PRACTICE EXAM 8: RED SEAL STEAMFITTER/PIPEFITTER SIMULATION (130 QUESTIONS)

1. A crew proposes four ways to deal with a solvent that produces hazardous vapours during a degreasing task. Following the hierarchy of controls, which proposal should the supervisor adopt first?

A. Issue half-face respirators to all workers

B. Replace the solvent with a non-hazardous product

C. Post signage warning of the vapour hazard

D. Rotate workers to limit exposure time each

2. Two workers must enter a process vessel that previously held a toxic chemical. The atmosphere tests at 20.9% oxygen but the toxic reading is unknown because the detector's toxic sensor failed. What is the correct action?

A. Enter quickly while oxygen is still normal

B. Enter with the attendant watching closely

C. Enter using only a dust mask for protection

D. Do not enter until a working detector confirms safety

3. During a group lockout, a worker discovers their assigned isolation valve passes a small amount of pressure when closed. What does this most likely indicate?

A. The lockout is complete and safe to proceed

B. The valve is the correct isolation point regardless

C. The valve seat leaks and positive isolation is needed

D. Stored energy has been fully dissipated already

4. A pipe must be threaded, but the only cutting oil available is contaminated with metal chips and grit. What is the best course of action?

A. Thread the pipe dry to avoid contamination

B. Use clean cutting oil before threading the pipe

C. Strain the dirty oil through a rag and reuse it

D. Add water to the dirty oil to thin it out

5. A worker plans hot work in an area where combustibles cannot all be removed. After protecting what remains and assigning a fire watch, for what minimum period should the fire watch typically continue after the work stops?

A. No fire watch is needed once work stops

B. Until the next coffee break is taken

C. At least 30 to 60 minutes after work ends

D. Only while the torch is actively burning

6. A condensate line must fall 1/8 inch per foot. The run is 48 feet. The fitter measures the actual drop as 3 inches. How does the installed drop compare to the required drop?

A. The installed drop is too small by 3 inches

B. The installed drop is correct as measured

C. The installed drop is too large by 3 inches

D. The installed drop exceeds the requirement

7. A worker is asked to sign off that a confined space rescue plan is in place, but no retrieval equipment or trained rescuers are available. What should the worker do?

A. Sign off since the attendant can call 911

B. Sign off and arrange rescue gear later

C. Refuse entry until a real rescue plan exists

D. Enter alone and leave the space unattended

8. An apprentice asks why the journeyperson always explains the reasoning behind each procedure rather than just the steps. Which response best reflects good mentoring practice?

A. Reasoning slows the work down unnecessarily

B. Steps alone are all an apprentice needs

C. Explaining wastes the journeyperson's time

D. Understanding the why builds true competence

9. A WHMIS-controlled product arrives on site with a damaged, unreadable supplier label. Before the product is used, what must happen?

A. A proper label and SDS must be obtained

B. The product can be used if the SDS is missing

C. Workers may guess the contents from the smell

D. The product is fine to use as delivered

10. During a lockout, the equipment is electrically isolated and locked, but a vertical ram remains raised by hydraulic pressure. The work begins below it. What hazard has been overlooked?

A. The electrical isolation was unnecessary

B. The lock should have been a tag instead

C. Stored gravitational and hydraulic energy

D. The notification step was skipped entirely

11. Four PPE choices are offered for grinding steel pipe overhead. Which combination is most appropriate for the task?

A. Earplugs and steel-toe boots only

B. A dust mask and cloth gloves only

C. Face shield, safety glasses, and hard hat

D. A welding helmet and leather apron only

12. A worker finds the gauge glass on a steam boiler is too dirty to read the water level clearly. What is the correct response before continuing operation?

A. Service the gauge glass so the level is visible

B. Estimate the level from the feed pump cycle

C. Continue operating and clean it next shift

D. Rely on the pressure gauge reading instead

13. A material take-off lists 240 feet of pipe needed for a run. Experience shows about 8% waste from cuts and threading. Approximately how much pipe should be ordered?

A. Exactly 240 feet with no allowance

B. About 220 feet to reduce surplus

C. About 248 feet rounding up slightly

D. About 260 feet including the allowance

14. Drawings call for Schedule 80 pipe but the specification clearly states Schedule 40 for the same line. The fitter cannot reach the engineer. What should be done?

A. Install Schedule 80 since the drawing rules

B. Install Schedule 40 since the spec rules

C. Stop and obtain written clarification first

D. Average the two and install Schedule 60

15. A worker must communicate a complex pipe routing to a crew member across a noisy plant. Which method is most likely to convey it clearly?

A. Shouting the dimensions across the room

B. Sending a verbal message through a third worker

C. Waiting until the end of the shift to explain

D. Sketching a quick isometric of the routing

16. A confined-space atmosphere reads 24% oxygen. What does this condition represent and why is it hazardous?

A. Oxygen-enriched, increasing the risk of fire

B. Oxygen-deficient, risking worker suffocation

C. A normal atmosphere safe for entry

D. An inert atmosphere ideal for hot work

17. A fitter receives a drawing marked 1:50 with a printed dimension of 2,400 mm on one run, but scaling that run with a ruler gives 2,250 mm. Which dimension should be used and why?

A. The scaled 2,250 mm, since rulers don't lie

B. An average of the two conflicting values

C. Neither; the run should be left unmeasured

D. The printed 2,400 mm, since figured dimensions govern

18. A pipe run must offset 600 mm around an obstruction using two 45° elbows. After calculating the centre-to-centre travel, what additional step is required before cutting the pipe?

A. Multiply the travel by 1.414 a second time

B. Add the two elbow take-outs to the travel

C. Subtract the elbow take-outs from the travel

D. Cut the pipe to the full travel dimension

19. A 45° offset must shift a line 350 mm. What is the centre-to-centre travel, rounded to the nearest millimetre?

A. 495 mm of travel

B. 247 mm of travel

C. 700 mm of travel

D. 405 mm of travel

20. A horizontal steam line reduces from 6 inch to 4 inch. The fitter installs a concentric reducer and later gets water hammer at that point. What is the most likely cause?

A. The reducer was rated for too low a pressure

B. The concentric reducer created a condensate pocket

C. The pipe schedule was too thick for the flow

D. The reducer was installed with the taper reversed

21. Two Schedule 40 and Schedule 80 pipes share the same Nominal Pipe Size. A fitter must order matching fittings. Which dimension allows one fitting size to suit both?

A. The identical inside diameter of both pipes

B. The identical outside diameter of both pipes

C. The identical wall thickness of both pipes

D. The identical pressure rating of both pipes

22. A fitter is choosing a joining method for a buried water main expected to last 50 years with no access for repair. Which method best suits this requirement?

A. Heat-fused HDPE for a leak-free buried joint

B. Threaded steel with pipe-joint compound

C. Mechanical compression couplings underground

D. Soldered copper buried directly in the soil

23. During weld fit-up, a fitter notices one pipe end sits 2 mm higher than the other at the joint. What is this condition called, and whose responsibility is it to correct?

A. High-low, corrected by the fitter at fit-up

B. Undercut, corrected by the welder mid-pass

C. Porosity, corrected after the weld cools

D. Burn-through, corrected by adding more filler

24. A medical gas copper line is being brazed without a nitrogen purge to save time. What internal defect will most likely result, and why does it matter?

A. External rust that weakens the joint surface

B. Excess flux residue that improves flow

C. Copper-oxide scale that can contaminate the gas

D. Softened tube from over-annealing the copper

25. A fitter must join PVC to a hot domestic water line operating at 70°C. What is the correct assessment of this plan?

A. PVC is ideal for hot water service

B. PVC handles any temperature when cemented

C. PVC is stronger than copper at high heat

D. PVC is unsuitable; it softens at that temperature

26. A steel steam branch line runs 10 m and heats from 15°C to 175°C. Using a coefficient of 0.000012 per °C, approximately how much will it expand?

A. About 19 mm of growth

B. About 38 mm of growth

C. About 58 mm of growth

D. About 77 mm of growth

27. A fitter is told to rigidly clamp both ends of the 40 m hot steam main above with no expansion provision between them. What is the predictable outcome?

A. The main will cool faster and stay in place

B. The main will operate with no movement at all

C. Thermal stress will buckle the pipe or crack fittings

D. The clamps will absorb all the thermal growth

28. PTFE tape applied to a male thread keeps unravelling during assembly and shreds into the line. What was most likely done wrong?

A. Too few wraps were applied to the thread

B. The tape was applied to the female fitting

C. Cutting oil was used instead of the tape

D. The tape was wrapped against the thread direction

29. A fitter prepares a butt weld and leaves no root gap between the two beveled ends. What weld defect is this most likely to cause?

A. Incomplete penetration at the root

B. Excessive burn-through at the root

C. Undercut along the weld toe

D. Porosity throughout the weld bead

30. A copper line and a steel steam line of the same size run side by side. The copper sags noticeably between supports while the steel does not. What explains this difference?

A. Copper carries far more fluid weight

B. The steel was installed with extra hangers

C. Steel is stiffer and spans farther than copper

D. Copper expands less and needs no support

31. A fitter must close off the end of a flanged line so a connected vessel can be entered safely. Which component provides positive isolation?

A. A fully closed gate valve at the flange

B. A union installed at the flanged end

C. A reducing tee capping the opening

D. A blind flange bolted to the flange

32. During threading, a die produces rough, torn threads that leak when tested. The fitter used sharp dies and reamed the ends. What was most likely missing?

A. The pipe was cut to the wrong length

B. Cutting oil was not used during threading

C. The thread sealant was applied too thinly

D. The fitting was over-tightened on assembly

33. A spool is being fabricated in the shop rather than the field. Which drawing does the fitter work from for this assembly?

A. A schematic flow diagram of the system

B. A spool drawing of the prefabricated assembly

C. A scaled site plan of the building

D. A single-line riser diagram of the floor

34. A reducer must be installed on the horizontal suction line to a pump so that air cannot collect at the top of the line and cause the pump to lose prime. Which reducer and orientation is correct?

A. A concentric reducer centred on the line

B. A concentric reducer with the taper down

C. An eccentric reducer with the flat side up

D. An eccentric reducer with the flat side down

35. A weld inspection finds a groove melted into the base metal along the toe of the weld, reducing the wall section. What is this rejectable defect called?

A. Undercut at the weld toe

B. Incomplete root penetration

C. Internal gas porosity

D. Excess weld reinforcement

36. A fitter must select copper tube for a high-pressure buried service connection. Which type is most appropriate?

A. Type M for its thin, economical wall

B. Type K for its thickest wall

C. Type DWV for drainage service

D. Type L for light interior service

37. A 30° offset is needed to shift a line 500 mm. Using the 30° travel constant of 2.000, what is the centre-to-centre travel?

A. 707 mm of travel

B. 1,000 mm of travel

C. 250 mm of travel

D. 1,414 mm of travel

38. A critical pressure-pipe joint requires a clean, fully fused root. Which welding process is most commonly chosen for the root pass?

A. GTAW (TIG) for a clean, sound root

B. FCAW for its high deposition rate

C. Oxy-acetylene gas welding for the root

D. Solvent cementing of the root joint

39. A fitter cuts and threads a steel pipe but skips reaming. What is the likely consequence in service?

A. The threads will leak immediately on test

B. An internal burr will restrict flow and cause turbulence

C. The pipe outside diameter will be too large

D. The joint will be impossible to disassemble

40. A drawing shows a single line representing a pipe with fittings drawn as symbols, with no attempt at true scale or physical layout. What type of drawing is this?

A. A spool fabrication drawing

B. A schematic flow diagram

C. A scaled orthographic plan

D. A dimensioned isometric drawing

41. A fitter is selecting filler for joining copper refrigeration tube that must withstand high pressure and vibration. Which joining approach is appropriate?

A. Soft solder with a tin-based filler

B. Solvent cement rated for refrigerant

C. A threaded compression joint only

D. Brazing with a high-temperature filler

42. Two beveled pipe ends are prepared with a 37½° angle on each side. What is the total included angle of the V-groove?

A. 37½° included angle

B. 45° included angle

C. 60° included angle

D. 75° included angle

43. A pipe run will see significant thermal cycling. The designer wants natural flexibility built into the routing without adding a separate device. Which approach achieves this?

A. Rigidly anchoring the run at both ends

B. Using changes in direction and offsets

C. Installing a blind flange mid-run

D. Welding the run into one straight length

44. A fitter must support a horizontal run that includes a heavy valve. Where should a support be added beyond the normal spacing?

A. Only at the far ends of the run

B. Nowhere; valves need no extra support

C. Midway between two existing hangers only

D. At the concentrated load of the valve

45. A 45° offset calculation yields a travel of 707 mm for a 500 mm set. The fitter cuts the pipe to exactly 707 mm and the offset will not seat. What was the error?

A. The 1.414 constant was applied incorrectly

B. The set should have been doubled first

C. The elbow take-outs were not deducted

D. A 30° constant should have been used

46. A 2,000 kg load is lifted by two sling legs at 30° from horizontal. Approximately what tension does each leg carry, and what does this illustrate?

A. About 500 kg, showing tension drops at low angles

B. About 1,000 kg, equal to a vertical lift

C. About 2,000 kg, showing low angles raise tension

D. About 250 kg, showing the legs share lightly

47. A rigger finds a synthetic web sling with a clean body but a missing capacity tag. What is the correct decision?

A. Use it for light loads only with care

B. Estimate its rating from a similar sling

C. Derate it to half and use it cautiously

D. Remove it from service as unverifiable

48. An irregular load is heavier on one end. The rigger positions the hook at the load's geometric midpoint and lifts. What happens and what is the correct fix?

A. It lifts level; the midpoint is always correct

B. It lifts level once the slings stretch evenly

C. It tilts; the hook must be over the centre of gravity

D. It tilts; the solution is to lift faster next time

49. A crane's load chart shows 12,000 kg at 8 m radius and 6,000 kg at 16 m radius. A planner needs to lift 9,000 kg. Which configuration is safe?

A. Either radius lifts 9,000 kg safely

B. The 16 m radius, since longer reach helps

C. The 8 m radius, which is rated above the load

D. Neither radius can lift the load safely

50. During a lift, a worker who is not the signaller sees a sling slipping and raises both arms in the emergency stop signal. How must the operator respond?

A. Ignore it, since only the signaller may signal

B. Stop the lift immediately as instructed

C. Continue and confirm with the signaller first

D. Lower quickly without stopping the swing

51. A rigger plans a tandem lift with two identical cranes sharing one beam. Each crane is rated 10,000 kg. What is the maximum each should be loaded to?

A. 10,000 kg, the full chart capacity each

B. 5,000 kg, half the rating for safety

C. About 7,500 kg, roughly 75% of capacity

D. 2,500 kg, one quarter of the rating

52. A wire rope sling shows several broken wires and a kink. The rigger needs it for one quick lift. What is the correct action?

A. Use it once since the lift is brief

B. Wrap the damaged section with tape

C. Apply grease to restore its flexibility

D. Remove it from service as defective

53. A load must be guided into a tight opening while suspended. What is the safe method to control its position?

A. Use tag lines handled from a safe distance

B. Have a worker steady it by hand at the gap

C. Swing it sharply to drop it into place

D. Ride the load down to guide it precisely

54. A crane is set up on soft ground with outriggers only partially extended. The load is within chart capacity. Why is this still unsafe?

A. The load chart already includes a soft-ground margin

B. Partial outriggers increase the crane's capacity

C. The chart assumes the load is over-rated

D. The chart assumes firm ground and full outrigger support

55. A rigger must lift a load near energized overhead power lines. Which precaution is essential?

A. Touch the line first to confirm it is dead

B. Work faster to minimize time near the line

C. Maintain the required minimum clearance distance

D. Use a metal tag line for better control

56. A chain sling and a nylon web sling are both available for a hot lift near a furnace. Which is appropriate and why?

A. The nylon sling, because it is lighter to handle

B. Either sling, since heat affects neither one

C. The nylon sling, since synthetics resist heat best

D. The chain sling, since it resists heat best

57. A load tilts as it just clears the ground during a trial lift. What is the correct response?

A. Continue lifting to clear the obstruction faster

B. Add workers to push the low end level

C. Swing the load to redistribute the weight

D. Set it down and reposition the rigging

58. A planner reviews a lift where the load is 90% of the crane's chart capacity at the working radius. How should this lift be classified and handled?

A. As a critical lift requiring an engineered plan

B. As a routine lift needing no special planning

C. As a light lift that any operator can do alone

D. As a lift that needs no load chart review

59. Two supervisors begin giving the crane operator different signals at the same time. What rule has been violated?

A. Only one designated signaller may direct the lift

B. Signals must always be given by radio only

C. Supervisors are the only ones allowed to signal

D. The operator should average the two signals

60. A rigger estimates a steel plate's weight from its volume and the density of steel. Which density value is correct for steel?

A. About 1,000 kg/m³, the density of water

B. About 2,700 kg/m³, the density of aluminum

C. About 500 kg/m³, the density of softwood

D. About 7,850 kg/m³, the density of steel

61. A heat exchanger using saturated steam suddenly heats less effectively, and the steam trap discharges continuously with a rush of live steam to the return. What is the most likely fault?

A. The trap has failed closed and flooded the unit

B. The trap has failed open and is blowing steam

C. The condensate return line is undersized

D. The steam pressure has been set too high

62. A radiator in a two-pipe system stays cold while others heat normally. The supply valve is open and pressure is normal. Which fault best explains the cold radiator?

A. A steam trap failed closed, flooding the radiator

B. The boiler is producing superheated steam

C. The system pressure is set far too high

D. The radiator is correctly off by design

63. Operators report violent banging in a steam main shortly after start-up each morning. The main was recently re-pitched incorrectly. What is the cause of the banging?

A. The steam is superheated on start-up

B. The boiler safety valve is lifting early

C. Condensate pooling and being struck by steam

D. The condensate pump is oversized for the load

64. A saturated steam system runs at a higher pressure to raise its delivery temperature. Which principle explains why this works?

A. Saturation temperature rises with pressure

B. Latent heat increases with pipe diameter

C. Sensible heat is unrelated to the pressure

D. Higher pressure lowers the steam temperature

65. A PRV station's reducing valve fails open. The downstream low-pressure system is suddenly exposed to high-side pressure but does not rupture. Which device prevented disaster?

A. The strainer ahead of the reducing valve

B. The downstream safety relief valve

C. The upstream isolation gate valve

D. The pressure gauge on the high side

66. A boiler's low-water cutoff is found jumpered out so it cannot trip the burner. Why is operating in this state extremely dangerous?

A. The stack temperature will read too low

B. The feedwater will become over-treated

C. The safety valve will lift prematurely

D. Overheated surfaces can fail catastrophically

67. A cold steam main is brought online by snapping the main valve fully open at once. Severe hammer follows. What procedure was violated?

A. Slow warm-up to drain condensate and vent air

B. Closing the drip-leg traps before start-up

C. Raising the boiler pressure above rating first

D. Removing the separators ahead of the main

68. A steam trap on a heat exchanger has failed closed. What symptoms would the operator most likely observe?

A. Continuous live steam blowing to the return

B. A rise in the boiler operating pressure

C. Faster heating with no condensate present

D. A cold exchanger with water hammer present

69. A high-pressure steam main shows condensate accumulation just ahead of a riser, with hammer at that point. What design feature was most likely inadequate?

A. The insulation thickness on the main

B. A drip leg with a trap ahead of the riser

C. The pressure rating of the riser pipe

D. The colour-coding of the steam line

70. A separator is installed ahead of a steam turbine. What is its purpose, and what damage does it prevent?

A. It reduces pressure to protect the turbine seals

B. It adds moisture to cool the turbine blades

C. It raises steam temperature for more power

D. It removes entrained water that erodes blades

71. An operator must classify a steam system operating at 12 psi. Into which category does it fall, and what governs the limit?

A. High-pressure, since it exceeds 5 psi

B. High-pressure, since 10 psi is the limit

C. Low-pressure, since it is at or below 15 psi

D. Low-pressure, since any building steam is low

72. A two-pipe steam system has no traps at the radiator outlets. What problem will develop?

A. The radiators will overheat from excess steam

B. The boiler pressure will steadily decrease

C. Live steam will blow into the condensate return

D. The condensate will return too quickly to boil

73. An inverted bucket trap and a thermostatic trap are compared. On what principle does the inverted bucket trap operate?

A. The temperature difference of the condensate

B. The velocity of flash steam across a disc

C. The electrical conductivity of the water

D. The density difference between steam and water

74. A gravity condensate return line in a small system fails to return condensate, which backs up at the radiators. Inspection shows the return line is back-pitched. Why does this stop the return?

A. Back-pitch increases the steam pressure too much

B. Gravity cannot move condensate uphill against the slope

C. Back-pitch causes the steam to superheat

D. The condensate freezes in the level section

75. A boiler feedwater system recovers condensate to the boiler. What two benefits does this provide?

A. It cools the boiler and lowers efficiency

B. It conserves heat and treated water

C. It adds raw cold water to the boiler

D. It raises the stack temperature for draft

76. Steam delivered to a coil condenses and gives up energy at constant temperature. Which form of heat is being transferred to the load?

A. Sensible heat raising the steam temperature

B. Frictional heat from steam velocity

C. Latent heat released as steam condenses

D. Radiant heat from the pipe surface only

77. A high-pressure steam system uses threaded joints throughout and develops repeated leaks under pressure. What joining method should have been specified?

A. Solvent-cemented plastic joints

B. Welded steel joints for integrity

C. Bell-and-spigot gasketed joints

D. Compression tubing fittings

78. An operator notices a radiator heats partway then stops, and an air vent on it appears stuck shut. Why does a failed air vent leave the radiator partly cold?

A. The vent failure raises the steam pressure

B. Trapped air blocks steam from filling the radiator

C. The vent failure floods the unit with condensate

D. The closed vent superheats the incoming steam

79. A thermodynamic (disc) steam trap is selected for an outdoor steam main drip. On what principle does this trap operate?

A. Velocity and pressure changes of flash steam

B. The density difference of steam and water

C. The temperature difference of the condensate

D. The electrical resistance of the condensate

80. A steam main is being warmed up. The fitter opens a small bypass valve first rather than the main valve. What is the purpose of this practice?

A. To warm the line gradually and drain condensate

B. To raise the boiler pressure more quickly

C. To bypass the steam trap during start-up

D. To test the main valve seat for leaks

81. A heat exchanger floods with condensate and hammers; the trap is suspected. Before condemning the trap, what failure mode matches these symptoms?

A. The trap failed open, wasting live steam

B. The trap is correctly venting only air

C. The trap is discharging flash steam normally

D. The trap failed closed, backing up condensate

82. Why must a steam line be isolated, depressurized, and cooled before a fitter breaks a joint on it?

A. To raise the line to test pressure first

B. To record the gauge glass reading only

C. To open the air vents for ventilation

D. To prevent severe steam and condensate burns

83. A fire-tube and a water-tube boiler are compared. In a fire-tube boiler, what passes through the tubes?

A. Boiler water surrounded by hot gases

B. Hot combustion gases surrounded by water

C. Superheated steam to the distribution main

D. Treated feedwater under high pressure

84. A drip leg is installed at a low point in a steam main and routed to a trap. What is the drip leg's function?

A. To collect condensate for the trap to remove

B. To increase the velocity of the steam

C. To vent the building air into the main

D. To support the weight of the steam main

85. A hydronic zone must deliver 100,000 Btuh at a design ΔT of 20°F. Using Btuh = gpm × 500 × ΔT, what flow is required?

A. 5 gpm of flow

B. 20 gpm of flow

C. 10 gpm of flow

D. 100 gpm of flow

86. A closed hydronic loop loses pressure and lifts its relief valve every time it heats up. The air separator works fine. Which missing or failed component best explains this?

A. A waterlogged or absent expansion tank

B. An oversized circulating pump

C. A closed balancing valve on one zone

D. A missing pressure gauge on the loop

87. A hydronic circuit is air-bound and will not circulate despite a running pump. What is the immediate corrective action?

A. Increase the pump speed to force the air through

B. Vent the trapped air from the circuit

C. Raise the boiler temperature setpoint

D. Close the balancing valve completely

88. A technician searches for a suspected high-pressure hydraulic leak by running a gloved hand along the line. Why is this dangerous?

A. The glove will be damaged by the oil

B. The oil will make the line too slippery to hold

C. A pinhole can inject oil through the skin

D. The hand will cool the line and cause a fault

89. A pneumatic system's air tools run roughly and the air carries water. The FRL is suspect. Which FRL function addresses moisture and conditioning at the tool?

A. It increases the system's storage volume

B. It filters moisture, regulates, and lubricates

C. It generates additional compressed air

D. It measures total air consumption only

90. A refrigeration system is brazed and charged without being evacuated first. What problem is most likely, and why?

A. The joints will be too strong to service

B. Moisture forms acids and ice in the system

C. The refrigerant pressure will be too high

D. The lines will need no insulation at all

91. A process line previously carried a corrosive chemical. A fitter is told to "just cut into it" based on the line label alone. What is the correct safe practice?

A. Cut quickly before any residue can react

B. Trust the label and cut without verifying

C. Isolate, drain, purge, and verify before cutting

D. Cut and flush the residue out afterward

92. A hydronic system delivers 80,000 Btuh and the design flow is 8 gpm. What is the design temperature difference (ΔT) across the loop?

A. 10°F across the loop

B. 16°F across the loop

C. 20°F across the loop

D. 40°F across the loop

93. A medical gas system passes its pressure test but an outlet labelled "oxygen" is found to deliver medical air during verification. What test caught this, and why is it vital?

A. Cross-connection testing; a wrong gas can kill a patient

B. A simple leak test; it saves compressed gas

C. An insulation test; it improves efficiency

D. A flow test; it speeds up installation

94. A boiler develops scale on its heat-transfer surfaces and begins to overheat locally. What is the most likely root cause?

A. The steam pressure was set too low

B. The condensate was returned too quickly

C. Inadequate feedwater treatment allowed scale

D. The insulation on the boiler was too thick

95. A counterflow and a parallel-flow heat exchanger are compared for a recovery application. Which arrangement transfers the most heat?

A. Parallel flow, with both streams together

B. Counterflow, with streams in opposite directions

C. Both transfer heat equally regardless of flow

D. Stagnant flow, with both streams held still

96. A hydronic system uses water/glycol. The glycol concentration is found too weak for the climate. What risk does this create?

A. The loop will circulate too quickly

B. The pump will draw excessive current

C. The water will boil at a lower temperature

D. The loop can freeze and rupture in the cold

97. A compressed-air main slopes back toward the compressor with no drip points, and water collects in the tools. What installation principle was violated?

A. The main should have been larger in diameter

B. The main needed a higher operating pressure

C. The main should slope to drains to remove condensate

D. The main needed an oil lubricator at the source

98. A fitter joins refrigerant tube using soft solder instead of brazing. Why is this inappropriate for the service?

A. Solder flows too slowly into the joint

B. Solder requires no flux on copper

C. Solder lacks the strength for high-pressure refrigerant

D. Solder melts at too high a temperature

99. A hydronic loop's zones heat unevenly — some too hot, some too cold — despite adequate boiler output. Which adjustment corrects this?

A. Raising the boiler pressure across all zones

B. Balancing the flow to each zone with valves

C. Removing the expansion tank from the loop

D. Increasing the glycol concentration in the loop

100. A medical gas brazing operation uses oil-free nitrogen flowing through the tube. What does this purge accomplish?

A. It prevents internal copper-oxide scale

B. It cools the joint faster after brazing

C. It adds strength to the filler metal

D. It cleans flux residue from the exterior

101. A process piping system for hazardous chemicals must meet a recognized code. Which standard most commonly applies?

A. The residential plumbing bylaw

B. The fire-alarm wiring standard

C. The elevator safety code

D. ASME B31.3 for process piping

102. An evacuated-tube and a flat-plate solar collector are compared for a cold, cloudy region. Which performs better and why?

A. Flat-plate, because it is simpler in design

B. Flat-plate, because it has more surface area

C. Either; climate does not affect collectors

D. Evacuated-tube, because the vacuum cuts heat loss

103. A chilled-water system absorbs heat from a building space. How does it carry that heat away?

A. By venting steam to the atmosphere

B. By circulating cool water to a chiller

C. By burning fuel to consume the heat

D. By compressing air to absorb the heat

104. A hydraulic press operates with immediate, rigid force, while a connected air cylinder feels cushioned. Which fluid property explains the difference?

A. Liquids are compressible; gases are not

B. Liquids are incompressible; gases are compressible

C. Both fluids are equally compressible

D. Gases transmit force more rigidly than liquids

105. A hydronic system's heat exchanger surfaces are fouled with scale and output has dropped. What maintenance restores performance?

A. Cleaning the fouled heat-exchanger surfaces

B. Increasing the system operating pressure

C. Adding more antifreeze to the loop

D. Removing the air separator from the loop

106. Oxygen-service medical gas tube must be specially cleaned and kept free of oil. What hazard does residual oil create?

A. It makes the tube harder to bend

B. It lowers the delivered gas pressure

C. It improves the brazing filler flow

D. It can ignite in an oxygen-rich line

107. A fuel-gas line must be checked for leaks after installation. Which method is correct and safe?

A. Pass a lit match along each joint

B. Sniff each joint to detect the odorant

C. Use approved leak-detection solution

D. Wait for a pressure drop over a week

108. A heat recovery ventilator is installed to cut heating costs. How does it achieve savings without generating heat?

A. By transferring heat from exhaust to fresh air

B. By burning recovered gas for extra heat

C. By venting all stale air heat outdoors

D. By compressing incoming air to warm it

109. A hydronic system needs a device to absorb the volume change of water as it heats and cools. Which component does this?

A. An expansion tank on the loop

B. A balancing valve at each zone

C. A check valve on the return

D. A strainer ahead of the pump

110. A refrigerant line set is exposed to humid air during installation and not evacuated. The compressor later fails. What is the most likely cause?

A. The lines were oversized for the charge

B. Moisture in the lines formed acids and ice

C. The brazing filler was too strong

D. The insulation was applied too thickly

111. A process fluid is toxic and flammable. Before any line break, which sequence protects the worker?

A. Cut, then isolate, then verify the contents

B. Verify the label only, then cut the line

C. Drain after cutting and ventilate the room

D. Isolate, drain, purge, then verify before breaking in

112. A ground-source heat pump and an air-source unit are compared for a cold Canadian winter. Why does the ground-source unit stay more efficient?

A. The ground stays at a stable, moderate temperature

B. It burns supplemental fuel in cold weather

C. It needs no circulating pump in winter

D. Air-source units never lose efficiency at all

113. A closed-loop geo-exchange field is being installed in a small urban lot with little land. Which loop configuration suits the site?

A. A vertical closed loop in deep boreholes

B. A wide horizontal loop in shallow trenches

C. An open loop drawing from a large pond

D. A surface loop laid on top of the soil

114. A buried geo-exchange loop must last decades with no access for repair. Which pipe and joint best meets this need?

A. Threaded steel with joint compound

B. Soldered copper buried in the trench

C. Solvent-cemented PVC underground

D. Heat-fused HDPE for a leak-free joint

115. A direct (open-loop) solar thermal system is proposed for a region with hard winter freezes. Why is this the wrong choice?

A. Open-loop systems are too expensive to build

B. Potable water cannot carry solar heat at all

C. Open systems require a heat exchanger always

D. Potable water in the collector will freeze and burst

116. A solar collector full of fluid sits in strong sun with no heat being drawn off, and its temperature climbs sharply. What is this condition called?

A. Air-binding of the collector loop

B. Backflow through the collector

C. Stagnation of the collector

D. Freezing of the collector fluid

117. An indirect solar thermal system keeps the antifreeze loop separate from the potable water. How is the captured heat delivered to the water?

A. Through a heat exchanger keeping fluids separate

B. By mixing the antifreeze into the water directly

C. By circulating potable water through the collector

D. By venting collector steam into the tank

118. An open-loop geo-exchange system is planned where the only available well water is high in minerals and sediment. What is the primary concern?

A. The loop will have too much available land

B. Poor water quality will foul and corrode the system

C. The roof will not face the correct direction

D. The system will need a compressed-air supply

119. A heat recovery economizer is added to a boiler. What does it recover, and what does it preheat?

A. It recovers pump energy to preheat the oil

B. It recovers steam pressure to preheat the air

C. It recovers flue-gas heat to preheat feedwater

D. It recovers condensate to preheat the building

120. A new high-pressure line must be pressure tested. The crew debates water versus air. Which method is preferred and why?

A. Pneumatic, because air leaks are easier to hear

B. Hydrostatic, because water stores little energy

C. Pneumatic, because compressed air is cheaper

D. Either; the stored energy is the same in both

121. A pneumatic test is unavoidable because the system cannot tolerate water. What is the key danger that demands extra precautions?

A. Water freezing inside the test section

B. The slow speed of the pneumatic test

C. The high cost of the compressed gas

D. The large stored energy that can release explosively

122. During commissioning, a fitter wants to throw the system straight to full operation. Why is a gradual, sequential start-up required instead?

A. Gradual start-up uses more fuel overall

B. Rushing risks hammer, damage, and missed faults

C. A single-step start is faster and equally safe

D. Sequential start-up skips the safety-device checks

123. Before turnover, a commissioning technician must verify the safety relief valves. What exactly must be confirmed?

A. That they are painted to match the piping

B. That they are gagged shut during testing

C. That they are correctly set and proven functional

D. That they are removed before the system runs

124. A system is handed over with drawings that show the original design but not the field changes made during installation. Why is this a problem at turnover?

A. As-builts must reflect what was actually installed

B. Original drawings are always preferred at turnover

C. Field changes never need to be recorded

D. The owner does not need any drawings at all

125. A hydrostatic test is performed in freezing conditions and the system is left full of water afterward. What risk has been created?

A. The trapped water can freeze and rupture the pipe

B. The water will raise the operating pressure

C. The full system will be easier to commission

D. The water improves the insulation value

126. Commissioning a steam system includes a controlled start-up. How should the steam lines be brought up to temperature?

A. Pressurized fully in one rapid step

B. Left isolated and cold until first use

C. Warmed slowly, draining condensate as they heat

D. Filled with water before admitting steam

127. A turnover package is being assembled for the owner. Which set of documents should it contain?

A. Test reports, equipment manuals, and as-builts

B. Only the installer's daily time sheets

C. Only photographs of the finished work

D. Only the original material purchase orders

128. A pressure test shows a slow pressure drop over the hold period. What does this indicate and what is the next step?

A. A leak exists; locate, depressurize, repair, retest

B. The test passed; record it and move on

C. The gauge is faulty; ignore the reading

D. The pressure should simply be raised higher

129. During commissioning, a circulating pump is started and found to run backward. Why must pump rotation be checked at start-up?

A. Backward rotation increases the flow rate

B. Wrong rotation gives low flow and poor performance

C. Rotation direction has no effect on the pump

D. Reverse rotation is the normal running condition

130. Owner training is part of turnover. Why is walking the operator through the system important?

A. So the owner can run and maintain it safely

B. So the installer can avoid writing manuals

C. So the warranty period can be shortened

D. So the as-built drawings can be discarded

Practice Exam 8: Answer Key and Explanations

1. B — Substitution ranks above PPE, signage, and administrative rotation in the hierarchy of controls. Replacing the hazardous solvent with a non-hazardous product removes the vapour risk at its source rather than managing exposure to it, protecting every worker regardless of behaviour or compliance.

2. D — Entry is prohibited until a working detector confirms the toxic level is safe. A normal oxygen reading says nothing about toxic gas, and the failed sensor leaves a lethal unknown. Confined-space entry requires verified atmospheric testing for oxygen, flammables, and toxics before anyone enters.

3. C — A valve passing pressure when closed means the seat leaks and cannot provide positive isolation. A leaking valve is not a safe isolation point; a blind or spectacle blind is needed to give a true physical barrier before work proceeds.

4. B — Clean cutting oil must be used; contaminated oil with grit damages the die and the thread. Cutting oil cools the die, flushes chips, and produces clean threads, so dirty oil or dry threading both yield rough, leak-prone threads.

5. C — A fire watch typically continues at least 30 to 60 minutes after hot work ends. Sparks and smouldering material can ignite combustibles long after the torch is off, so the post-work watch period is the safeguard against a delayed fire.

6. A — Required drop = 48 ft × 1/8 in./ft = 6 inches; the installed 3 inches is short by 3 inches. An under-pitched line will not self-drain, leaving condensate to pool and cause water hammer, so the grade must be corrected.

7. C — Entry must be refused until a genuine rescue plan with retrieval equipment and trained rescuers exists. A confined-space rescue must be planned before entry; relying on a 911 call is not a rescue plan and most confined-space deaths are unprepared rescuers.

8. D — 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, not just rote steps, and the ability to teach the why also signals the journeyperson's own mastery.

9. A — A proper label and SDS must be obtained before the product is used. WHMIS requires that every controlled product be identified and have its hazard and handling data available; an unreadable label leaves workers without the information needed to work safely.

10. C — Stored gravitational and hydraulic energy in the raised ram was overlooked. Lockout must dissipate all stored energy — not just electrical — so the ram must be blocked or lowered and pressure bled before anyone works beneath it.

11. C — A face shield, safety glasses, and hard hat suit overhead grinding, protecting against flying particles and falling debris. Grinding throws sparks and chips toward the eyes and face, and overhead work adds an impact hazard, so this combination matches the task.

12. A — The gauge glass must be serviced so the water level is clearly visible before continuing. The gauge glass is the operator's direct view of boiler water level, and low water is the most dangerous boiler condition, so an unreadable glass cannot be tolerated.

13. D — 240 ft × 1.08 ≈ 259 ft, so about 260 feet should be ordered. A sensible waste allowance for cuts and threading prevents a mid-job shortage; ordering the exact measured footage almost guarantees running short.

14. C — Work must stop until written clarification resolves the drawing-versus-spec conflict. Schedule 40 and Schedule 80 differ in wall thickness and pressure rating, so guessing or averaging risks an underrated line; an RFI settles it before any pipe is installed.

15. D — Sketching a quick isometric conveys a complex routing most clearly, especially in a noisy plant where voice is unreliable. A drawing shows direction, fittings, and dimensions at once, avoiding the errors that shouted or relayed verbal instructions invite.

16. A — At 24% oxygen the atmosphere is oxygen-enriched, which sharply increases fire and combustion risk. Normal air is about 20.9%; above 23% materials ignite more easily and burn more fiercely, so an enriched atmosphere is a serious hazard, not a safe one.

17. D — The printed 2,400 mm governs because figured dimensions always take precedence over scaled measurements. Drawings can be distorted in reproduction or plotting, making a ruler reading unreliable, so the printed number is the authority.

18. C — The elbow take-outs must be subtracted from the calculated centre-to-centre travel to get the cut length. The 1.414 formula gives travel between fitting centrelines; cutting to the full travel without deducting take-outs produces an offset that is too long to seat.

19. A — Travel = set × 1.414 = 350 × 1.414 ≈ 495 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. B — A concentric reducer in a horizontal line leaves a low pocket where condensate collects. High-velocity steam then drives that trapped slug against the fitting, producing water hammer; an eccentric reducer installed flat-side-down would have prevented the pocket.

21. B — The identical outside diameter of both pipes lets one fitting size suit both schedules. For a given Nominal Pipe Size the OD stays constant while only the wall thickness and bore change with schedule, which is what allows fittings and threads to be standardized.

22. A — Heat-fused HDPE gives a leak-free buried joint as strong as the pipe itself, ideal for a 50-year main with no access. A fusion weld eliminates the mechanical or threaded joints that would become future leaks underground.

23. A — A 2 mm offset between pipe ends is high-low, and the fitter corrects it at fit-up before welding. Proper alignment is the fitter's responsibility; uncorrected high-low weakens the joint and impedes root penetration.

24. C — Without a nitrogen purge, internal copper-oxide scale forms inside the brazed line. That scale can break loose and contaminate the gas delivered to a patient, which is why purging is a mandatory code requirement for medical gas.

25. D — PVC is unsuitable for 70°C water because it softens and loses strength as temperature rises. PVC is limited to cold-water and drainage service; hot water requires CPVC or another rated material, so this plan would lead to failure.

26. A — Expansion = 10 m × 160°C × 0.000012 = 0.0192 m ≈ 19 mm. Applying the expansion formula with consistent units gives the growth a loop, joint, or offset must absorb; even 19 mm rigidly restrained generates damaging force.

27. C — Rigidly clamping both ends of a hot main with no expansion provision causes thermal stress to buckle the pipe or crack fittings. Hot pipe must grow; with nowhere to go the generated force is enormous, so loops, joints, or offsets are required.

28. D — Wrapping the tape against the thread direction makes it unravel and shred during assembly. PTFE tape must be wound a few neat turns in the thread direction so it tightens rather than peels, keeping debris out of the line.

29. A — Leaving no root gap most likely causes incomplete penetration at the root, because the root pass cannot fully fuse the inside of the joint. A controlled gap allows full penetration; too little risks lack of fusion, too much risks burn-through.

30. C — Steel is stiffer and spans farther than copper, so it sags less between the same support spacing. Copper deflects more readily and needs closer supports; the difference in stiffness, not fluid weight, explains the sag.

31. D — A blind flange bolted to the open flange provides positive isolation, a solid barrier with no bore. Unlike a closed gate valve, which can leak or be opened, the blind gives a true physical barrier for safe vessel entry.

32. B — Rough, torn, leaking threads despite sharp, reamed dies point to no cutting oil during threading. Cutting oil cools the die, flushes chips, and lubricates the cut; without it the threads tear and leak even with good tooling.

33. B — A spool drawing of the prefabricated assembly is used for shop fabrication. It breaks the isometric into individual spools built in the shop, which is exactly the drawing a fitter works from for shop assembly.

34. C — On a horizontal pump-suction line, an eccentric reducer with the flat side up keeps the top of the line continuous so air cannot pocket and break the pump's prime. Flat-side-up prevents air accumulation on suction; flat-side-down is used where condensate must drain.

35. A — A groove melted into the base metal at the weld toe is undercut. It reduces the wall cross-section and creates a stress concentration, making it a recognized rejectable weld defect.

36. B — Type K copper has the thickest wall of the common types, suiting it to high-pressure and buried service. Wall thickness decreases K to L to M, so K is the correct choice where pressure and burial demand the most robust tube.

37. B — Travel = set × 2.000 = 500 × 2.000 = 1,000 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. A — GTAW (TIG) is most commonly chosen 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.

39. B — Skipping reaming leaves an internal burr that restricts flow and creates turbulence. The burr does not prevent assembly or leak by itself, but it disturbs flow, so reaming the cut end is standard practice.

40. B — A single-line drawing using symbols with no true scale or physical layout is a schematic flow diagram. It shows how the system functions, not where components physically sit, distinguishing it from plans and isometrics.

41. D — Brazing with a high-temperature filler suits copper refrigeration tube under high pressure and vibration. Brazed joints melt above 450°C and are far stronger than soft-soldered joints, which is why refrigeration lines are brazed.

42. D — 37½° per side gives a 75° total included angle for the V-groove. This standard bevel preparation provides the access the weld needs to achieve full penetration through the joint.

43. B — Using changes in direction and offsets builds natural flexibility into the routing to absorb thermal cycling without a separate device. The pipe's own geometry flexes to take up growth, supplementing or replacing loops and joints.

44. D — A support must be added at the concentrated load of the heavy valve, beyond the normal spacing. Valves are heavy point loads; supporting them keeps their weight off the connecting pipe and joints.

45. C — The elbow take-outs were not deducted from the 707 mm travel. The offset formula gives centre-to-centre travel, but the pipe must be cut shorter by each elbow's take-out, or the assembly will be too long to seat.

46. C — At 30° from horizontal each leg of a two-leg sling carries roughly the full load — about 2,000 kg here — illustrating that low sling angles sharply raise leg tension. The same load near vertical would load each leg far less, which is why shallow angles are dangerous.

47. D — A sling with no legible capacity tag must be removed from service as unverifiable. Its rating cannot be confirmed, and there is no acceptable way to estimate or derate untagged rigging in the field.

48. C — The load tilts because the hook is over the geometric midpoint, not the centre of gravity; the fix is to position the hook directly above the CG. An off-CG lift hangs unevenly and can slip, so the hook must align with the actual balance point.

49. C — The 8 m radius is rated at 12,000 kg, above the 9,000 kg load, so it is safe; the 16 m radius rates only 6,000 kg and would be overloaded. Crane capacity falls as radius increases, so the shorter radius provides the needed margin.

50. B — The operator must stop the lift immediately, because anyone — not just the designated signaller — may give the emergency stop signal. Universal emergency-stop authority exists precisely so a hazard like a slipping sling can be halted at once.

51. C — Each crane should be loaded to about 75% of its 10,000 kg rating in a tandem lift. Because the load can shift between cranes as they move, the de-rating provides margin for the uneven, dynamic load sharing.

52. D — Wire rope with broken wires and a kink must be removed from service as defective, even for a brief lift. Such damage cannot be repaired with tape or grease and can lead to sudden failure under load.

53. A — Tag lines handled from a safe distance are the safe way to guide a suspended load into a tight opening. Hands must never be on a suspended load, and swinging or riding it invites a dropped or crushing-load incident.

54. D — The load chart assumes firm, level ground with outriggers fully deployed; partial outriggers on soft ground void that assumption. The crane can tip even within its rated load, so a proper, fully supported setup is required to achieve charted capacity.

55. C — 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 for boom, load, and tag lines alike.

56. D — The chain sling is appropriate for a hot lift because chain resists heat best. Synthetic web slings melt and lose strength near heat, so chain is the correct choice for rugged, high-temperature conditions.

57. D — When a load tilts as it just clears the ground, the correct response is to set it down and reposition the rigging. The trial lift exists to catch off-CG or slipped-sling conditions before the load is high and dangerous.

58. A — A lift at 90% of chart capacity is a critical lift requiring an engineered plan. Loads approaching rated capacity demand verified weights, defined roles, ground assessment, and a written plan rather than routine handling.

59. A — The rule violated is that only one designated signaller may direct the operator at a time. Two simultaneous signallers create conflicting commands; a single identified signaller ensures the operator receives unambiguous direction.

60. D — Steel has a density of about 7,850 kg/m³, the correct value for estimating a steel plate's weight from its volume. Using water, aluminum, or wood densities would badly misjudge the load and the rigging required.

61. B — Reduced heating with continuous discharge of live steam to the return is the signature of a trap failed open. The open trap blows steam straight through instead of holding it to condense, wasting energy and starving the exchanger.

62. A — A single cold radiator with open supply and normal pressure points to a steam trap failed closed, flooding that radiator with condensate. The trapped condensate fills the unit so steam cannot enter and give up its heat.

63. C — The banging is condensate pooling in the incorrectly re-pitched main and being struck by high-velocity steam. This is classic water hammer; restoring proper pitch and drainage eliminates the slugs that the steam hurls against fittings.

64. A — Raising pressure raises delivery temperature because the saturation temperature of steam rises with pressure. There is one saturation temperature for each pressure, so pressure is used to control the temperature steam delivers to the load.

65. B — The downstream safety relief valve prevented disaster by relieving the overpressure when the PRV failed open. A PRV station must include this relief sized for full flow on the reduced-pressure side, protecting the low-pressure system.

66. D — With the low-water cutoff jumpered out, overheated surfaces can fail catastrophically if water drops below them. The cutoff exists to shut the burner on low water — the most dangerous boiler condition — so defeating it removes the last protection.

67. A — Snapping the main valve open violated the slow warm-up needed to drain condensate and vent air. Rapid admission of steam into a cold line causes sudden condensation and a violent condensate slug, producing the severe hammer observed.

68. D — 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. B — Inadequate drip-leg-and-trap provision ahead of the riser let condensate accumulate and hammer at that point. Drip legs at low points and ahead of risers collect condensate for a trap to remove before it builds up.

70. D — A separator ahead of a turbine removes entrained water that would otherwise erode the blades. Wet steam carries less usable energy and damages turbine blades and valve seats, so the separator delivers drier steam to protect the equipment.

71. C — At 12 psi the system is low-pressure, because the limit is at or below 15 psi. Above 15 psi a system is classified high-pressure with stricter code requirements, so the 15 psi line is the governing threshold.

72. C — Without traps at the radiator outlets, live steam blows straight into the condensate return. The trap's job is to discharge condensate while holding back steam; omitting it wastes steam and pressurizes the return.

73. D — An inverted bucket 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.

74. B — A back-pitched gravity return stops condensate because gravity cannot move it uphill against the slope. Gravity returns depend entirely on correct downhill pitch, so back-pitch leaves condensate to back up at the radiators.

75. B — Recovering condensate conserves heat and treated water, since the returned condensate is already hot and chemically conditioned. Reusing it cuts fuel, water, and treatment costs and prevents accumulation in the system.

76. C — Energy given up at constant temperature as steam condenses is latent heat. The latent heat of vaporization released during the phase change is the large reservoir of energy that makes steam an effective heating medium.

77. B — Welded steel joints should have been specified for high-pressure steam, because they provide the integrity that repeatedly leaking threaded joints cannot. High temperature and pressure rule out plastic, bell-and-spigot, and compression joints.

78. B — A stuck-shut air vent leaves the radiator partly cold because trapped air blocks steam from filling it. Air must be vented for steam to reach the heating surface and condense; a failed vent leaves an air-bound, partly heated unit.

79. A — A thermodynamic (disc) trap operates on the velocity and pressure changes of flash steam across its disc. This makes it well suited to steam-main drips and outdoor service where its simple, freeze-resistant design is an advantage.

80. A — Opening a small bypass valve first warms the line gradually and lets condensate drain before full flow. This controlled warm-up prevents the rapid condensation and condensate slug that cause water hammer in a cold main.

81. D — Flooding and hammer at a heat exchanger match a trap failed closed, which backs condensate up into the equipment. The backed-up condensate floods the unit and hammers, distinct from a failed-open trap that blows live steam.

82. D — A steam line must be isolated, depressurized, and cooled to prevent severe steam and condensate burns. Steam holds enormous energy, and breaking a joint on a live or hot, pressurized line can release scalding fluid with fatal force.

83. B — In a fire-tube boiler, hot combustion gases pass through tubes surrounded by water. This simpler design suits lower-pressure heating, whereas a water-tube boiler runs water through tubes for higher pressures.

84. A — A drip leg collects condensate at a low point so the trap can remove it before it accumulates. Without drip legs and traps along a main, condensate builds up and causes water hammer.

85. C — gpm = Btuh ÷ (500 × ΔT) = 100,000 ÷ (500 × 20) = 100,000 ÷ 10,000 = 10 gpm. Recognizing the heat-transfer formula and substituting with consistent units gives the flow needed to meet the load.

86. A — A waterlogged or absent expansion tank explains pressure spiking and relief lifting on every heat-up. Water expands when heated, and without a functioning expansion tank that volume has nowhere to go, so the relief valve lifts.

87. B — Venting the trapped air is the immediate fix for an air-bound circuit. Air blocks circulation even with the pump running, so removing it through the air vents restores flow; raising pump speed or temperature does not clear the air.

88. C — Running a hand along a high-pressure hydraulic line is dangerous because a pinhole can inject oil through the skin. A fluid injection injury looks minor but is a surgical emergency, so leaks are sought with cardboard after depressurizing.

89. B — The FRL filters moisture, regulates pressure, and lubricates the air at the point of use. Water in the tools and rough operation point to FRL conditioning, which removes moisture and dirt and adds lubrication for air tools.

90. B — Charging without evacuation leaves moisture that forms acids and ice in the system. Acids attack components and ice blocks the expansion device, which is why refrigeration systems are evacuated to deep vacuum before charging.

91. C — The line must be isolated, drained, purged, and verified before cutting, never opened on the strength of a label alone. Residual corrosive product or pressure can remain after a label is read, so verification protects against chemical burns.

92. C — $\Delta T = Btuh \div (gpm \times 500) = 80{,}000 \div (8 \times 500) = 80{,}000 \div 4{,}000 = 20°F$. Rearranging the heat-transfer formula isolates the temperature difference across the loop for the given load and flow.

93. A — Cross-connection testing caught the mislabelled outlet, confirming each outlet delivers the correct gas. A cross-connected medical gas system can deliver the wrong gas to a patient and prove fatal, so independent verification before use is mandatory.

94. C — Inadequate feedwater treatment allowed scale to form on the heat-transfer surfaces. Scale insulates the metal, causing local overheating and lost efficiency, so water treatment is essential to protect the boiler.

95. B — Counterflow, with the streams moving in opposite directions, transfers the most heat. The opposing flow maintains a temperature difference along the whole exchanger, making it more effective than parallel flow.

96. D — Weak glycol concentration means the loop can freeze and rupture in the cold. The water/glycol mix provides freeze protection only at the correct concentration, so an under-strength solution leaves the loop vulnerable to a hard freeze.

97. C — The main should slope to drip points and drains to remove condensate; compressing air condenses water that must be drained. A back-sloping main with no drains lets water collect and carry into the tools, the fault observed.

98. C — Soft solder lacks the strength for high-pressure refrigerant service. Refrigeration joints are brazed because brazing melts above 450°C and produces a far stronger joint than soft solder can provide.

99. B — Balancing the flow to each zone with balancing valves corrects uneven heating. Without balancing, some circuits are starved while others are over-supplied; setting design flow to each zone evens out the output.

100. A — Flowing oil-free nitrogen through the tube during brazing prevents internal copper-oxide scale. That scale would otherwise break loose and contaminate the patient gas stream, so the purge is a mandatory medical-gas practice.

101. D — ASME B31.3 most commonly governs process piping design and construction, dictating materials, welding, and testing. Compliance ensures the hazardous-chemical system meets recognized safety and integrity standards.

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

103. B — A chilled-water system carries heat away by circulating cool water to a chiller. The water absorbs heat from the space and releases it at the chiller, the cooling counterpart of hydronic heating.

104. B — Liquids are incompressible while gases are compressible, which is why the hydraulic press feels rigid and the air cylinder feels cushioned. The compressibility of the fluid determines whether actuation is immediate or springy.

105. A — Cleaning the fouled heat-exchanger surfaces restores performance. Scale insulates the surface and reduces heat transfer, so periodic cleaning recovers the lost output rather than raising pressure or adding antifreeze.

106. D — Residual oil can ignite in an oxygen-rich line, which is why oxygen-service tube is specially cleaned and kept oil-free. Oxygen dramatically accelerates combustion, so any oil presents a serious fire hazard inside the line.

107. C — Fuel-gas lines are checked with approved leak-detection solution, never a flame. An open flame near a leak risks ignition, and smell alone is unreliable, so an approved solution or instrument is the correct, safe method.

108. A — A heat recovery ventilator transfers heat from outgoing exhaust air to incoming fresh air, saving heating energy without generating heat. The two air streams exchange heat through the core while staying separate.

109. A — An expansion tank absorbs the volume change of water as it heats and cools. Without it, expansion spikes the system pressure and lifts the relief valve, so the tank is essential in a closed hydronic loop.

110. B — Moisture in the un-evacuated line set formed acids and ice, leading to the compressor failure. Humid air left in refrigerant lines is the classic cause of acid formation and expansion-device icing, which evacuation prevents.

111. D — Isolate, drain, purge, then verify before breaking in protects the worker from a toxic, flammable process fluid. Verifying before cutting — not after — ensures no residual product or pressure remains, preventing exposure and fire.

112. A — The ground stays at a stable, moderate temperature year-round, so the ground-source heat pump remains efficient in cold weather. Air-source units lose efficiency as outdoor air drops, while the ground reservoir does not.

113. A — A vertical closed loop in deep boreholes suits a small urban lot with little land. Vertical loops need minimal surface area, making geo-exchange feasible where horizontal trenching is impossible.

114. D — Heat-fused HDPE gives a leak-free joint as strong as the pipe, ideal for a buried loop with no access for repair. Threaded, soldered, or solvent-cemented joints would become future leaks underground.

115. D — A direct open-loop solar system is wrong for hard freezes because potable water in the collector will freeze and burst. Freezing climates require an indirect closed-loop with antifreeze and a heat exchanger.

116. C — A collector overheating in strong sun with no heat drawn off is in stagnation. The system must handle the resulting high temperatures safely, and technicians must take care to avoid burns when servicing a stagnant collector.

117. A — Heat is delivered through a heat exchanger that keeps the antifreeze loop separate from the potable water. This prevents the antifreeze from mixing with drinking water while still capturing the solar heat.

118. B — With high-mineral, high-sediment water, the primary concern is that poor water quality will foul and corrode the open-loop system. Open loops draw actual groundwater, so the water resource quality governs their suitability.

119. C — A boiler economizer recovers flue-gas heat to preheat the feedwater. Capturing heat from the hot exhaust gases that would otherwise be lost improves overall boiler efficiency.

120. B — 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. D — The key danger of an unavoidable pneumatic test is the large stored energy that can release explosively. Compressed gas holds tremendous energy, so the test demands exclusion zones, gradual pressure steps, and rigorous precautions.

122. B — Rushing a start-up risks water hammer, equipment damage, and missed faults that proper sequencing would catch. Commissioning is gradual — confirm cleanliness and testing, fill and vent, start slowly, prove controls, then balance.

123. C — Safety relief valves must be confirmed correctly set and proven functional before turnover. They are the system's final protection against overpressure, so their operation is verified and recorded — never gagged, painted over, or removed.

124. A — As-built drawings must reflect what was actually installed, including field changes. An operator troubleshooting later relies on accurate as-builts, so handing over original-only drawings invites dangerous future mistakes.

125. A — Leaving the system full after a freezing-condition hydrostatic test risks trapped water freezing and rupturing the pipe. The test water must be fully drained, which also protects systems that must stay dry.

126. C — Steam lines are warmed slowly during controlled start-up, draining condensate as they heat. Admitting full pressure into a cold line causes severe water hammer, so gradual warm-up through a bypass is essential.

127. A — A turnover package should contain 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 — A slow pressure drop indicates a leak; the next step is to locate it, depressurize, repair, and retest. A pressure test only passes when it holds, so a drop must be resolved rather than recorded or ignored.

129. B — Wrong pump rotation gives low flow and poor performance, which is why rotation is checked at start-up. A pump running backward moves little fluid, so confirming correct rotation during commissioning prevents an undersupplied system.

130. A — Owner training matters so the operator can 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.