PRACTICE EXAM 11: RED SEAL STEAMFITTER/PIPEFITTER SIMULATION (130 QUESTIONS)

1. A confined-space entry requires continuous atmospheric monitoring. The lower explosive limit (LEL) reading on the meter climbs to 12%. What is the correct response?

A. Continue working since the reading is below 100% LEL

B. Increase ventilation and continue without re-testing

C. Evacuate, as readings at or above 10% LEL require withdrawal

D. Ignore the LEL channel and monitor only oxygen

2. What is the primary purpose of a hot work permit?

A. To control ignition sources and verify fire safeguards before cutting or welding

B. To document the welder's certification number

C. To schedule the welding machine rental

D. To record the ambient temperature of the shop

3. A worker must select gloves for handling a solvent listed on its SDS. Which SDS section identifies appropriate hand protection?

A. Section 2 — Hazard identification

B. Section 4 — First-aid measures

C. Section 9 — Physical properties

D. Section 8 — Exposure controls/personal protection

4. Why must abrasive cut-off wheels be stored flat and kept dry?

A. To make them easier to count for inventory

B. Moisture and warping weaken the wheel and can cause it to shatter in use

C. To preserve the manufacturer's label

D. To keep them at a constant electrical resistance

5. A fall-arrest harness shows a deployed (torn) energy-absorbing lanyard after a fall. What is the correct action?

A. Remove the entire system from service immediately

B. Repack the lanyard and continue using it

C. Use it only for travel restraint

D. Replace the buckle and keep the lanyard

6. What does the "competent person" designation on a worksite primarily require?

A. Holding a first-aid certificate only

B. Being the oldest worker on the crew

C. Knowledge of hazards plus authority to take corrective action

D. Possessing a valid driver's licence

7. A grinder wheel is rated 6,600 rpm. The grinder runs at 8,000 rpm. What is the hazard?

A. The wheel will run cooler than intended

B. The wheel may burst because operating speed exceeds its rated speed

C. The wheel will last longer at higher speed

D. There is no hazard if the guard is on

8. Why is housekeeping of the work area considered a safety control?

A. It improves the appearance for client visits

B. It reduces the material inventory required

C. It shortens the lunch break schedule

D. It eliminates slip, trip, and fire hazards from clutter and debris

9. A pipe-cutting machine requires a guard interlock. What is the function of the interlock?

A. To increase cutting speed automatically

B. To lubricate the cutting dies

C. To stop the machine if the guard is opened during operation

D. To record the number of cuts made

10. What is the primary reason for using a respirator fit test?

A. To verify the respirator forms an effective seal on the individual's face

B. To measure the worker's lung capacity

C. To check the colour of the cartridge

D. To determine the worker's height

11. A torque wrench reads in N·m but the bolt spec is given in ft·lb at 75 ft·lb. Using 1 ft·lb ≈ 1.356 N·m, what is the target torque in N·m?

A. 55 N·m

B. 75 N·m

C. 95 N·m

D. 102 N·m

12. What is the main purpose of a job hazard analysis (JHA) before a task?

A. To assign overtime hours

B. To break the task into steps and identify hazards and controls for each

C. To order replacement tools

D. To select the lunch vendor

13. Why must communication be confirmed (closed-loop) during a multi-trade lift?

A. To ensure instructions are received and understood, preventing errors

B. To reduce radio battery use

C. To shorten the workday

D. To avoid using hand signals entirely

14. A drawing shows a pipe dimension as 2"-150# RF flange. What does "150#" indicate?

A. The pipe's weight in pounds

B. The number of bolts required

C. The flange pressure class rating

D. The gasket thickness in inches

15. Using the offset constant for a 45° fitting (1.414), a fitter must run around an obstruction with a 600 mm offset. What is the travel (diagonal) length?

A. 424 mm

B. 848 mm

C. 600 mm

D. 1,200 mm

16. What is the purpose of a "tie-in" on a piping isometric?

A. To indicate the pipe's paint colour

B. To show the welder's identification

C. To mark a future demolition point

D. To show where new pipe connects to existing piping

17. A spool is fabricated 6 mm longer than the drawing dimension. What is the most likely consequence at installation?

A. The flow rate will increase

B. The pipe will weigh less

C. The spool will not align with mating flanges, forcing the joint

D. The insulation will fit better

18. Why is a "cut list" prepared before fabrication?

A. To specify each piece's length and quantity for efficient cutting

B. To schedule the crane lift

C. To record the welder's lunch break

D. To order the building permit

19. A 100 mm Schedule 40 carbon steel pipe must be threaded. What governs the correct thread length?

A. The pipe's colour code

B. The NPT taper standard for that pipe size

C. The ambient temperature

D. The weight of the threading machine

20. What is the purpose of an eccentric reducer in a horizontal pump suction line?

A. To increase the pipe diameter for storage

B. To add a drain point

C. To change the pipe material

D. To keep one side flat (top) and prevent air pockets

21. A weld joint requires a 1.6 mm root gap. The fitter sets the gap at 3 mm. What is the likely result?

A. Burn-through or excessive penetration at the root

B. Improved weld appearance

C. Faster cooling with no defect

D. Reduced filler metal use with no effect

22. What does the "schedule" number of a pipe primarily indicate?

A. The delivery date of the pipe

B. The pipe's installation sequence

C. The wall thickness relative to pressure rating

D. The pipe's colour code

23. A flange gasket is rated for 200°C service. The line operates at 250°C. What is the risk?

A. The gasket will perform better at higher temperature

B. The gasket may degrade and the joint may leak or fail

C. The flange bolts will loosen automatically

D. The pipe diameter will shrink

24. Why is a backing ring or consumable insert sometimes used in a pipe butt weld?

A. To increase the pipe's external diameter

B. To replace the need for a welding procedure

C. To change the pipe's colour

D. To support the root pass and ensure full penetration

25. A heat-tracing circuit on a 30 m line draws 10 W/m. What is the total connected load?

A. 300 W

B. 30 W

C. 3,000 W

D. 100 W

26. What is the purpose of a thermal expansion calculation before installing a long straight steam run?

A. To determine the pipe's resale value

B. To size expansion provisions and prevent stress damage

C. To select the pipe's colour

D. To schedule the lunch break

27. A gate valve and a globe valve are both available. For precise throttling of flow, which is correct and why?

A. Gate valve, because it has lower flow resistance

B. Either, because both throttle equally well

C. Neither, because valves cannot throttle

D. Globe valve, because its disc-and-seat design controls flow precisely

28. Why must a check valve be installed with attention to orientation?

A. The valve only closes against reverse flow when installed per its flow arrow

B. Orientation affects only the valve's colour

C. Orientation has no functional effect

D. It must always be installed vertically regardless of marking

29. A pipe support spacing table specifies maximum spans by pipe size. What happens if spans are exceeded?

A. Excessive sag, stress, and possible joint failure

B. Improved flow characteristics

C. Reduced material cost with no downside

D. Lower operating temperature

30. What is the purpose of a guided expansion joint in a piping run?

A. To increase the system pressure

B. To absorb axial movement while preventing buckling/misalignment

C. To filter the fluid

D. To reduce the pipe's wall thickness

31. Calculate the force on a blind flange: line pressure 700 kPa acting on an area of 0.02 m^2. Using Force = Pressure × Area, what is the force in newtons? (700 kPa = 700,000 Pa)

A. 1,400 N

B. 7,000 N

C. 700 N

D. 14,000 N

32. A two-leg bridle lifts a 2,000 kg load at a 60° angle from horizontal. Compared with a vertical lift, the tension in each leg is what?

A. Higher than half the load because of the angle

B. Exactly half the load regardless of angle

C. Less than half the load

D. Equal to the full load on each leg

33. What is the working load limit (WLL) concept based on?

A. The maximum load lifted in the past

B. The weight of the rigging hardware

C. The breaking strength reduced by a design (safety) factor

D. The crane's boom length

34. A wire rope sling has the formula for d^2 capacity. The most important pre-use action is what?

A. Painting the sling for identification

B. A documented inspection for damage and a verified rated capacity tag

C. Measuring the sling's temperature

D. Coiling it tightly for storage

35. During a tandem (two-crane) lift, what is the most critical coordination requirement?

A. Painting both cranes the same colour

B. Using the longest boom available

C. Lifting as fast as possible

D. A detailed lift plan with synchronized signals and load-share limits

36. A load chart shows reduced capacity at greater radius. Why does capacity decrease as radius increases?

A. The increased leverage (moment) reduces safe lifting capacity

B. The crane's engine weakens with distance

C. The wire rope shortens automatically

D. The load becomes lighter farther out

37. What is the purpose of cribbing under crane outriggers?

A. To raise the operator's seat

B. To distribute the load over a larger area and stabilize on soft ground

C. To store rigging hardware

D. To increase the boom length

38. A shackle is rated 4.75 t WLL. The calculated load on it is 5 t. What is the correct action?

A. Use it anyway since it is close

B. Reduce the safety factor to compensate

C. Select a shackle with adequate WLL for the load

D. Lift quickly to reduce the stress duration

39. Why must a load never be lifted over workers?

A. It blocks the operator's view of the load colour

B. It increases fuel consumption

C. It reduces the lift speed

D. A dropped or shifting load could strike personnel below

40. When using a chain hoist to position a valve, the load chain is twisted. What is the correct action?

A. Stop and remove the twist before lifting to prevent chain damage and load instability

B. Continue lifting to straighten the chain under load

C. Add oil to the twisted links

D. Lift faster to untwist it

41. A low-pressure steam boiler operates at 100 kPa gauge. Converting to psi (1 kPa = 0.145 psi), what is the pressure?

A. 100 psi

B. 7.25 psi

C. 14.5 psi

D. 1.45 psi

42. What is the primary function of a steam separator installed in a steam main?

A. To increase steam temperature

B. To remove entrained moisture, delivering drier steam downstream

C. To add water to the steam

D. To reduce the pipe diameter

43. A float-and-thermostatic (F&T) steam trap handles what conditions?

A. Heavy condensate loads with automatic air venting

B. Only superheated steam

C. Only vacuum service with no condensate

D. Compressed air filtration

44. Using EDR, 1 ft² of steam EDR = 240 Btuh. A radiator rated 50 ft² EDR delivers how much heat?

A. 4,800 Btuh

B. 12,000 Btuh

C. 6,000 Btuh

D. 24,000 Btuh

45. What causes a steam trap to "fail open," and what is the consequence?

A. A blocked orifice; condensate cannot drain

B. An over-tightened bonnet; the trap runs cold

C. A worn valve/seat; live steam blows through, wasting energy

D. Excess insulation; the trap overheats

46. A high-pressure steam system requires a blowdown procedure. What is its primary purpose?

A. To increase boiler pressure rapidly

B. To remove sludge, sediment, and dissolved solids from the boiler

C. To cool the steam piping

D. To add chemicals to the steam

47. Why is feedwater treatment critical in a steam boiler system?

A. To change the water's colour

B. To increase the water's flow rate

C. To make the water heavier

D. To prevent scale, corrosion, and carryover that damage the system

48. A steam main must be sloped in the direction of flow. What is the purpose?

A. To carry condensate to drip legs and prevent water hammer

B. To increase steam velocity dangerously

C. To reduce the number of supports

D. To change the steam colour

49. What is the function of a desuperheater in a steam system?

A. To increase steam superheat

B. To filter the steam

C. To reduce steam temperature toward saturation by adding water

D. To pressurize the boiler

50. A safety valve on a high-pressure boiler "chatters" (rapidly opens and closes). What is a likely cause?

A. The valve set pressure is too high for the system

B. Oversized valve or excessive inlet pressure drop causing instability

C. The boiler is operating below design pressure

D. The valve is brand new

51. A condensate pump is short-cycling. Using system logic, the most likely cause is what?

A. A receiver level control or float switch set with too narrow a band or malfunctioning

B. The pump is painted the wrong colour

C. The steam pressure is too low

D. The pipe insulation is too thick

52. What is the purpose of a steam pressure-reducing station with two valves in series?

A. To increase the pressure in two stages

B. To filter the steam twice

C. To add redundant gauges only

D. To reduce pressure in stages for stable control across a large pressure drop

53. Why must high-pressure steam piping be properly anchored and guided?

A. To control thermal expansion forces and direct movement safely

B. To increase the steam temperature

C. To reduce the pipe's weight

D. To change the steam colour

54. A boiler's water column gauge glass shows no visible water. What is the immediate concern and action?

A. The boiler is overfilled; open the vent

B. Possible low-water condition; verify level and follow low-water emergency procedure

C. The gauge glass is too clean; ignore it

D. The steam pressure is too low; add fuel

55. What is the role of a steam trap's "subcooling" in some thermostatic designs?

A. It holds condensate until it cools below saturation, conserving flash steam

B. It heats the condensate above steam temperature

C. It filters the steam supply

D. It increases the boiler pressure

56. A high-pressure condensate return is flashing in the receiver. What component recovers this energy?

A. A larger boiler

B. A simple gate valve

C. A check valve only

D. A flash tank that captures and reuses the flash steam

57. Using Btuh = gpm × 500 × ΔT, a hydronic system delivers 240,000 Btuh at a 20°F ΔT. What is the required flow rate?

A. 12 gpm

B. 24 gpm

C. 48 gpm

D. 6 gpm

58. What is the purpose of a primary-secondary piping arrangement in a hydronic system?

A. To increase the system pressure dramatically

B. To eliminate the need for pumps

C. To hydraulically decouple loops so flows do not interfere

D. To reduce the water temperature only

59. A circulator pump curve crosses the system curve at the operating point. What does this point represent?

A. The actual flow and head at which the pump will operate in the system

B. The pump's maximum possible speed

C. The pipe's wall thickness

D. The fluid's colour

60. Why is a backflow preventer required where a boiler make-up line connects to potable water?

A. To increase make-up flow rate

B. To heat the incoming water

C. To soften the water automatically

D. To prevent treated boiler water from contaminating the potable supply

61. A process line carries a slurry with abrasive particles. What design consideration reduces erosion at changes in direction?

A. Using the thinnest available pipe wall

B. Using long-radius elbows and erosion-resistant materials

C. Increasing the flow velocity sharply

D. Removing all supports

62. What does a hydraulic system accumulator primarily do?

A. Store pressurized fluid energy and dampen pressure fluctuations

B. Filter the hydraulic fluid only

C. Increase the fluid temperature

D. Reduce the system to atmospheric pressure

63. In an HVACR system, low refrigerant charge typically produces what symptom?

A. Excessively high suction pressure

B. Flooded compressor with liquid slugging

C. Constant high head pressure with no change

D. Low suction pressure and poor cooling capacity

64. Why must a medical gas system be installed with brazed (not soldered) copper joints?

A. Soldered joints are easier to inspect

B. Brazing is faster than soldering

C. Brazed joints provide higher strength and integrity for the service

D. Solder changes the gas colour

65. A compressed air receiver tank serves what primary function?

A. To increase the compressor speed

B. To store air and dampen pulsations, providing steady supply

C. To filter incoming city water

D. To heat the compressed air

66. A pneumatic system loses pressure overnight with no equipment running. What is the most logical diagnosis?

A. A leak in the distribution piping or fittings

B. The compressor is oversized

C. The air is too cold

D. The receiver is painted incorrectly

67. What is the purpose of a moisture trap/separator in a compressed air line feeding instruments?

A. To add lubricant to the air

B. To increase the air pressure

C. To remove condensed water that would damage instruments

D. To change the air's colour

68. A fuel gas line must be purged before commissioning. Why?

A. To increase the gas pressure

B. To paint the interior of the pipe

C. To test the pipe colour

D. To remove air so a combustible mixture does not form at start-up

69. Why are medical gas outlets gas-specific (non-interchangeable) by design?

A. To match the room's paint scheme

B. To prevent connecting equipment to the wrong gas, protecting patients

C. To reduce installation cost

D. To increase the gas flow rate

70. A hydraulic cylinder drifts down under load when the valve is centered. What is the likely cause?

A. Internal leakage past the cylinder seals or valve spool

B. The cylinder is painted incorrectly

C. The fluid is too cold to flow

D. The pump is oversized

71. A geo-exchange system's ground loop shows declining performance over a season. What is a likely cause?

A. The heat pump is too new

B. The building is too small

C. Loss of loop fluid or air entrainment reducing heat transfer

D. The thermostat colour faded

72. Why must a horizontal ground loop be installed below the frost line?

A. To reduce excavation cost

B. To make the loop easier to inspect

C. To keep it visible from the surface

D. To access stable ground temperature and avoid freeze-affected soil

73. A solar thermal system uses a drainback design. What is its main advantage?

A. It eliminates the need for a collector

B. Collector fluid drains to a tank when the pump stops, preventing freezing/overheating

C. It generates electricity directly

D. It requires no piping

74. What is the function of a differential temperature controller in a solar thermal system?

A. To start the pump when the collector is hotter than storage by a set margin

B. To increase the collector's surface area

C. To filter the heat-transfer fluid

D. To pressurize the storage tank

75. A heat recovery ventilator's efficiency is measured by what?

A. The colour of the core

B. The number of fans installed

C. The percentage of heat transferred from exhaust to supply air

D. The size of the ductwork only

76. Why is loop-field flushing and purging critical before charging a geothermal system?

A. To paint the loop interior

B. To increase the loop diameter

C. To test the loop colour

D. To remove air and debris that would impair circulation and heat transfer

77. A solar collector array is connected in series. What is the effect compared with parallel connection?

A. Higher temperature rise but increased flow resistance

B. Lower outlet temperature always

C. No effect on performance

D. Reduced collector area

78. What is the primary maintenance task for a geo-exchange system's circulating pump?

A. Painting the pump housing

B. Checking for leaks, proper flow, and correct loop pressure

C. Replacing the collector glass

D. Adding refrigerant to the loop

79. Before commissioning, why is a system "walk-down" with the design documents performed?

A. To schedule the crew's vacation

B. To order additional pipe

C. To select the building's paint colour

D. To verify the installation matches the design and identify deficiencies

80. A hydrostatic test holds 1,035 kPa for the required duration with no pressure drop. What does this confirm?

A. The system colour is correct

B. The fluid temperature is correct

C. The system is leak-tight and structurally sound at test pressure

D. The pipe is the wrong schedule

81. Why must air be vented from a hydronic system during commissioning?

A. Trapped air causes noise, poor circulation, and reduced heat transfer

B. Air increases the system efficiency

C. Air lowers the pump's required head

D. Air improves the water colour

82. A pump runs but delivers no flow at start-up. What is the most likely cause?

A. The motor is too powerful

B. The pump is air-bound or not primed

C. The pipe is too short

D. The fluid is too clean

83. What is verified by a "point-to-point" check during controls commissioning?

A. The paint matches between panels

B. The crew's hours worked

C. The pipe's wall thickness

D. That each field device correctly maps to its control point/signal

84. During start-up, a relief valve lifts below its set pressure repeatedly. What is the corrective focus?

A. Increase the system operating pressure to match

B. Remove the relief valve entirely

C. Verify the set pressure, seat condition, and operating margin

D. Paint the valve to mark it as tested

85. Why is balancing performed after a hydronic system is filled and air-free?

A. To distribute design flow to each circuit for even performance

B. To increase the system's total pressure only

C. To reduce the number of circuits

D. To change the water temperature permanently

86. A turnover package must include commissioning records. Why are these records important?

A. They change the pipe colour

B. They document that tests passed and the system meets design intent

C. They schedule the demolition

D. They list the crew's lunch orders

87. What is the purpose of functional performance testing during commissioning?

A. To verify equipment and controls operate correctly under real conditions

B. To paint the equipment

C. To measure the room's floor area

D. To order replacement parts

88. A commissioned chilled-water system shows uneven cooling across zones. What is the likely commissioning gap?

A. The pipe colour was wrong

B. The system was overfilled with refrigerant

C. The ductwork was painted

D. Incomplete or incorrect balancing of flow to the zones

89. Why is a final documented sign-off required before owner turnover?

A. It formally confirms the system is complete, tested, and safe to operate

B. It transfers liability to the apprentice

C. It eliminates the warranty

D. It sets the building's tax rate

90. During commissioning, a pump's measured flow is far below design. After confirming rotation, what is the next logical check?

A. The pump's paint finish

B. The operator's certification

C. A closed/throttled valve or clogged strainer restricting flow

D. The colour of the impeller

91. What does an "as-built" drawing reflect?

A. The original design before any changes

B. The system as actually installed, including field modifications

C. The manufacturer's catalogue only

D. The crew's daily schedule

92. A safety relief valve discharge pipe must be sized and routed how?

A. As small as possible to save material

B. With no support, hanging freely

C. Capped at the end to prevent debris entry

D. Full-size or larger, supported, and routed to a safe discharge point

93. Why is a steam trap survey conducted as part of system maintenance?

A. To identify failed traps that waste steam or cause water hammer

B. To paint each trap

C. To count the traps for inventory only

D. To measure the room temperature

94. A pressure gauge reads erratically on a commissioned pump discharge. After checking the gauge, what is the next logical cause?

A. The pipe is the wrong colour

B. The gauge is too large

C. Pump cavitation or pulsation in the line

D. The insulation is too thick

95. Why must isolation valves be tagged during commissioning and turnover?

A. To indicate their position and prevent unsafe operation

B. To change their colour permanently

C. To increase the flow rate

D. To reduce the valve count

96. A long copper line will expand 25 mm when heated. What provision accommodates this?

A. Rigidly anchoring both ends

B. An expansion loop, offset, or expansion joint

C. Reducing the pipe diameter

D. Removing all supports

97. Why are dissimilar-metal connections (copper to steel) a corrosion concern?

A. Galvanic action corrodes the less noble metal without isolation

B. The pipe colour changes

C. The flow rate increases

D. The pipe becomes lighter

98. A pipe must penetrate a fire-rated wall. What is required at the penetration?

A. An oversized hole left open for ventilation

B. No special treatment is needed

C. A listed firestop system maintaining the wall's fire rating

D. A coat of paint over the opening

99. What is the purpose of a vibration isolator under a pump base?

A. To increase the pump's flow rate

B. To raise the pump's operating temperature

C. To change the pump's colour

D. To reduce transmission of vibration and noise to the structure

100. A threaded joint on a high-pressure line is leaking. The fitter applies more sealant over the leaking joint while pressurized. Why is this incorrect?

A. It improves the joint permanently

B. Sealant cannot seal a pressurized active leak; the joint must be depressurized and remade

C. It increases the flow rate

D. It changes the pipe colour

101. A pump's net positive suction head available (NPSHA) must exceed what for reliable operation?

A. The net positive suction head required (NPSHR) by the pump

B. The discharge pressure

C. The pipe's wall thickness

D. The fluid's colour

102. Why is pipe deburring/reaming important after cutting tubing for a flared joint?

A. To change the tube colour

B. To increase the tube diameter

C. A clean, burr-free end is needed for a leak-free flare and full bore

D. To reduce the wall thickness

103. A pressure-relief valve's "blowdown" refers to what?

A. The pipe's colour after testing

B. The bolt torque on the flange

C. The valve's weight

D. The pressure drop below set pressure before the valve reseats

104. Why must valve packing be properly adjusted on a control valve stem?

A. To change the valve colour

B. To seal against stem leakage without binding the stem

C. To increase the flow rate

D. To reduce the valve's weight

105. A pipe alignment for welding shows high-low (mismatch) at the joint. What is the correct action?

A. Realign the pipe ends to within tolerance before welding

B. Weld over the mismatch and grind it smooth

C. Add extra filler to hide it

D. Ignore it since it self-corrects

106. Why is preheat sometimes required before welding thick-wall or high-carbon pipe?

A. To change the pipe colour

B. To speed up the cooling rate

C. To reduce cracking by slowing cooling and reducing thermal shock

D. To increase the pipe diameter

107. A steam coil in an air handler is freezing in winter. What is the most likely cause?

A. The coil is painted incorrectly

B. Condensate not draining (failed trap or vacuum), allowing water to freeze

C. The steam is too hot

D. The air filter is too clean

108. What is the function of a strainer's blowdown valve?

A. To change the strainer colour

B. To increase the system pressure

C. To increase the flow rate

D. To flush accumulated debris from the strainer without disassembly

109. A pump coupling is found misaligned during inspection. What is the consequence of running it misaligned?

A. Premature wear of bearings, seals, and the coupling

B. Improved efficiency

C. Lower operating temperature

D. No effect on the pump

110. Why is a torque sequence and final torque value specified for flange bolts?

A. To change the bolt colour

B. To increase the gasket thickness

C. To achieve uniform gasket compression and a leak-free seal

D. To reduce the number of bolts

111. A condensate line is undersized for the flash steam it carries. What symptom results?

A. The line runs cooler than expected

B. Back-pressure and waterlogging that impair trap operation

C. Improved drainage

D. Reduced corrosion

112. What is the purpose of a "weep hole" in a pipe sleeve or support detail?

A. To allow drainage and detect leakage

B. To increase the pipe diameter

C. To change the pipe colour

D. To add structural strength

113. A relief valve is removed for testing and reinstalled. Why must it be reset and sealed by a qualified person?

A. To change its colour

B. To increase the system pressure

C. To reduce the valve count

D. To ensure it opens at the correct set pressure protecting the system

114. Why must a globe valve be installed so flow follows the body's directional arrow?

A. To change the valve colour

B. To reduce the bolt count

C. So pressure assists seating and minimizes erosion and chatter

D. To increase the pipe diameter

115. A pipe is being cold-sprung during installation. What is the purpose of cold springing?

A. To pre-stress the pipe to offset thermal expansion forces in service

B. To change the pipe colour

C. To reduce the pipe's weight

D. To increase the flow rate

116. What is the consequence of installing a steam trap without a strainer upstream?

A. Debris can foul the trap, causing it to fail or stick

B. The trap operates more efficiently

C. The steam runs cooler

D. The trap needs no maintenance

117. A welded pipe joint must be inspected for porosity. Which method detects internal porosity?

A. Visual inspection of the surface only

B. Measuring the pipe length

C. Weighing the pipe

D. Radiographic (X-ray) or ultrasonic examination

118. Why is a flexible connector installed at a pump's suction and discharge?

A. To change the pump colour

B. To increase the flow rate

C. To absorb vibration and minor misalignment, protecting connected piping

D. To reduce the pipe schedule

119. A drawing calls for a "FW" notation at a joint. What does FW indicate?

A. Field weld — to be welded on site rather than in the shop

B. Flow Width

C. Final Wash

D. Forward Wall

120. What is the purpose of a "high-point vent" and "low-point drain" in a piping system?

A. To change the pipe colour at those points

B. To vent trapped air at high points and drain liquid at low points

C. To increase pressure at the high point

D. To reduce the pipe diameter

121. A pump is cavitating due to a clogged suction strainer. The immediate corrective action is what?

A. Increase the discharge throttling

B. Run the pump faster to clear it

C. Add more fluid to the discharge

D. Shut down, clean the strainer, and restore adequate suction flow

122. Why must expansion joints be installed with the proper preset/cold position?

A. To change their colour

B. To increase the system pressure

C. So the joint accommodates the full thermal movement range without bottoming out

D. To reduce the bolt count

123. A steam system's pressure gauge reads higher than the relief valve set pressure, yet the valve has not lifted. What is the most serious concern?

A. A stuck or failed relief valve creating an overpressure hazard

B. The gauge is too accurate

C. The steam is too dry

D. The pipe is the wrong colour

124. What is the function of an orifice plate in a process flow measurement?

A. To stop all flow permanently

B. To create a measurable pressure drop proportional to flow rate

C. To heat the fluid

D. To change the fluid colour

125. Why is a system pressure-tested in sections rather than all at once on a large project?

A. To change the pipe colour in stages

B. To use less test water overall

C. To reduce the number of welds

D. To isolate and locate leaks more easily and limit risk

126. A control valve hunts (oscillates) around setpoint. What is a likely cause?

A. Improper controller tuning or an oversized valve for the flow range

B. The valve is painted incorrectly

C. The pipe is too short

D. The fluid is too clean

127. What is the purpose of a sacrificial anode in a steel tank or system?

A. To corrode preferentially and protect the steel from corrosion

B. To increase the tank pressure

C. To change the water colour

D. To heat the water

128. Why must a newly installed gas line have its joints tested with a leak-detection solution or instrument?

A. To change the joint colour

B. To confirm no leaks exist before placing the line in service

C. To increase the gas pressure

D. To reduce the pipe schedule

129. A pump seal is leaking steadily. For a mechanical seal, what is the likely cause?

A. The pump is painted incorrectly

B. The fluid is too clean

C. The pipe is too short

D. Worn or damaged seal faces requiring replacement

130. What is the final verification before a steam system is released for normal operation?

A. The equipment room is painted

B. All isolation valves are removed

C. The power is permanently disconnected

D. All tests pass, safeties are proven, and documentation is signed off

Practice Exam 11: Answer Key and Explanations

1. C — Evacuate, as readings at or above 10% LEL require withdrawal. Standard confined-space practice sets 10% LEL as the action limit because flammable atmospheres can build rapidly and unpredictably. Withdrawing at this threshold leaves a safety margin well below the explosive range.

2. A — To control ignition sources and verify fire safeguards before cutting or welding. A hot work permit forces a formal check that combustibles are removed, fire watch is posted, and extinguishers are ready. This system prevents the fires that commonly result from sparks and hot slag.

3. D — Section 8 — Exposure controls/personal protection. SDS Section 8 lists required PPE, including glove material, along with exposure limits and engineering controls. Consulting it ensures the glove resists the specific solvent rather than guessing.

4. B — Moisture and warping weaken the wheel and can cause it to shatter in use. Abrasive wheels absorb moisture and distort if stored poorly, compromising their structural integrity. A weakened wheel can burst at speed, the most severe grinder hazard.

5. A — Remove the entire system from service immediately. A deployed energy absorber means the system has arrested a fall and is no longer reliable. Personal fall-arrest equipment subjected to fall forces must be retired, not repaired or reused.

6. C — Knowledge of hazards plus authority to take corrective action. A competent person is defined by both recognizing hazards and having the authority to correct them. Knowledge alone without authority cannot stop unsafe conditions, so both elements are required.

7. B — The wheel may burst because operating speed exceeds its rated speed. Running a wheel above its rated rpm generates centrifugal force beyond its design limit, risking explosive failure. Wheel and tool speed ratings must always match.

8. D — It eliminates slip, trip, and fire hazards from clutter and debris. Good housekeeping removes the accumulated materials that cause falls and feed fires. It is a recognized engineering/administrative control, not merely cosmetic.

9. C — To stop the machine if the guard is opened during operation. A guard interlock cuts power when the guard is opened, preventing contact with moving parts. This protects the operator from the cutting hazard during the machine cycle.

10. A — To verify the respirator forms an effective seal on the individual's face. A fit test confirms the specific respirator seals on that worker's face, since face shapes vary. A poor seal lets contaminated air bypass the filter, defeating protection.

11. D — 102 N·m. Multiplying 75 ft·lb × 1.356 N·m/ft·lb gives 101.7, rounded to 102 N·m. Converting torque units correctly ensures the bolt receives its specified preload.

12. B — To break the task into steps and identify hazards and controls for each. A JHA analyzes each task step to find hazards and assign controls before work begins. This proactive method prevents incidents rather than reacting to them.

13. A — To ensure instructions are received and understood, preventing errors. Closed-loop communication has the receiver repeat back the message so the sender confirms understanding. On a complex lift, this prevents miscommunication that could cause an accident.

14. C — The flange pressure class rating. The "150#" designation identifies the flange's ANSI/ASME pressure class, governing its pressure-temperature limits. Matching class ratings ensures the joint is rated for the service.

15. B — 848 mm. Travel equals offset × 1.414, so 600 × 1.414 = 848 mm. This 45° constant from the formula sheet gives the diagonal pipe length for the offset.

16. D — To show where new pipe connects to existing piping. A tie-in marks the interface between new work and existing systems on the isometric. Identifying tie-ins is essential for coordinating shutdowns and fit-up.

17. C — The spool will not align with mating flanges, forcing the joint. An over-length spool throws off the face-to-face dimension, so flanges will not meet cleanly. Forcing the joint induces stress and leakage, which is why dimensional accuracy is critical.

18. A — To specify each piece's length and quantity for efficient cutting. A cut list itemizes every piece's dimension and count so material is cut accurately with minimal waste. It drives efficient, error-free fabrication.

19. B — The NPT taper standard for that pipe size. Thread length is governed by the National Pipe Taper standard, which defines engagement for each size. Following NPT specs ensures a proper, leak-tight threaded joint.

20. D — To keep one side flat (top) and prevent air pockets. An eccentric reducer installed flat-side-up keeps the top of the line level on a pump suction, avoiding air pockets that cause cavitation. This protects pump performance.

21. A — Burn-through or excessive penetration at the root. A root gap nearly double the spec lets too much heat and filler reach the root, causing burn-through. Correct fit-up gap is essential for a sound root pass.

22. C — The wall thickness relative to pressure rating. Pipe schedule denotes wall thickness for a given size, which determines pressure capability. Higher schedules mean thicker walls for higher-pressure service.

23. B — The gasket may degrade and the joint may leak or fail. Operating above the gasket's temperature rating breaks down the material, leading to loss of seal. Gaskets must be selected for the actual service temperature.

24. D — To support the root pass and ensure full penetration. A backing ring or consumable insert backs the joint so the root fuses fully without burn-through. This produces a sound, fully penetrated weld root.

25. A — 300 W. Total load equals 10 W/m × 30 m = 300 W. Calculating connected load correctly sizes the circuit and controls for the heat-tracing system.

26. B — To size expansion provisions and prevent stress damage. Thermal expansion calculations quantify the pipe's growth so loops or joints can be sized to absorb it. Without this, expansion stress can buckle pipe or fail joints.

27. D — Globe valve, because its disc-and-seat design controls flow precisely. The globe valve's plug-and-seat geometry allows fine, stable throttling. A gate valve throttled partly open suffers seat erosion and vibration, so it is unsuitable.

28. A — The valve only closes against reverse flow when installed per its flow arrow. A check valve is directional; installing it backward prevents normal flow or fails to stop backflow. The flow arrow must match the intended direction.

29. A — Excessive sag, stress, and possible joint failure. Exceeding maximum support spans lets the pipe sag, overstressing the material and joints. Proper spacing maintains alignment and prevents failure.

30. B — To absorb axial movement while preventing buckling/misalignment. A guided expansion joint takes up axial thermal movement while guides keep it aligned and stable. This prevents the joint from squirming or buckling under pressure and movement.

31. D — 14,000 N. Force = Pressure × Area = 700,000 Pa × 0.02 m² = 14,000 N. Calculating thrust on a blind flange verifies bolts and the flange withstand the end load.

32. A — Higher than half the load because of the angle. At any angle below vertical, each sling leg carries more than half the load due to the horizontal force component. This is why sling angle must be accounted for when rating a lift.

33. C — The breaking strength reduced by a design (safety) factor. Working load limit is the breaking strength divided by a design factor, giving a safe margin below failure. This ensures hardware operates well within its capacity.

34. B — A documented inspection for damage and a verified rated capacity tag. Before use, a wire rope sling must be inspected for damage and carry a legible rated-capacity tag. This confirms it is sound and rated for the lift.

35. D — A detailed lift plan with synchronized signals and load-share limits. A tandem lift demands a plan defining each crane's load share and synchronized movement under one signaler. Coordination prevents overloading either crane or losing control.

36. A — The increased leverage (moment) reduces safe lifting capacity. As radius grows, the load's moment about the crane increases, so rated capacity drops to maintain stability. Load charts reflect this radius-capacity relationship.

37. B — To distribute the load over a larger area and stabilize on soft ground. Cribbing spreads the outrigger force over more area, lowering ground pressure and preventing the crane from settling. Stable footing is essential for a safe lift.

38. C — Select a shackle with adequate WLL for the load. A shackle must have a WLL meeting or exceeding the calculated load; 4.75 t is below the 5 t load. Choosing properly rated hardware preserves the safety margin.

39. D — A dropped or shifting load could strike personnel below. Lifting over workers exposes them to being struck if the load falls or swings. Keeping personnel out from under suspended loads is a fundamental rigging rule.

40. A — Stop and remove the twist before lifting to prevent chain damage and load instability. A twisted load chain can kink, weaken, and cause the load to spin or jam. The twist must be cleared before applying load.

41. C — 14.5 psi. Converting 100 kPa × 0.145 psi/kPa = 14.5 psi. This confirms the boiler is at the low-pressure steam limit of about 15 psi.

42. B — To remove entrained moisture, delivering drier steam downstream. A steam separator mechanically removes water droplets carried in the steam, improving dryness. Drier steam improves heat transfer and reduces erosion and water hammer.

43. A — Heavy condensate loads with automatic air venting. A float-and-thermostatic trap discharges large condensate loads via the float while the thermostatic element vents air. This makes it ideal for high-load heat-exchange equipment.

44. B — 12,000 Btuh. Output equals 50 ft^2 × 240 Btuh/ft^2 = 12,000 Btuh, using the steam EDR conversion from the formula sheet. This lets a fitter size radiation and piping to the building's heat load.

45. C — A worn valve/seat; live steam blows through, wasting energy. A trap fails open when its valve or seat wears, letting live steam escape continuously to the condensate side. This wastes energy and can overload the return system.

46. B — To remove sludge, sediment, and dissolved solids from the boiler. Blowdown expels accumulated solids and sludge that concentrate in the boiler water. This controls water chemistry and prevents scale and carryover.

47. D — To prevent scale, corrosion, and carryover that damage the system. Feedwater treatment removes hardness, oxygen, and impurities that cause scale and corrosion. Proper treatment protects the boiler and maintains efficiency.

48. A — To carry condensate to drip legs and prevent water hammer. Sloping the main toward drip points lets condensate drain rather than collect. Removing condensate prevents the slugging that causes water hammer.

49. C — To reduce steam temperature toward saturation by adding water. A desuperheater injects water to lower superheated steam temperature toward saturation for process needs. This delivers steam at the required controlled temperature.

50. B — Oversized valve or excessive inlet pressure drop causing instability. Chatter results when an oversized valve or high inlet pressure loss makes the valve cycle rapidly. This damages the seat, so sizing and inlet piping must be corrected.

51. A — A receiver level control or float switch set with too narrow a band or malfunctioning. Short-cycling points to a level control that switches the pump on and off over too small a range or is faulty. Adjusting or repairing the control restores normal operation.

52. D — To reduce pressure in stages for stable control across a large pressure drop. Two PRVs in series split a large pressure reduction into stages, giving stable control and less wear. Single-stage reduction across a big drop causes instability and noise.

53. A — To control thermal expansion forces and direct movement safely. Anchors and guides fix reference points and steer thermal growth into expansion provisions. This prevents damaging forces on equipment and supports.

54. B — Possible low-water condition; verify level and follow low-water emergency procedure. No visible water may indicate a dangerous low-water condition risking dry-firing. The operator must confirm the true level and follow emergency procedures immediately.

55. A — It holds condensate until it cools below saturation, conserving flash steam. Subcooling traps retain condensate until it drops below saturation temperature, reducing flash steam loss. This improves energy efficiency in suitable applications.

56. D — A flash tank that captures and reuses the flash steam. A flash tank separates and reuses the steam released when hot condensate drops in pressure. Recovering flash steam returns usable energy to the system.

57. B — 24 gpm. Rearranging Btuh = gpm × 500 × ΔT gives gpm = 240,000 ÷ (500 × 20) = 24 gpm. This sizes the required flow for the heating load.

58. C — To hydraulically decouple loops so flows do not interfere. Primary-secondary piping uses common piping so each loop's pump sees its own circuit without affecting others. This simplifies control of multiple loads on one system.

59. A — The actual flow and head at which the pump will operate in the system. The intersection of pump and system curves defines the real operating flow and head. This determines whether the pump suits the application.

60. D — To prevent treated boiler water from contaminating the potable supply. A backflow preventer stops chemically treated boiler water from siphoning back into potable water. This protects public health at the cross-connection.

61. B — Using long-radius elbows and erosion-resistant materials. Long-radius elbows reduce turbulence and impingement at direction changes, lowering erosion from abrasive slurry. Erosion-resistant materials extend service life.

62. A — Store pressurized fluid energy and dampen pressure fluctuations. A hydraulic accumulator stores energy under pressure and smooths pulsations or supplies surge demand. This stabilizes the system and protects components.

63. D — Low suction pressure and poor cooling capacity. A low refrigerant charge starves the evaporator, dropping suction pressure and reducing cooling. These symptoms point to an undercharge or leak.

64. C — Brazed joints provide higher strength and integrity for the service. Medical gas piping is brazed because brazed copper joints are stronger and more reliable than soldered ones. Joint integrity is critical for life-safety gas systems.

65. B — To store air and dampen pulsations, providing steady supply. An air receiver stores compressed air to meet demand surges and smooths compressor pulsations. This stabilizes system pressure and reduces compressor cycling.

66. A — A leak in the distribution piping or fittings. Pressure loss with nothing running indicates the air is escaping through leaks in piping or fittings. Leak detection and repair restores the system.

67. C — To remove condensed water that would damage instruments. A moisture separator removes water from the air supply that would otherwise foul or corrode sensitive instruments. Dry air is essential for instrument reliability.

68. D — To remove air so a combustible mixture does not form at start-up. Purging displaces air from the line so no flammable air-gas mixture exists when gas is introduced. This prevents an explosion hazard at commissioning.

69. B — To prevent connecting equipment to the wrong gas, protecting patients. Gas-specific outlets physically prevent attaching a device to the wrong gas. This is a critical patient-safety safeguard against misadministration.

70. A — Internal leakage past the cylinder seals or valve spool. Cylinder drift with the valve centered means fluid is bypassing internally through worn seals or the spool. Replacing the worn component stops the drift.

71. C — Loss of loop fluid or air entrainment reducing heat transfer. Declining loop performance often stems from lost fluid or trapped air that interrupts circulation and heat exchange. Restoring fluid and purging air corrects it.

72. D — To access stable ground temperature and avoid freeze-affected soil. Installing below the frost line places the loop in stable-temperature ground unaffected by surface freezing. This ensures consistent heat exchange year-round.

73. B — Collector fluid drains to a tank when the pump stops, preventing freezing/overheating. In a drainback system, fluid returns to a tank whenever the pump is off, so it cannot freeze or stagnate hot in the collector. This passively protects the array.

74. A — To start the pump when the collector is hotter than storage by a set margin. A differential controller compares collector and storage temperatures and runs the pump only when useful heat is available. This maximizes solar collection efficiency.

75. C — The percentage of heat transferred from exhaust to supply air. HRV efficiency is the fraction of heat recovered from the exhaust stream into incoming fresh air. Higher percentages mean greater energy savings.

76. D — To remove air and debris that would impair circulation and heat transfer. Flushing and purging clears air pockets and construction debris from the loop before charging. Clean, air-free loops circulate properly and transfer heat efficiently.

77. A — Higher temperature rise but increased flow resistance. Series-connected collectors raise the fluid through each in turn, giving a larger temperature rise but more pressure drop. This trade-off is chosen when higher output temperature is needed.

78. B — Checking for leaks, proper flow, and correct loop pressure. Routine circulating-pump maintenance verifies the loop is sealed, flowing, and at correct pressure. These checks keep the geo-exchange system performing.

79. D — To verify the installation matches the design and identify deficiencies. A walk-down compares the installed system against drawings to confirm conformance and catch defects. This is a key pre-commissioning quality step.

80. C — The system is leak-tight and structurally sound at test pressure. Holding test pressure with no drop proves the system has no leaks and withstands the pressure. This confirms mechanical integrity before service.

81. A — Trapped air causes noise, poor circulation, and reduced heat transfer. Air pockets impede flow, create noise, and block heat exchange in a hydronic loop. Venting air is essential for proper commissioning.

82. B — The pump is air-bound or not primed. A pump that runs without delivering flow is typically air-bound or unprimed, so the impeller cannot move liquid. Priming and venting restores flow.

83. D — That each field device correctly maps to its control point/signal. Point-to-point checking verifies every sensor and actuator corresponds to the correct control signal. This confirms the control system is wired and programmed correctly.

84. C — Verify the set pressure, seat condition, and operating margin. A valve lifting below set pressure suggests an incorrect setting, damaged seat, or too small a margin above operating pressure. Correcting these stops the premature lifting.

85. A — To distribute design flow to each circuit for even performance. Balancing sets the correct flow to each circuit so all zones receive design heating or cooling. This prevents starved or overserved areas.

86. B — They document that tests passed and the system meets design intent. Commissioning records prove the required tests were completed and passed. This documentation supports owner acceptance and future maintenance.

87. C — To verify equipment and controls operate correctly under real conditions. Functional performance testing runs the system through its sequences to confirm it works as designed. It validates real operation, not just installation.

88. D — Incomplete or incorrect balancing of flow to the zones. Uneven cooling indicates the flow to each zone was not properly balanced during commissioning. Re-balancing corrects the distribution.

89. A — It formally confirms the system is complete, tested, and safe to operate. A documented sign-off is the formal record that the system meets design and is ready for the owner. It is the gate before turnover.

90. C — A closed/throttled valve or clogged strainer restricting flow. With rotation confirmed, low flow most likely results from a closed valve or fouled strainer in the line. Clearing the restriction restores design flow.

91. B — The system as actually installed, including field modifications. As-built drawings record the system exactly as installed, capturing any field changes. They are essential for future operation and maintenance.

92. D — Full-size or larger, supported, and routed to a safe discharge point. A relief discharge line must be at least full port, supported, and directed where discharge harms no one. Undersized or unsupported piping can restrict relief or fail.

93. A — To identify failed traps that waste steam or cause water hammer. A trap survey finds traps that have failed open or closed, which waste steam or cause water hammer. Locating them guides repair and energy savings.

94. C — Pump cavitation or pulsation in the line. After ruling out the gauge, erratic discharge pressure points to cavitation or flow pulsation. Correcting suction conditions stabilizes the reading.

95. A — To indicate their position and prevent unsafe operation. Tagging isolation valves shows their required position so they are not operated incorrectly. This protects against unsafe startup or isolation errors.

96. B — An expansion loop, offset, or expansion joint. A 25 mm thermal growth must be absorbed by a loop, offset, or joint that flexes. Rigidly anchoring both ends would induce damaging stress.

97. A — Galvanic action corrodes the less noble metal without isolation. Joining copper and steel forms a galvanic cell that corrodes the steel unless a dielectric fitting isolates them. Isolation prevents premature joint failure.

98. C — A listed firestop system maintaining the wall's fire rating. A pipe through a fire-rated wall requires a listed firestop to preserve the rating. This stops fire and smoke spread through the penetration.

99. D — To reduce transmission of vibration and noise to the structure. Vibration isolators under a pump absorb vibration so it is not transmitted into the building structure. This reduces noise and protects connected piping.

100. B — Sealant cannot seal a pressurized active leak; the joint must be depressurized and remade. Applying sealant over a live, pressurized leak cannot create a seal and gives a false fix. The line must be isolated, depressurized, and the joint properly remade.

101. A — The net positive suction head required (NPSHR) by the pump. NPSHA must exceed the pump's NPSHR to prevent cavitation. Adequate margin ensures the liquid stays above its vapour pressure at the impeller.

102. C — A clean, burr-free end is needed for a leak-free flare and full bore. Burrs prevent a proper flare and restrict flow, so the tube end must be reamed clean. This ensures a tight, full-bore flared joint.

103. D — The pressure drop below set pressure before the valve reseats. Blowdown is the difference between set pressure and reseat pressure on a relief valve. Proper blowdown prevents chatter and ensures the valve closes cleanly.

104. B — To seal against stem leakage without binding the stem. Packing must be tight enough to stop stem leakage yet loose enough to let the stem move freely. Correct adjustment balances sealing and operability.

105. A — Realign the pipe ends to within tolerance before welding. High-low mismatch must be corrected by realignment before welding to ensure a sound joint. Welding over mismatch creates stress risers and defects.

106. C — To reduce cracking by slowing cooling and reducing thermal shock. Preheat slows the weld's cooling rate, reducing hardening and cracking in thick or high-carbon pipe. This produces a sound, crack-free weld.

107. B — Condensate not draining (failed trap or vacuum), allowing water to freeze. A coil freezes when condensate cannot drain and pools, then freezes in cold air. A failed trap or vacuum condition is the usual cause.

108. D — To flush accumulated debris from the strainer without disassembly. A blowdown valve lets the strainer be flushed of trapped debris under pressure without opening it. This simplifies maintenance and maintains flow.

109. A — Premature wear of bearings, seals, and the coupling. Running a misaligned coupling imposes cyclic loads that wear bearings, seals, and the coupling quickly. Proper alignment extends equipment life.

110. C — To achieve uniform gasket compression and a leak-free seal. A specified torque sequence and value compress the gasket evenly across the flange. Uniform compression is essential for a reliable, leak-free joint.

111. B — Back-pressure and waterlogging that impair trap operation. An undersized condensate line cannot pass the flash steam volume, raising back-pressure and waterlogging the system. This prevents traps from discharging properly.

112. A — To allow drainage and detect leakage. A weep hole lets accumulated liquid drain and makes a leak visible for early detection. This protects the surrounding structure and signals problems.

113. D — To ensure it opens at the correct set pressure protecting the system. A relief valve must be reset and sealed by a qualified person so it lifts at the proper pressure. This guarantees overpressure protection is intact.

114. C — So pressure assists seating and minimizes erosion and chatter. Installing a globe valve per its flow arrow lets line pressure help seat the disc, reducing erosion and chatter. Reverse flow causes premature wear.

115. A — To pre-stress the pipe to offset thermal expansion forces in service. Cold springing installs the pipe with a deliberate pre-stress so thermal growth is partly offset at operating temperature. This reduces peak stresses on anchors and equipment.

116. A — Debris can foul the trap, causing it to fail or stick. Without an upstream strainer, dirt and scale reach the trap and jam its mechanism. The strainer protects the trap and keeps it operating.

117. D — Radiographic (X-ray) or ultrasonic examination. Internal porosity is detected by radiographic or ultrasonic methods that see inside the weld. Surface inspection alone cannot reveal subsurface defects.

118. C — To absorb vibration and minor misalignment, protecting connected piping. Flexible connectors at the pump dampen vibration and accommodate slight misalignment. This protects the piping and reduces transmitted noise.

119. A — Field weld — to be welded on site rather than in the shop. "FW" on a drawing designates a field weld made on site during installation. Identifying field welds helps plan fabrication versus on-site work.

120. B — To vent trapped air at high points and drain liquid at low points. High-point vents release trapped air and low-point drains remove liquid. Together they allow proper filling, venting, and draining of the system.

121. D — Shut down, clean the strainer, and restore adequate suction flow. Cavitation from a clogged suction strainer is corrected by stopping the pump and clearing the restriction. Restoring suction flow eliminates the cavitation and protects the impeller.

122. C — So the joint accommodates the full thermal movement range without bottoming out. Presetting an expansion joint to the correct cold position lets it absorb the full range of movement. Incorrect presetting causes it to bottom out or overextend.

123. A — A stuck or failed relief valve creating an overpressure hazard. Pressure above the set point without the valve lifting indicates a stuck or failed relief valve, leaving the system unprotected. This is a serious overpressure hazard requiring immediate action.

124. B — To create a measurable pressure drop proportional to flow rate. An orifice plate produces a pressure differential that relates to flow rate for measurement. This is a common, reliable flow-measurement method.

125. D — To isolate and locate leaks more easily and limit risk. Testing in sections confines any leak to a smaller area for easier location and limits the stored energy at risk. This makes large-project testing safer and more manageable.

126. A — Improper controller tuning or an oversized valve for the flow range. Hunting around setpoint usually means poor tuning or a valve too large to control the flow finely. Retuning or resizing stabilizes the loop.

127. A — To corrode preferentially and protect the steel from corrosion. A sacrificial anode of a more active metal corrodes in place of the steel, protecting it. This galvanic protection extends tank and system life.

128. B — To confirm no leaks exist before placing the line in service. Leak-testing every joint verifies the gas line is tight before commissioning. This prevents gas escape and the resulting fire or explosion hazard.

129. D — Worn or damaged seal faces requiring replacement. Steady mechanical-seal leakage indicates worn or damaged seal faces that no longer seal. Replacing the seal stops the leak.

130. A — All tests pass, safeties are proven, and documentation is signed off. A steam system is released only after all tests pass, safety devices are proven, and records are signed off. This confirms it is safe and ready for normal operation.