate and air while holding back live steam. Removing condensate keeps heat-transfer surfaces full of steam and prevents water hammer, while trapping steam conserves energy.

65. D — A trap failed open blows live steam through to the return, wasting energy. It is often heard as a continuous rush and seen as steam at the return, the opposite of a trap failed closed, which backs up condensate.

66. C — A steam main must be pitched so condensate drains toward collection points and does not pool. A sagging or back-pitched line collects condensate that high-velocity steam then hurls against fittings, causing water hammer.

67. D — A drip leg collects condensate at low points and intervals along a main so a trap can remove it before it accumulates. Without adequate drip points, condensate builds up and causes water hammer.

68. B — A trap failed closed produces a cold exchanger with water hammer, because condensate backs up and floods the unit. The flooded equipment cannot heat, and the trapped condensate hammers, the opposite signature of a trap failed open.

69. D — Low water level is the most dangerous condition in a steam boiler, because the heated surfaces overheat once water drops below them. Continued firing or introducing water onto overheated metal can lead to catastrophic failure.

70. D — A PRV station must include a safety relief valve on its downstream side, sized to relieve full flow if the reducing valve fails open. Without it, a failed-open PRV would expose the low-pressure system to full high-side pressure.

71. B — A fire-tube boiler runs hot combustion gases through tubes surrounded by water. This simpler design suits lower-pressure heating, whereas a water-tube boiler reverses the arrangement for higher pressures.

72. A — A cold steam line is warmed up slowly to drain condensate and vent air, avoiding water hammer from rapid condensation. Snapping the main valve open creates a vacuum and a violent condensate slug.

73. C — A steam separator removes entrained water from flowing steam, delivering drier, higher-quality steam. Wet steam carries less usable energy and erodes turbine blades and valve seats, so separators protect downstream equipment.

74. B — In a two-pipe steam system a steam trap is installed at each radiator outlet to discharge condensate while holding back steam. Separate supply and return pipes make this trap-at-each-emitter arrangement possible.

75. B — Superheated steam carries extra sensible heat above its saturation temperature and resists condensing, suiting it to power generation and long-distance transport. Saturated steam, by contrast, readily gives up its latent heat at the load.

76. D — A partly cold radiator with a stuck air vent points to an air-bound unit, because trapped air blocks steam from filling the radiator. Air vents and thermostatic traps must release the air so steam can reach the heating surface.

77. D — A gravity condensate return relies on proper pitch and the force of gravity to move condensate back to the boiler. It needs no pump, depending entirely on sloped return lines, common in simple, small systems.

78. A — Recovering condensate conserves hot, treated water and energy, since the returned condensate is already heated and chemically conditioned. Reusing it reduces fuel, water, and treatment costs and prevents accumulation in the system.

79. C — A thermostatic steam trap operates on the temperature difference of the condensate, opening when condensate cools below steam temperature. This makes it well suited to radiators, low-pressure service, and air venting.

80. C — High-pressure steam systems require welded steel joints for integrity under high temperature and pressure. The greater stresses rule out plastic, compression, and bell-and-spigot joints in this service.

81. A — Water hammer is a condensate slug struck by high-velocity steam, producing a violent shock against pipe walls, elbows, or valves. It can crack fittings and injure personnel, and is prevented by proper pitch and drainage.

82. C — An inverted bucket steam trap operates on the density difference between steam and water, with the bucket rising and sinking as steam or condensate fills it. This mechanical principle suits drips and higher condensate loads.

83. C — Before servicing a steam component it must be isolated, depressurized, and allowed to cool, with stored energy dissipated and lockout applied. Steam and condensate burns are severe, so the system is never opened while live or hot.

84. D — Trapped air must be vented because it blocks heat transfer at the emitter, leaving it cold. Air vents and thermostatic traps remove the air so steam can reach the heating surface and condense.

85. B — $\text{gpm} = \text{Btuh} \div (500 \times \Delta T) = 50,000 \div (500 \times 20) = 50,000 \div 10,000 = 5 \text{ gpm}$. Recognizing the heat-transfer formula and substituting with consistent units gives the flow needed to meet the load.

86. B — A closed hydronic system needs an expansion tank and an air-removal device. Water expands when heated, so the tank prevents pressure spikes, and air separation prevents air-bound circuits that will not heat.

87. C — Trapped air blocks circulation and heating in an air-bound hydronic circuit, even with the pump running. Venting the air restores flow; air does not improve output or pump efficiency, so it must be removed.

88. B — Liquids are incompressible while gases are compressible, which explains the behaviour of the two systems. Hydraulics deliver immediate, rigid, high-force actuation; pneumatics store energy in the compressed air and provide cushioned power.

89. B — The FRL unit filters moisture and dirt, regulates pressure, and lubricates the compressed air at the point of use. It conditions the air for tools rather than generating, storing, or merely measuring it.

90. A — Refrigerant piping joints are brazed under a nitrogen purge for strength and integrity. The nitrogen purge prevents internal copper-oxide scale that would otherwise circulate and damage the system.

91. C — A refrigeration system is evacuated before charging to remove moisture and non-condensable air. Moisture forms acids and freezes at the expansion device, so deep evacuation protects the compressor and ensures proper operation.

92. B — A hydraulic fluid injection injury is a serious surgical emergency, even though it can look minor on the surface. High-pressure oil injected through the skin causes severe internal damage requiring immediate medical care.

93. D — Line identification prevents dangerous mix-ups because many different and hazardous fluids may run through one facility. Labelling and colour-coding by content and flow direction prevent errors when working on or breaking into a line.

94. D — Untreated boiler feedwater causes scale and corrosion in the boiler. Scale insulates heat-transfer surfaces and overheats metal, while dissolved oxygen pits and corrodes the boiler and piping.

95. B — A suspected high-pressure hydraulic leak is searched for with cardboard after depressurizing the system, never with a bare hand. A pinhole can inject oil through the skin, so the hand is kept well clear.

96. A — In a freezing climate a solar thermal system must be indirect closed-loop with antifreeze, circulating a non-freezing fluid through the collector and transferring heat through a heat exchanger. A direct system would freeze and burst outdoors.

97. A — A heat exchanger transfers heat between two fluids without allowing them to mix, passing the streams through separate passages with a conductive wall. It is the core component of heat recovery, hydronic, and refrigeration systems.

98. B — A hydronic system circulates water or a water/glycol mix as its heat-carrying medium, hot for heating and chilled for cooling. This distinguishes it from steam, pneumatic, and refrigerant systems.

99. A — Medical gas systems are brazed rather than soldered because brazing produces stronger, higher-integrity joints suited to critical service. Combined with nitrogen purging, brazing helps ensure the line integrity a patient depends on.

100. C — Cross-connection testing confirms that each outlet delivers the correct gas. A cross-connected system, where an outlet labelled oxygen delivers a different gas, is potentially fatal, so independent verification before use is mandatory.

101. C — Contamination is the leading cause of hydraulic system failure, which is why cleanliness is critical. Dirt damages close-tolerance components and valves, so lines are flushed clean and filtration is maintained throughout service.

102. B — An evacuated-tube collector performs better in cold, cloudy conditions because the vacuum reduces heat loss. The reduced loss lets it reach higher temperatures and maintain output where a flat-plate collector would lose too much heat.

103. C — A balancing valve sets the design flow to each circuit so every zone receives its intended flow. Without balancing, some circuits are starved while others are over-supplied, leaving uneven heating or cooling.

104. C — Compressing air condenses water, so moisture is the by-product that must be managed in a pneumatic system. Drains, dryers, and proper slope remove the condensate that would otherwise foul tools and controls.

105. D — Oxygen-service tube must be kept free of oils because oils can ignite in oxygen-rich lines. Oxygen dramatically accelerates combustion, so any residual oil presents a fire hazard inside the line.

106. A — A chilled-water cooling system circulates cool water that absorbs heat from the space and carries it to the chiller. The water-based loop transports the heat away, the cooling counterpart of hydronic heating.

107. B — ASME B31.3 most commonly governs process piping design and construction, dictating materials, welding, and testing. Compliance ensures the system meets recognized safety and integrity standards.

108. B — Refrigerant lines must be kept clean and dry because moisture forms acids and ice in the system. Acids attack components and ice blocks the expansion device, so cleanliness and dryness protect the compressor and operation.

109. A — A heat recovery system reclaims heat from a waste stream that would otherwise be lost. It does not create new energy; a heat exchanger transfers existing waste heat to a useful incoming stream, improving efficiency.

110. B — The most efficient heat-exchanger arrangement runs the two streams in counterflow, moving in opposite directions, which maximizes the heat transferred. Same-direction (parallel) flow transfers less heat across the exchanger.

111. D — Refrigerant line brazing is performed under a continuous nitrogen purge to prevent internal copper-oxide scale, then the system is evacuated and charged. Brazing with no purge, with soft solder, or after charging would all leave the line contaminated or weak, so the purge during brazing is the correct practice.

112. B — A ground-source heat pump exchanges heat with the ground or groundwater, which stays at a stable temperature year-round. This stability is what gives the system its efficiency advantage over air-source units.

113. B — A ground-source heat pump is more efficient in cold climates because ground temperature is far more stable than air temperature. While air-source performance drops in the cold, the ground stays moderate, sustaining efficiency.

114. C — Closed-loop geo-exchange piping is HDPE joined by heat fusion, giving a leak-free joint as strong as the pipe for decades of buried service. Threaded, soldered, or solvent-cemented joints would become future leaks underground.

115. D — A vertical closed loop in deep boreholes suits a site with very limited land area, needing minimal surface area. This makes geo-exchange feasible where wide horizontal trenching is impossible.

116. B — Stagnation is the collector overheating when full of fluid in strong sun with no heat being drawn off. The system must handle the resulting high temperatures safely, and technicians must take care to avoid burns when servicing.

117. C — A heat recovery ventilator exchanges heat between outgoing exhaust air and incoming fresh air, recovering heating energy while ventilating. The two air streams exchange heat through the core without mixing.

118. C — In an indirect solar thermal system a heat exchanger keeps the antifreeze loop separate from the potable water while transferring the captured heat. This prevents the antifreeze from mixing with the drinking water.

119. B — An open-loop geo-exchange system depends most critically on a clean, suitable water source, since it draws actual groundwater through the heat pump. Poor water quality fouls and corrodes the system.

120. C — Hydrostatic testing is preferred because water stores little energy, so a failure releases harmlessly. Water is nearly incompressible, while compressed gas holds dangerous energy, making the water test the safer choice.

121. C — Water is the medium used in a hydrostatic pressure test. Filling the system with incompressible water and pressurizing it confirms the system holds pressure while keeping a test failure safe.

122. B — A system is cleaned and flushed before service to remove debris, scale, and construction residue that would foul valves, traps, strainers, and equipment. Clean lines protect the components on start-up.

123. B — During commissioning, safety relief valves must be verified as correctly set and proven functional. These devices are the final protection against overpressure, so their operation is confirmed and recorded — never gagged, removed, or merely painted.

124. A — Commissioning is a gradual, sequential start-up and verification process, not a single switch thrown to full operation. Confirming cleanliness and testing, filling and venting, starting slowly, proving controls, then balancing catches faults that rushing would miss.

125. B — As-built drawings reflect what was actually installed, including field changes from the original design. An operator troubleshooting years later relies on accurate as-builts, so outdated drawings invite dangerous mistakes.

126. C — A pneumatic pressure test is dangerous mainly because of the large stored energy in the compressed gas. Unlike water, compressed gas holds tremendous energy, so a failure under test can be explosive and lethal.

127. C — A turnover package should include test reports, equipment manuals, and as-built drawings, among other records. Together they give the owner the documentation and knowledge to operate and maintain the system safely.

128. A — During controlled start-up, steam lines should be warmed slowly while draining condensate as they heat. Admitting full pressure into a cold line would cause severe water hammer, so gradual warm-up is essential.

129. D — Balancing during commissioning sets the design flows to each circuit or zone so every area receives its intended flow. Without it, some zones are starved while others are over-supplied, producing uneven performance.

130. C — Owner training lets the owner run and maintain the system safely. Turnover transfers not just the system and records but the knowledge of how it works, where the safety devices are, and what maintenance it needs.