PRACTICE EXAM 9: RED SEAL STEAMFITTER/PIPEFITTER SIMULATION (130 QUESTIONS)

1. A steamfitter calculates that a 60 m run of carbon steel pipe will be heated from 15 °C to 215 °C. Using a coefficient of expansion of approximately 0.0000117 m/m·°C, what is the approximate total expansion?

A. About 140 mm of growth over the full length, requiring an expansion provision in the run

B. About 14 mm, small enough to be absorbed by the natural flexibility of the pipe alone

C. About 1.4 mm, negligible for a run of this length under normal operating temperatures

D. About 1400 mm, which would make the run impossible to support with standard hangers

2. A worker is about to enter a 3 m deep trench to install underground piping. The soil is previously disturbed fill. What is the correct protective measure?

A. Enter quickly to complete the connection before the trench walls have time to shift

B. Place a worker at the top edge to watch for any movement of the trench walls below

C. Slope the upper edges only and leave the lower vertical face unsupported for access

D. Use a protective system such as shoring, sloping, or a trench box before any entry

3. A pump curve shows the relationship between flow and head. As flow rate increases, the head produced by a centrifugal pump generally:

A. Increases proportionally, since more flow requires the pump to generate more pressure

B. Remains perfectly constant across the entire operating range of the pump at fixed speed

C. Decreases, following the downward-sloping characteristic curve of the centrifugal pump

D. Rises sharply to a peak and then returns to exactly zero at maximum rated flow output

4. A steamfitter must select pipe for a 1035 kPa saturated steam line. The saturation temperature at this pressure is approximately:

A. 100 °C, the boiling point of water that applies to all steam systems regardless of pressure

B. 150 °C, a fixed value used for sizing all low-pressure heating distribution piping systems

C. 184 °C, reflecting that saturation temperature rises with pressure above atmospheric levels

D. 260 °C, which corresponds to a highly superheated condition well above saturation point

5. During a confined-space entry to repair a tank, the attendant outside loses radio contact with the entrant. The correct action is to:

A. Initiate the emergency response procedure rather than entering the space to investigate

B. Enter the space immediately to locate the entrant and assess what has gone wrong inside

C. Wait several minutes to see whether contact is restored before taking any further action

D. Shut all valves to the tank and assume the entrant has simply stepped out of radio range

6. A flanged joint rated Class 150 is being specified. The class number primarily indicates the flange's:

A. Outside diameter in millimetres at the bolt circle where the connecting bolts pass through

B. Number of bolt holes arranged evenly around the circumference of the mating flange face

C. Pressure-temperature rating, defining allowable pressure that decreases as temperature rises

D. Gasket thickness in thousandths of an inch required between the two mating flange faces

7. A steamfitter measures 1.5 turns of usable thread engagement on a hand-threaded 1" NPT pipe. If the thread make-up is too shallow, the most likely result is:

A. The fitting will be impossible to start onto the pipe threads without cross-threading badly

B. The thread sealant will cure too quickly before the joint can be properly tightened down

C. The pipe outside diameter will increase beyond the standard tolerance for the nominal size

D. The joint will leak under pressure because insufficient thread engagement cannot seal fully

8. A two-stage air compressor delivers air to a receiver at 860 kPa. The receiver's primary purpose is to:

A. Store compressed air and dampen pulsations so supply can meet fluctuating demand smoothly

B. Increase the final discharge pressure above what the second compression stage can produce

C. Cool the incoming ambient air before it enters the first stage of the compression process

D. Filter oil mist from the compressed air before it is distributed to the plant air tools

9. A steam trap is suspected of failing closed. The symptom that confirms this is:

A. Continuous live steam blowing through the trap discharge into the condensate return line

B. Condensate backing up ahead of the trap, causing water hammer and reduced heat output

C. The trap body running cold while the inlet line shows full operating steam temperature

D. A rapid clicking sound from the trap as it cycles open and closed many times per minute

10. A pipefitter must calculate the cut length of pipe between two 90° threaded elbows. The centre-to-centre dimension is 800 mm, and each elbow has a take-out of 35 mm with a thread engagement of 16 mm. The cut pipe length is:

A. 730 mm, found by subtracting both take-outs and both thread engagements from the centre dimension

B. 762 mm, found by subtracting the two take-outs and adding back the two thread engagements

C. 800 mm, since the centre-to-centre dimension already equals the required cut length of pipe

D. 870 mm, found by adding both take-outs and both thread engagements to the centre dimension

11. A hydronic system serving a four-storey building reads 240 kPa at the boiler in the basement. The pressure at the top floor, 12 m higher, will be approximately:

A. 122 kPa, reduced by the static head of the 12 m water column above the basement gauge

B. 240 kPa, because pressure in a closed loop is identical at every point regardless of height

C. 358 kPa, increased by the head of the water column as elevation rises through the building

D. 480 kPa, doubled because the top floor is at the farthest point from the circulating pump

12. A pipefitter notices a globe valve installed so flow enters above the disc and exits below. This installation is:

A. Incorrect, because globe valves are normally installed so flow enters below the disc and seat

B. Correct, since globe valves are bidirectional and the flow direction has no effect on function

C. Correct only if the valve is used for throttling rather than for full isolation of the line

D. Incorrect only when the valve is mounted vertically rather than in a horizontal pipe run

13. When sizing a relief valve for a steam boiler, the relieving capacity must be at least equal to the:

A. Volume of the boiler's water side measured between the low- and high-water cutoff levels

B. Average steam demand of the building's heating load during the coldest expected weather

C. Capacity of the feedwater pump at its maximum rated discharge flow under full pressure

D. Maximum steam generating capacity of the boiler at its maximum allowable working pressure

14. A steamfitter is commissioning a hydronic loop and finds one zone is not heating. The pump runs and other zones work. The most likely cause is:

A. The boiler is undersized for the total connected heating load of the entire building

B. The expansion tank has become waterlogged and lost its ability to control pressure

C. The main circulating pump is rotating in the reverse direction from its designed rotation

D. An air pocket or a closed valve is blocking flow through that particular zone's circuit

15. A weld procedure calls for a 2 mm root gap on a butt joint. The purpose of the root gap is to:

A. Reduce the total volume of filler metal needed to complete the multi-pass welded joint

B. Allow the two pipe ends to be aligned more quickly during the fit-up before tacking

C. Permit full penetration of the root pass so the weld fuses completely through the joint

D. Provide space for thermal expansion of the pipe ends as the weld zone is heated up

16. A pipefitter reads a specification calling for "Schedule 80" pipe instead of "Schedule 40" for the same nominal size. Compared to Schedule 40, the Schedule 80 pipe has:

A. A larger outside diameter, allowing it to thread into oversized fittings of the same class

B. A thicker wall and smaller inside bore, giving it a higher pressure rating for the service

C. A lighter weight per metre, making it easier to handle and support over long horizontal runs

D. A lower carbon content, improving its weldability for high-temperature steam applications

17. A relief valve on a hot-water heating system is discharging intermittently. The most likely cause is a:

A. Circulating pump that is running too slowly to maintain adequate flow through the boiler

B. Steam trap downstream that has failed open and is bleeding pressure from the system

C. Strainer that has become clogged and is restricting flow to the building's heating zones

D. Waterlogged or failed expansion tank, allowing pressure to rise as the water is heated

18. A steamfitter must determine the offset travel for a 22.5° offset where the set is 400 mm. The constant for a 22.5° offset is 2.613. The travel is approximately:

A. 153 mm, found by dividing the set by the offset constant for the 22.5° angle of the fitting

B. 400 mm, equal to the set because at small offset angles the travel and set are the same value

C. 1045 mm, found by multiplying the set of 400 mm by the 22.5° offset constant of 2.613

D. 2613 mm, the offset constant applied directly as the travel regardless of the set distance

19. A boiler's combustion is producing yellow, lazy flames and soot. This indicates:

A. Excess combustion air is cooling the flame and producing the characteristic yellow colour

B. Incomplete combustion from insufficient air, risking carbon monoxide and sooting of surfaces

C. The fuel-air mixture is correctly balanced and the burner is operating at peak efficiency

D. The pilot flame has failed and the main burner is operating on residual gas in the manifold

20. A pipefitter must support a copper hot-water line. The correct hanger material is one that:

A. Maximizes the contact area between dissimilar metals to improve the electrical bond

B. Is made of plain carbon steel to provide the strongest possible support for the line

C. Allows the copper to corrode sacrificially, protecting the steel structure above it

D. Is copper-plated or isolated to prevent galvanic corrosion between the copper and steel

21. A steamfitter encounters a refrigerant labelled A1 under the ASHRAE safety classification. This designation means the refrigerant is:

A. Lower toxicity and no flame propagation, the safest combination in the classification system

B. Higher toxicity and highly flammable, requiring the most stringent handling precautions

C. Lower toxicity but mildly flammable, requiring leak detection in occupied machinery spaces

D. Higher toxicity and non-flammable, used only in sealed industrial process applications

22. During pump alignment, a dial indicator reads a difference of 0.5 mm across the coupling faces. This measurement checks for:

A. The axial end-float of the pump shaft as it moves in and out of the bearing housing

B. The total run-out of the impeller relative to the volute casing at operating speed

C. The amount of grease remaining in the coupling housing before the next service interval

D. Angular misalignment, where the shafts meet at an angle rather than being parallel

23. A steamfitter is told to install a "swing check" valve on a pump discharge. This valve type:

A. Reduces the discharge pressure to a constant value set by an adjustable spring mechanism

B. Throttles the pump output to match the system demand by partially closing the flow area

C. Uses a hinged disc that swings open with forward flow and closes against reverse flow

D. Isolates the pump for maintenance by sealing tightly when the handwheel is fully closed

24. A pressure gauge reads 700 kPa gauge. The absolute pressure is approximately:

A. 801 kPa, found by adding atmospheric pressure of about 101 kPa to the gauge reading

B. 599 kPa, found by subtracting atmospheric pressure of about 101 kPa from the reading

C. 700 kPa, since gauge and absolute pressure are identical at normal operating conditions

D. 1400 kPa, found by doubling the gauge reading to account for the atmospheric component

25. A steamfitter must braze a copper joint that will carry high-pressure refrigerant. The filler metal chosen should be:

A. A soft 50/50 tin-lead solder, which melts at low temperature and is easy to apply quickly

B. A pure tin solder, selected because it contains no lead and is approved for potable water

C. A silver-bearing brazing alloy that produces a strong, high-temperature joint for the service

D. An aluminum-based filler rod, chosen for its light weight and resistance to corrosion damage

26. A steam main is being warmed up after a shutdown. The drip legs and traps must be open so that:

A. Air can enter the line to equalize the pressure before steam is admitted to the main

B. The steam velocity is increased to carry condensate through the line more rapidly

C. Condensate formed during warmup is removed before it can cause damaging water hammer

D. The main reaches operating pressure as quickly as possible to minimize heat loss period

27. A steamfitter calculates flow through a pipe and finds the velocity is too high, causing erosion and noise. To reduce velocity for the same flow rate, the correct action is to:

A. Increase the system pressure so the fluid is compressed into a smaller effective volume

B. Add more elbows and fittings to the run to dissipate the excess energy in the flow

C. Raise the temperature of the fluid to reduce its density and therefore its momentum

D. Install a larger-diameter pipe, since velocity decreases as the cross-sectional area increases

28. A pipefitter is asked to identify a "Y-type strainer." Its defining feature is a:

A. Spherical body containing a floating ball that rises to block flow when debris collects

B. Screen element set in a branch angled off the main flow path like the leg of the letter Y

C. Pair of parallel screens that alternate in service so one can be cleaned while flowing

D. Magnetic rod inserted into the flow to capture only ferrous particles from the stream

29. A steamfitter must determine why a centrifugal pump is drawing excessive motor current. A likely cause is:

A. The suction line is partially blocked, starving the pump and reducing its power draw

B. The discharge valve is closed, deadheading the pump and minimizing its energy demand

C. The pump is operating far out on its curve at high flow, overloading the driving motor

D. Cavitation has reduced the effective flow, lowering the load on the motor windings

30. A welder must avoid arc strikes on the pipe surface outside the weld joint because they:

A. Create localized hardened spots that can become crack initiation sites under stress

B. Improve the surface finish of the pipe by removing scale at the point of the strike

C. Increase the wall thickness slightly where the molten metal is deposited on the surface

D. Have no effect on the pipe and are simply an aesthetic concern for the finished work

31. A steamfitter installs a backflow preventer on a make-up water line to a boiler. Its purpose is to:

A. Reduce the city water pressure to the lower pressure required by the boiler feed system

B. Prevent treated or contaminated boiler water from flowing back into the potable supply

C. Meter the volume of make-up water added to the system for water-treatment dosing

D. Filter sediment from the incoming city water before it reaches the boiler feed pump

32. A pipefitter reads "FNPT" on a fitting specification. This indicates the fitting has:

A. A flared end designed to seal against a matching flared tube without any thread sealant

B. A flat face suitable for a full-faced gasket between two bolted flange connections

C. A grooved end requiring a mechanical coupling with a gasket seated in the groove

D. Female National Pipe Taper threads, the internal tapered threads that receive a male pipe end

33. A steamfitter is told a pump is "deadheading." This dangerous condition means the pump is:

A. Running dry with no liquid in the casing, allowing the impeller to spin freely in air

B. Operating at its best efficiency point with the discharge valve set to the design opening

C. Running against a closed discharge, churning the same liquid and overheating it rapidly

D. Spinning backward because two of the three motor phase leads have been reversed

34. A boiler feedwater system uses a deaerator. Its primary function is to:

A. Remove dissolved oxygen and other gases from the feedwater to reduce corrosion

B. Increase the dissolved oxygen content to improve heat transfer in the boiler tubes

C. Add chemical treatment to the feedwater at a precisely metered injection rate

D. Cool the returning condensate before it enters the boiler feed pump suction line

35. A pipefitter must thread a long run and finds the threads are torn and rough. The most likely cause is:

A. The pipe was cut too short, leaving insufficient length for full thread engagement

B. The die was turned too slowly, allowing the threads to cool between each cutting pass

C. The pipe diameter was larger than the nominal size marked on the supplier's label

D. Insufficient or wrong cutting oil was used, causing the dies to tear rather than cut cleanly

36. A steam system has a pressure-reducing station feeding a low-pressure main. A relief valve is installed downstream of the PRV to:

A. Maintain the upstream high pressure if the reducing valve begins to close unexpectedly

B. Protect the low-pressure main if the reducing valve fails open and passes high pressure

C. Drain condensate that accumulates in the low-pressure main during normal operation

D. Vent air from the low-pressure main automatically each time the system is started up

37. A steamfitter must select a gasket for a flange carrying 200 °C steam. A suitable choice is:

A. A compressed non-asbestos fibre or spiral-wound gasket rated for the temperature and pressure

B. A natural rubber gasket, valued for its excellent compression and low cost in this service

C. A cork gasket, chosen for its ability to absorb vibration from nearby rotating equipment

D. A paper gasket coated with grease to help it conform to the irregular flange surface

38. A pipefitter encounters water hammer in a pump discharge line each time the pump stops. The best solution is to:

A. Increase the pump speed so it builds pressure faster and prevents the column separation

B. Remove the check valve so the flow can reverse freely and dissipate the pressure surge

C. Reduce the pipe diameter to increase velocity and carry the surge through more quickly

D. Install a slow-closing check valve or surge arrestor to control the momentum change

39. A steamfitter calculates the area of a circle to find pipe cross-section. For a pipe with 100 mm inside diameter, the cross-sectional area is approximately:

A. 7854 mm^2, found using the formula pi times the radius squared with a 50 mm radius

B. 314 mm^2, found by multiplying pi by the 100 mm diameter without squaring the radius

C. 31 416 mm^2, found by multiplying pi by the diameter squared without dividing by four

D. 100 mm^2, equal to the diameter itself since the bore determines the flow area directly

40. A pipefitter must install a steam trap on a heat exchanger that experiences varying load. The best trap choice for modulating loads is generally a:

A. Thermodynamic disc trap, preferred for its single moving part on superheated steam mains

B. Float and thermostatic (F&T) trap, which handles varying condensate loads and removes air

C. Inverted bucket trap, chosen specifically for its resistance to water hammer on long mains

D. Fixed orifice trap, selected because it has no moving parts and never needs any servicing

41. A steamfitter reads that a system must be "purged" of air before a pressure test. Failing to purge air before a hydrostatic test would:

A. Make the test pressure rise too slowly because water cannot compress to fill the lines

B. Cause the water to freeze in the lines before the required hold time has been reached

C. Leave a compressible air pocket that stores energy and falsifies the pressure-hold reading

D. Improve the accuracy of the test by cushioning the system against sudden pressure spikes

42. A pipefitter is installing pipe through a fire-rated floor assembly. The penetration must be sealed with a firestop system that:

A. Allows smoke to pass freely while blocking only the flames from spreading between floors

B. Provides a watertight seal only, since fire ratings do not apply to floor penetrations

C. Permits the pipe to slide freely so it can be removed without disturbing the assembly

D. Restores the fire-resistance rating of the floor for the rated time period at the opening

43. A steamfitter measures superheat at an evaporator outlet as 2 °C when the target is 8 °C. This low superheat indicates:

A. The evaporator is starved of refrigerant and the metering device is feeding too little

B. The condenser is rejecting insufficient heat, raising the high-side pressure excessively

C. The compressor is undersized for the connected evaporator load on this particular system

D. The metering device is overfeeding, risking liquid floodback to the compressor suction

44. A pipefitter must determine the bolt-up torque sequence for a 12-bolt flange. The correct first four bolts to tighten are:

A. In a crossing star pattern across the flange, so compression is distributed evenly around it

B. The four adjacent bolts at the top of the flange, working clockwise around to the bottom

C. The four bolts nearest the gasket seam, to seat that area before moving outward around it

D. All twelve bolts hand-tight first, then a single full-torque pass clockwise around the flange

45. A steamfitter notices a hydronic system constantly loses pressure and must be refilled. The most likely cause is:

A. The expansion tank is oversized for the volume of water contained in the closed loop

B. A leak somewhere in the system, or a relief valve weeping due to excess system pressure

C. The circulating pump is running too fast and forcing water out through the air vents

D. The boiler is operating below its rated temperature, contracting the water in the loop

46. A welder is qualifying for a 6G pipe weld position. The 6G position means the pipe is fixed at:

A. A vertical orientation with the axis straight up and down, welded all the way around it

B. A horizontal orientation with the axis level, rotated during welding for easier access

C. A 45° inclined angle, fixed and not rotated, requiring welding in all positions at once

D. A flat orientation laid on a bench, welded only along the top accessible surface of the joint

47. A steamfitter must size feedwater piping to a boiler. The feedwater pump must develop a discharge pressure that:

A. Exactly equals the boiler operating pressure so the water enters without any extra margin

B. Exceeds the boiler pressure plus piping losses so water can be forced into the boiler drum

C. Is lower than the boiler pressure so steam pressure assists the water into the boiler shell

D. Matches the city water pressure available at the building's incoming service connection

48. A pipefitter encounters a "spectacle blind" in a process line. This device is used to:

A. Throttle flow continuously by rotating a perforated disc into the path of the stream

B. Filter large debris from the flow using a coarse mesh mounted between two flanges

C. Reduce the pipe size at a flanged connection between two different diameter sections

D. Positively isolate a line by swinging a solid blank into place between two flanges

49. A steamfitter must select PPE for cutting and grinding galvanized pipe. Beyond eye protection, a key concern is:

A. Hearing protection only, since galvanized coatings produce no harmful fumes when heated

B. Cut-resistant gloves only, since the zinc coating poses no inhalation risk during the work

C. Steel-toed boots only, because the main hazard is dropping the heavy pipe on the foot

D. Respiratory protection, because heating zinc coatings releases fumes that cause metal fume fever

50. A pipefitter must verify a 90° elbow is truly square during fit-up. The correct tool is a:

A. Dial caliper measuring the inside diameter at two points around the elbow circumference

B. Framing square or combination square checked against the two faces of the fitting

C. Feeler gauge inserted into the root gap to confirm the spacing between the pipe ends

D. Plumb bob hung from the top of the elbow to mark the centreline on the floor below

51. A steamfitter finds a boiler short-cycling rapidly on its operating control. A likely cause is:

A. The boiler is badly undersized for the connected building heating load during cold weather

B. The expansion tank is correctly sized and maintaining stable pressure across the loop

C. The circulating pump has failed completely, stopping all flow through the heating system

D. The differential setting on the operating control is too narrow, cycling the burner too often

52. A pipefitter must lubricate a valve stem on a rising-stem gate valve. The correct lubricant is one that:

A. Hardens into a solid film to permanently lock the stem against any further movement

B. Conducts electricity to bond the valve body to the connected piping for grounding

C. Is compatible with the service fluid and rated for the operating temperature of the valve

D. Dissolves in the process fluid so excess lubricant is carried away and never accumulates

53. A steamfitter must determine the developed length of pipe needed for a 90° bend with a centreline radius of 300 mm. The arc length is approximately:

A. 471 mm, found using one quarter of the circumference at the 300 mm centreline radius

B. 300 mm, equal to the radius because a 90° bend turns the pipe through one radius length

C. 600 mm, equal to the diameter of the bend measured straight across the curved section

D. 1885 mm, the full circumference of a circle with the 300 mm centreline bending radius

54. A pipefitter installs a thermometer well (thermowell) in a pipe so that:

A. The thermometer reads the ambient room temperature rather than the fluid temperature

B. A temperature sensor can be removed or replaced without draining or depressurizing the line

C. The flow velocity is measured by the drag force of the fluid against the well's surface

D. The pipe wall is reinforced at the point where the branch connection has weakened it

55. A steamfitter is told a steam system operates at "15 psig." Converted to approximate gauge pressure in kPa, this is:

A. About 15 kPa, since psig and kPa are nearly equivalent units of pressure measurement

B. About 50 kPa, found by multiplying the psig value by a conversion factor near three

C. About 103 kPa, found by multiplying 15 psi by the factor of approximately 6.9 kPa per psi

D. About 1500 kPa, found by multiplying the psig reading by one hundred for the conversion

56. A pipefitter must connect copper tube to a steel valve in a heating system. To prevent galvanic corrosion, the correct fitting is a:

A. Standard brass coupling threaded directly onto both the copper and the steel components

B. Welded transition joint fusing the copper and steel directly together at the connection

C. Compression fitting that grips both metals tightly to exclude moisture from the joint

D. Dielectric union or fitting that electrically isolates the copper from the steel valve

57. A steamfitter observes that a relief valve has been "gagged" shut with a clamp during operation. This is:

A. An acceptable temporary practice during commissioning to prevent nuisance lifting of the valve

B. Required by code whenever the system is operating above its normal design pressure setting

C. An extremely dangerous and prohibited practice that defeats the system's overpressure protection

D. A normal method of adjusting the relief valve set pressure to a higher operating value

58. A pipefitter calculates that a tank holds 5000 L and must be filled in 50 minutes. The required flow rate is:

A. 50 L/min, found by dividing the tank volume by ten regardless of the fill time given

B. 100 L/min, found by dividing the 5000 L volume by the 50-minute required fill time

C. 250 L/min, found by multiplying the fill time by five to account for the line losses

D. 500 L/min, found by dividing the volume by the fill time and then multiplying by five

59. A steamfitter must commission a new gas-fired boiler. Before lighting, the gas piping must be purged to:

A. Increase the gas pressure at the burner manifold to the maximum the regulator allows

B. Remove air from the piping so a stable, ignitable gas mixture reaches the burner safely

C. Test the structural strength of the gas piping by pressurizing it well above service pressure

D. Lubricate the gas valve seats with a film of oil before the first ignition of the burner

60. A pipefitter must select a valve for frequent throttling of steam to a process. The most appropriate choice is a:

A. Globe valve, because its disc-and-seat design is built for controllable throttling service

B. Gate valve, because its wedge disc gives the finest possible control of partial flow rates

C. Ball valve, because its quarter-turn action provides smooth proportional flow adjustment

D. Check valve, because it automatically modulates flow in response to downstream demand

61. A steamfitter reviews a P&ID and sees a valve symbol with a diagonal line and a spring above it. This typically represents a:

A. Manually operated gate valve with a rising stem indicated by the diagonal line shown

B. Spring-loaded relief or safety valve, with the spring symbol denoting the set-point mechanism

C. Three-way mixing valve combining two inlet streams into a single controlled outlet flow

D. Motorized control valve driven by an electric actuator mounted on the valve bonnet

62. A pipefitter must support a long horizontal steam line that will expand. The supports between anchors should be:

A. Roller or sliding supports that allow the line to move axially as it heats and cools

B. Rigid clamps that lock the pipe firmly to prevent any movement at every support point

C. Spring hangers at every support to carry the full vertical load through the expansion

D. Removable supports that are taken out during operation and replaced when the line is cold

63. A steamfitter measures the discharge of a steam trap and finds it discharges condensate intermittently in slugs. For an inverted bucket trap, this is:

A. A sign the trap has failed and is passing live steam continuously into the return line

B. Evidence the trap is undersized and cannot keep up with the condensate load present

C. Normal operation, since the inverted bucket trap discharges in cyclic, intermittent bursts

D. An indication the trap has lost its prime and is blowing through without trapping anything

64. A pipefitter must determine which pipe schedule to use for a higher-pressure application. As pressure rises for a given material and diameter, the required:

A. Outside diameter increases while the wall thickness stays constant for the nominal size

B. Inside diameter increases to allow more flow at the higher operating pressure of the line

C. Pipe length must be shortened to reduce the total stress accumulated along the run

D. Wall thickness increases, calling for a higher schedule number to contain the pressure

65. A steamfitter encounters a "Hartford loop" on a low-pressure steam boiler. Removing it would:

A. Risk the boiler losing its water through a return-line failure, exposing it to dry-firing damage

B. Improve the circulation of condensate back to the boiler by reducing the return-line restriction

C. Have no effect because the Hartford loop is purely a code-required labelling arrangement

D. Lower the steam pressure delivered to the radiators on the building's upper floors

66. A pipefitter calculates the total head loss in a system as 8 m of friction plus 4 m of static lift plus a required 3 m residual pressure at the outlet. The pump must develop at least:

A. 15 m of total head, found by adding the friction, static lift, and residual pressure together

B. 12 m of total head, found by adding only the friction loss and the static lift components

C. 5 m of total head, found by subtracting the static lift from the sum of the other two values

D. 4 m of total head, found by using only the static lift since friction losses are negligible

67. A steamfitter must select tubing for a medical compressed-gas system. The tubing must be:

A. Standard refrigeration-grade copper cleaned on site with ordinary solvent before brazing

B. Specially cleaned and capped medical-gas tubing, brazed under a nitrogen purge for cleanliness

C. Galvanized steel pipe, chosen for its corrosion resistance in the humid hospital environment

D. PVC plastic pipe, selected because it is inexpensive and easy to assemble with solvent cement

68. A pipefitter observes that a centrifugal pump's mechanical seal is leaking steadily. The correct response is to:

A. Identify the cause and replace the seal, since a steady leak indicates seal failure or wear

B. Tighten the seal gland nut as hard as possible to crush the faces together and stop the leak

C. Ignore it, since all mechanical seals are designed to leak continuously during normal operation

D. Increase the pump speed to build pressure that will force the leaking faces back together

69. A steamfitter is asked the difference between "saturated" and "superheated" steam. Superheated steam is steam that has been:

A. Cooled below its saturation temperature so it begins to condense back into liquid water

B. Heated above its saturation temperature at a given pressure, containing no liquid moisture

C. Mixed with entrained water droplets, lowering its quality below the dry saturated point

D. Generated at exactly the saturation temperature with no additional heat added to the vapour

70. A pipefitter must install an air vent on a hydronic system. The correct location is at the:

A. Lowest point of the system, where air naturally settles due to its higher density than water

B. Highest point of the system, where air collects because it rises above the circulating water

C. Pump discharge, where the pressure is highest and forces air out through the vent quickly

D. Boiler outlet, where the water is hottest and releases the most dissolved air into the line

71. A steamfitter reviews a weld that shows undercut along the toe of the bead. Undercut is:

A. A groove melted into the base metal at the weld toe that reduces the section and concentrates stress

B. An acceptable feature that increases the strength of the joint by adding a smooth transition

C. A deposit of excess filler metal that builds the weld higher than the surrounding base metal

D. A region of incomplete fusion deep inside the root of the joint not visible from the surface

72. A pipefitter must determine why a boiler's low-water cutoff is tripping repeatedly. A probable cause is:

A. The feedwater pressure is too high, forcing excess water into the boiler above the normal level

B. The combustion air damper is stuck closed, reducing the firing rate of the burner significantly

C. The flue gas temperature is too low, indicating the economizer is recovering excessive heat

D. A feedwater supply problem or a leak causing the water level to fall to the cutoff setpoint

73. A steamfitter calculates that a relief valve is set at 1000 kPa and the system reaches 1050 kPa without the valve lifting. This indicates the valve:

A. Is functioning correctly, since relief valves are designed to lift only well above their set pressure

B. Has failed or is stuck, since it should have lifted at or just above its 1000 kPa set pressure

C. Is correctly set for a system that normally operates at 1050 kPa during peak demand periods

D. Needs its set pressure lowered to 500 kPa so it will lift earlier in the pressure rise cycle

74. A pipefitter installs a strainer ahead of a control valve. To service the strainer, the system must first be:

A. Operated at full pressure so the trapped debris is flushed out of the blowdown connection

B. Isolated and depressurized so the strainer cap and screen can be safely removed for cleaning

C. Heated to operating temperature so the debris softens and can be rinsed out more easily

D. Left running while the screen is pulled, since the flow will carry the debris clear of the body

75. A steamfitter must determine the correct expansion-tank type for a system that requires a positive separation between air and water. The correct choice is a:

A. Plain steel tank open to the atmosphere at the top of the system above the highest point

B. Closed steel tank with no internal separation, relying on the air cushion above the water

C. Diaphragm or bladder expansion tank, where a flexible membrane separates the air from water

D. Open overflow tank that simply spills excess water to a drain when the system expands

76. A pipefitter encounters a pipe marked "ERW." This indicates the pipe was manufactured by:

A. Electric resistance welding, where the seam is fused by resistance heating of the rolled edges

B. Extruding the pipe seamless through a die without any longitudinal weld seam at all

C. Casting molten metal into a mould and machining the bore to the finished dimension

D. Spinning a flat plate into a cylinder and bonding the edges with an adhesive sealant

77. A steamfitter notes a system relief valve is sized in part by its "set pressure" and "blowdown." Blowdown refers to the:

A. Total volume of water discharged from the boiler during the routine bottom blowdown cycle

B. Maximum pressure the valve can contain before the body of the valve ruptures from overpressure

C. Difference between the set pressure where the valve opens and the lower pressure where it reseats

D. Time delay built into the valve between reaching set pressure and the valve beginning to open

78. A pipefitter must install a condensate pump set. The pump should be located:

A. Below the lowest condensate source so condensate gravity-drains into the receiver tank

B. Above the boiler water line so condensate can flow down into the boiler by gravity alone

C. At the highest point of the system so it can vent air from all the connected return lines

D. Inside the boiler steam space so the heat keeps the condensate from cooling in the pump

79. A steamfitter must explain why a steam system uses "flash steam" recovery. Flash steam forms when:

A. Live steam is throttled through a reducing valve, raising its temperature above saturation

B. Air is admitted to the condensate line, causing the condensate to boil at room temperature

C. Hot condensate at high pressure is released to a lower pressure, where part of it re-evaporates

D. Cold feedwater is sprayed into the steam space, instantly condensing the surrounding vapour

80. A pipefitter must select the correct wrench for tightening a large flare fitting on copper tube. The correct tool is:

A. A pipe wrench gripping the flare nut firmly with its serrated jaws for maximum turning force

B. Two flare or open-end wrenches, one holding the fitting body while the other turns the nut

C. A strap wrench wrapped around the tube to prevent the copper from being marred by the jaws

D. A chain wrench to grip the round flare nut where a standard open-end wrench cannot fit

81. A steamfitter finds that a steam radiator heats unevenly, hot at the inlet and cold at the far end. The most likely cause is:

A. The radiator is oversized for the room and cannot reach full temperature across its surface

B. A failed or plugged air vent or trap preventing air from leaving so steam cannot fill the radiator

C. The steam pressure is far too high, overheating the entire radiator surface uniformly throughout

D. The condensate return is oversized, draining the radiator faster than steam can enter it

82. A pipefitter must calculate pipe weight to size hangers. A 6 m length of pipe weighing 12 kg/m, filled with water adding 8 kg/m, has a total supported weight of:

A. 72 kg, counting only the weight of the empty pipe without the water it contains in service

B. 48 kg, counting only the weight of the water and ignoring the pipe's own structural weight

C. 120 kg, found by adding the 12 and 8 kg/m, then multiplying the 20 kg/m by the 6 m length

D. 240 kg, found by doubling the combined per-metre weight before multiplying by the length

83. A steamfitter is asked why steam traps are grouped with isolation valves and a test valve in a "trap station." This arrangement allows the trap to be:

A. Isolated, tested, and serviced without shutting down the rest of the steam-using equipment

B. Operated at a higher pressure than the rest of the system for improved condensate removal

C. Bypassed permanently so condensate drains directly to the return without passing the trap

D. Used as a pressure-reducing station feeding a separate low-pressure branch of the system

84. A pipefitter must verify a pressure test holds for the required duration. A small steady pressure drop with no visible leak most likely indicates:

A. A very small leak or a temperature change cooling the test medium and reducing its volume

B. The test is invalid and must be restarted because pressure can never drop during a valid test

C. The pipe has permanently stretched, increasing its internal volume and lowering the pressure

D. The gauge is reading high and should be replaced before the test is repeated from the start

85. A steamfitter must choose between a "bull head" tee connection and a proper branch arrangement. Bull-heading a tee (feeding both branches and taking off the run) is generally avoided because it:

A. Requires special left-hand threads that are difficult to source from standard suppliers

B. Cannot be welded and must always be a threaded or flanged connection by code requirement

C. Reduces the pressure rating of the tee below that of the connected pipe on every side

D. Creates turbulence and uneven flow distribution where the two opposing streams collide

86. A pipefitter installs an expansion joint of the bellows type. A critical requirement for bellows joints is:

A. They must be installed pre-stretched to twice their free length to absorb the expected movement

B. Proper anchoring and guiding of the pipe so movement is directed axially into the bellows

C. They must be welded solidly at both ends to the structure to prevent any movement at all

D. They require no guides because the flexible bellows accommodates movement in any direction

87. A steamfitter measures pump suction and finds the available NPSH is below the pump's required NPSH. The result will be:

A. Improved pump efficiency because lower suction pressure reduces the load on the impeller

B. Cavitation, as the liquid flashes to vapour at the impeller eye and bubbles collapse violently

C. Increased flow rate as the lower suction pressure draws more liquid into the pump casing

D. No effect, since NPSH is only a theoretical value not relevant to actual pump operation

88. A pipefitter must determine the correct slope for a steam line to drain condensate in the direction of flow. A typical minimum pitch is:

A. Level with no pitch, since steam carries condensate along regardless of the pipe slope

B. Steeply pitched at 45° so condensate runs out as fast as physically possible from the line

C. Pitched against the flow direction so condensate collects at the steam inlet for removal

D. About 1 in 240 (roughly 40 mm per 10 m) downward in the direction of the steam flow

89. A steamfitter must explain "subcooling" in a refrigeration system. Subcooling is the:

A. Heating of the suction vapour above its saturation temperature before it enters the compressor

B. Pressure drop across the metering device as the refrigerant enters the low-pressure evaporator

C. Temperature rise of the refrigerant as it absorbs heat passing through the evaporator coil

D. Cooling of the liquid refrigerant below its saturation temperature after leaving the condenser

90. A pipefitter must connect a pump to piping and finds the pump flanges and pipe flanges do not quite align. The correct response is to:

A. Force the flanges together with the bolts, using the bolt tension to pull the pipe into position

B. Heat the pipe with a torch until it bends enough to bring the flanges into alignment quickly

C. Correct the piping alignment so the pump is not stressed by pipe strain through the connection

D. Add extra gaskets between the flanges to take up the gap so the bolts can be tightened evenly

91. A steamfitter reads that a boiler requires "blowdown" of the water column daily. The purpose of blowing down the water column is to:

A. Increase the steam pressure briefly to test the response of the safety relief valve setting

B. Add fresh treatment chemicals to the boiler water through the water-column connection port

C. Cool the water column glass so the operator can read the level more accurately during firing

D. Clear sediment from the column and connecting lines so the level reading remains accurate

92. A pipefitter must select between brazing and soldering a copper joint for a 1000 kPa system. Brazing is chosen over soldering because brazing:

A. Uses a lower melting-temperature filler that flows more easily into the joint clearance

B. Requires no flux, simplifying the joint preparation compared to the soldering process

C. Produces a stronger, higher-temperature joint suitable for the higher pressure of the service

D. Can be done with a small air-fuel torch whereas soldering always needs an oxy-acetylene flame

93. A steamfitter notices a gas appliance flame lifting off the burner ports. This condition usually indicates:

A. The gas supply pressure has dropped far below the minimum required for the burner to fire

B. Excessive gas or air velocity at the ports, lifting the flame so it burns unstably above them

C. The flame is correctly seated and the appliance is operating at peak combustion efficiency

D. The pilot has extinguished and the safety system has shut off the main gas supply already

94. A pipefitter calculates that a 25 mm pipe must carry the same flow as two 25 mm pipes combined. The single pipe diameter needed is approximately:

A. 25 mm, since the flow capacity depends only on velocity and not on the pipe diameter

B. 50 mm, found by simply adding the two 25 mm diameters together for the combined flow

C. 35 mm, since area scales with the square of diameter and two areas need about 1.41 times the diameter

D. 100 mm, found by multiplying the original diameter by the number of pipes squared

95. A steamfitter must explain why hot-water heating systems use a "fill valve" set to a specific pressure. The fill (PRV) valve maintains:

A. The maximum pressure the relief valve will allow before discharging excess from the system

B. A constant flow rate of make-up water regardless of the pressure in the connected loop

C. The city water pressure directly into the loop without any reduction at the connection point

D. A minimum system pressure that keeps the highest point filled and prevents air ingress

96. A pipefitter must determine why a newly welded joint failed a radiographic test for "porosity." Porosity in a weld is caused by:

A. Excessive heat input that melted too much base metal and thinned the section of the joint

B. The electrode travelling too fast, leaving the weld bead too narrow to fuse the joint fully

C. Two pieces of base metal that were misaligned, leaving a step across the welded joint face

D. Gas trapped in the molten weld pool that formed cavities as the weld metal solidified

97. A steamfitter must select the correct sequence to shut down a steam boiler for maintenance. The proper first step is to:

A. Reduce the firing rate and turn off the burner so the boiler stops generating steam first

B. Open all the steam valves to the building so the residual steam is used before shutdown

C. Drain the boiler completely while it is still at full pressure to speed the cooling process

D. Remove the safety relief valve so it does not lift while the pressure is being reduced slowly

98. A pipefitter installs a vacuum breaker on a heat exchanger that can develop a vacuum on shutdown. Its purpose is to:

A. Admit air to break the vacuum so condensate can drain freely and the shell does not collapse

B. Increase the steam pressure inside the shell to improve the rate of heat transfer to the water

C. Vent excess steam to atmosphere whenever the shell pressure exceeds the design set point

D. Trap condensate inside the shell to keep the heat-transfer surface flooded during operation

99. A steamfitter calculates the percentage of grade for a drain line that drops 150 mm over a 30 m run. The grade is:

A. 5%, found by dividing the 150 mm drop directly by the 30 m run without converting units

B. 1.5%, found by taking the drop as a fraction of the run and rounding to a convenient value

C. 0.5%, found by dividing the 150 mm drop by the 30 000 mm run and expressing it as a percent

D. 15%, found by multiplying the drop and the run together before dividing by one hundred

100. A pipefitter must select a pipe-joining method for a high-purity process where crevices must be minimized. The best choice is:

A. Threaded joints sealed with PTFE tape, which leaves no internal gap for product to collect in

B. Grooved mechanical couplings, whose gasket sits flush with the bore to eliminate all crevices

C. Orbital or fusion butt welding that produces a smooth, flush internal bore with no crevices

D. Soldered slip joints, which fill any internal gap completely with the molten filler metal alloy

101. A steamfitter encounters a system where the circulating pump is mounted with its suction directly off the expansion tank connection. This arrangement places the:

A. Point of no pressure change at the pump suction, which is the preferred pumping arrangement

B. Pump in danger of cavitation because the expansion tank reduces the available suction pressure

C. Expansion tank under excessive stress from the pump's discharge pressure during operation

D. Air vent in the wrong location, preventing the system from being purged of air at startup

102. A pipefitter must determine the correct response when a colleague is overcome inside a confined space. The first action is to:

A. Enter immediately without equipment to pull the colleague out before the situation worsens

B. Take a deep breath and enter quickly, holding the breath to avoid the contaminated atmosphere

C. Reach in with a long pole to try to hook the colleague's clothing from outside the space

D. Call for rescue and use the retrieval system, never entering without proper equipment and backup

103. A steamfitter must select the correct anchor for the midpoint of a steam main with expansion loops on each side. The anchor's purpose is to:

A. Allow the main to slide freely in both directions so expansion is shared between the two loops

B. Carry the entire vertical weight of the main and its contents at that single midpoint location

C. Fix the pipe at that point so expansion is forced outward into the loop on each side of the anchor

D. Permit rotation of the main around its axis to relieve torsional stress from the thermal cycling

104. A pipefitter reads that a valve is "lapped in" during maintenance. Lapping refers to:

A. Grinding the disc and seat together with a fine abrasive to restore a tight sealing surface

B. Wrapping the valve stem with packing material to prevent leakage along the moving stem

C. Coating the valve body with paint to identify the service and protect against corrosion

D. Adjusting the handwheel travel so the valve opens fully without binding against the backseat

105. A steamfitter calculates that a steam coil condenses 200 kg/h of steam. The steam trap selected should have a capacity that:

A. Exactly matches 200 kg/h with no margin, so the trap is never oversized for the application

B. Equals half the condensate load, since traps discharge intermittently rather than continuously

C. Is far below the load, relying on condensate backup to assist the trap during peak periods

D. Exceeds 200 kg/h by a safety factor so it handles startup loads and pressure variations

106. A pipefitter must explain why dissimilar-metal welds (such as carbon steel to stainless) require special procedures. The main concern is:

A. The two metals cannot be melted at the same time because their melting points are identical

B. Differing thermal expansion and metallurgy that can cause cracking or weak zones at the joint

C. Stainless steel cannot be welded to any other metal under any circumstances by code rule

D. The colour difference between the metals makes the finished weld difficult to inspect visually

107. A steamfitter finds a boiler gauge glass showing no visible water level. The correct immediate action is to:

A. Assume a low-water condition, stop firing the boiler, and verify the level before any refiring

B. Assume the glass is simply dirty and continue firing the boiler at the normal rate as before

C. Open the feedwater valve fully and force cold water into the hot boiler as fast as possible

D. Increase the firing rate to raise the steam pressure and push the water level back into view

108. A pipefitter must size a balancing valve for a hydronic branch. The valve is set to achieve a specific:

A. Maximum pressure rating for the branch piping regardless of the actual flow it carries

B. Temperature drop across the branch by limiting how hot the supply water can become

C. Design flow rate through that branch so each zone receives its intended share of the total flow

D. Reverse-flow prevention so the branch cannot backfeed into the main when the pump stops

109. A steamfitter must explain why a steam system is warmed up slowly rather than admitting full steam at once. Rapid admission of steam would:

A. Cause severe water hammer and thermal shock as cold pipe meets hot steam and condensate

B. Improve efficiency by bringing the system to operating temperature in the shortest possible time

C. Have no adverse effect because the steam traps remove all condensate instantly on contact

D. Reduce stress on the piping by heating all sections of the system uniformly and simultaneously

110. A pipefitter installs a pressure gauge with a "siphon" (pigtail) loop on a steam line. The loop's purpose is to:

A. Increase the pressure reading on the gauge by adding the head of the trapped water column

B. Trap a plug of condensate that protects the gauge mechanism from direct live steam heat

C. Dampen pressure pulsations only, having no effect on the temperature reaching the gauge

D. Allow the gauge to be removed under pressure without isolating the line being measured

111. A steamfitter must determine why a hydronic zone valve fails to open on a call for heat. A likely electrical cause is:

A. No power reaching the valve actuator, such as a failed transformer or an open thermostat circuit

B. The system pressure is too high, holding the valve mechanically closed against the actuator force

C. The water temperature is too low for the valve's wax motor to respond to the heat in the line

D. The circulating pump is running too fast and forcing the valve disc shut against its own seat

112. A pipefitter calculates that a 50 mm pipe reduces to a 25 mm pipe. The flow area of the smaller pipe compared to the larger is approximately:

A. One half, since the diameter was reduced by exactly half from the larger to the smaller pipe

B. One quarter, because flow area scales with the square of the diameter when it is halved

C. Two times larger, since reducing the diameter concentrates and increases the flow area

D. Unchanged, because the flow rate through both pipe sections must remain equal by continuity

113. A steamfitter must explain the function of a "steam separator" in a distribution main. The separator:

A. Raises the steam temperature above saturation by adding heat as the steam passes through it

B. Removes entrained water droplets from the steam to improve its dryness before use at equipment

C. Splits the steam flow into two equal branches feeding separate sections of the building load

D. Reduces the steam pressure to the value required by the downstream process or heating equipment

114. A pipefitter must select fasteners for a flange in a corrosive outdoor environment. The best choice is:

A. Plain carbon-steel bolts, which are the strongest and cheapest option for any flange service

B. Aluminum bolts, chosen because they are lightweight and never corrode in any environment

C. Corrosion-resistant bolts such as stainless or coated steel rated for the exposure conditions

D. Brass bolts, selected because their colour matches the bronze valve bodies in the system

115. A steamfitter notes that a pump is specified to operate at its "best efficiency point" (BEP). Operating far from the BEP causes:

A. Improved bearing life because the reduced flow lowers the radial loads on the pump shaft

B. Increased vibration, radial thrust, and reduced reliability as the pump runs off its design point

C. No measurable effect, since centrifugal pumps perform identically across their entire curve

D. Higher efficiency because the pump automatically compensates by adjusting its impeller speed

116. A pipefitter must determine the correct fit-up gap and bevel for a welded butt joint. These dimensions are specified by the:

A. Pipe manufacturer's shipping label attached to each individual length of the delivered pipe

B. Personal preference of the welder based on past experience with similar joints in the field

C. Diameter of the welding electrode being used, which sets the gap automatically during welding

D. Welding procedure specification (WPS) qualified for the material, thickness, and service involved

117. A steamfitter must explain why an inverted bucket steam trap can lose its prime. Loss of prime occurs when:

A. The condensate load suddenly increases beyond the rated capacity of the trap during startup

B. The trap is installed upside down relative to the direction marked on the body casting

C. A sudden pressure drop or superheat flashes the water seal, letting the bucket sink and blow through

D. The discharge line is too short, allowing condensate to drain back into the trap body too quickly

118. A pipefitter installs a "drip leg" at the base of a vertical steam riser. The drip leg's purpose is to:

A. Provide an air vent at the top of the riser so the steam can rise without resistance through it

B. Collect condensate draining down the riser and direct it to a trap for removal from the line

C. Reduce the steam pressure at the base of the riser before it rises to the upper floors served

D. Support the weight of the vertical riser by transferring the load to the floor at its base

119. A steamfitter calculates that a system operates at 800 kPa and the relief valve is set at 1000 kPa. The margin between operating and set pressure exists to:

A. Allow the relief valve to weep continuously, relieving small amounts of steam during operation

B. Ensure the relief valve lifts during every normal operating cycle to prove it still functions

C. Match the operating pressure exactly to the set pressure for maximum system efficiency gain

D. Prevent nuisance lifting of the valve during normal pressure fluctuations of the operating system

120. A pipefitter must explain why a long-radius elbow is preferred over a short-radius elbow for pump suction piping. The long-radius elbow:

A. Increases turbulence at the pump inlet, which helps to prime the pump more quickly at startup

B. Costs less and takes up less space, making it the economical choice for tight installations

C. Provides smoother flow with less turbulence and pressure drop, improving the pump's suction conditions

D. Has a thicker wall that withstands the suction vacuum better than a short-radius elbow does

121. A steamfitter must determine the correct action when a gas leak is smelled in a mechanical room. The first action is to:

A. Switch on the exhaust fan to ventilate the room and clear the gas before locating the source

B. Eliminate ignition sources, shut off the gas supply, and ventilate, then find and repair the leak

C. Light a match to locate the source of the leak by observing where the small flame flares up

D. Continue working while monitoring the smell, since natural gas disperses on its own over time

122. A pipefitter must explain why thermal expansion is more critical in steam systems than in cold-water systems. Steam systems experience:

A. Far greater temperature differences, producing much larger pipe expansion that must be accommodated

B. Lower pressures than cold-water systems, making the expansion forces negligible by comparison

C. No expansion at all because the steam itself absorbs the dimensional change within the pipe

D. Contraction rather than expansion, since heating causes steam pipe to shrink along its length

123. A steamfitter notes that a centrifugal pump's capacity can be changed by trimming the impeller. Reducing the impeller diameter will:

A. Increase both the flow and the head because the smaller impeller spins faster at the same power

B. Increase the flow while reducing the head, redistributing the pump's energy across the curve

C. Have no effect on performance, since pump output depends only on the motor speed setting

D. Reduce both the flow and the head the pump produces, lowering its position on the curve

124. A pipefitter must select the correct test for a buried gas line before backfilling. The required test is a:

A. Visual inspection of each joint with the line at atmospheric pressure before covering the trench

B. Flame test applied to each fitting to confirm there is no escaping gas igniting at the joints

C. Pressure test holding a specified pressure for a set duration to confirm there are no leaks

D. Continuity test using an electrical meter to confirm the metallic pipe is electrically bonded

125. A steamfitter must explain why a "steam quality" of 0.95 matters. A quality of 0.95 means the steam is:

A. Superheated by 5% above its saturation temperature at the operating pressure of the system

B. At 95% of the maximum pressure the boiler can safely produce during normal operation

C. 95% dry vapour and 5% entrained liquid water by mass, slightly wet rather than fully dry

D. 95% pure with 5% contamination from dissolved minerals carried over from the boiler water

126. A pipefitter installs a circulator pump and must check rotation direction. Reverse rotation of a centrifugal pump typically results in:

A. The same flow and head as correct rotation, since the impeller moves liquid in either direction

B. A higher flow rate than designed, since reverse rotation reduces the internal friction losses

C. Complete pump failure within seconds as the impeller unthreads and seizes against the casing

D. Greatly reduced flow and head, since the impeller is shaped to move liquid in one direction only

127. A steamfitter must explain why condensate is returned to the boiler rather than discarded. Returning condensate:

A. Saves energy and treated water, since the hot condensate is already purified and partly heated

B. Increases the boiler's fuel consumption because the returning water must be reheated from cold

C. Introduces oxygen and contaminants that the boiler treatment system cannot handle effectively

D. Is required only to reduce noise in the return lines, with no real energy or cost benefit gained

128. A pipefitter must select the correct support spacing for a 25 mm steel pipe carrying water. Compared to a larger pipe, the smaller pipe requires:

A. Closer support spacing because the smaller pipe is less rigid and sags more easily under load

B. Wider support spacing because the smaller pipe weighs less and can span greater distances

C. The identical support spacing as any other pipe size regardless of diameter or contents carried

D. No supports at all because small pipe is light enough to be self-supporting over any span

129. A steamfitter must explain the danger of "thermal shock" to a boiler. Thermal shock occurs when:

A. The boiler is fired too slowly, allowing the metal to cool unevenly between firing cycles

B. The steam pressure is held perfectly constant for a long period, stressing the metal uniformly

C. The boiler operates at its rated temperature continuously without any change in firing rate

D. Cold water suddenly contacts hot boiler metal, causing rapid uneven contraction and cracking

130. A pipefitter must determine the correct procedure to place a repaired steam line back in service. After isolation is removed, the line should be:

A. Brought to full pressure instantly so any remaining leaks are revealed under maximum load

B. Left cold and pressurized for several hours before any steam is admitted to the repaired section

C. Warmed up slowly with drains open to remove condensate, then brought up to pressure gradually

D. Tested only by feeling the pipe surface for heat, with no need to open any drains during startup

Practice Exam 9: Answer Key and Explanations

1. A — Expansion equals length × coefficient × temperature change: 60 m × 0.0000117 × 200 °C = 0.1404 m, about 140 mm. This is far too large to absorb passively, so a loop or joint is required. Underestimating expansion leads to buckled pipe and damaged equipment.

2. D — A trench 3 m deep in disturbed fill is highly prone to collapse, so a protective system — shoring, sloping, or a trench box — must be in place before any worker enters. Cave-ins kill quickly and without warning. No connection is worth entering an unprotected trench.

3. C — A centrifugal pump's characteristic curve slopes downward: as flow increases, the head it can develop decreases. This trade-off defines the operating point where the pump curve meets the system curve. Understanding it is essential for correct pump selection.

4. C — Saturation temperature rises with pressure; at roughly 1035 kPa (about 150 psia) saturated steam is near 184 °C. Steam is only 100 °C at atmospheric pressure, not in a pressurized system. Matching pipe and components to saturation temperature is critical for safe selection.

5. A — Loss of contact with an entrant triggers the emergency response procedure, not a rush into the space. Most confined-space deaths include would-be rescuers who entered unprotected. The attendant must summon trained rescue rather than become a second victim.

6. C — A flange class such as 150 is a pressure-temperature rating; the allowable pressure decreases as temperature rises along the published rating curve. It is not a dimension or bolt count. Selecting the correct class ensures the joint contains the service conditions safely.

7. D — Tapered NPT threads seal through full thread engagement; too shallow a make-up leaves too few engaged threads to seal and the joint leaks under pressure. Adequate engagement is what wedges the threads tight. Proper make-up depth is essential for a pressure-tight joint.

8. A — An air receiver stores compressed air and dampens the pulsations of the compressor, allowing supply to meet fluctuating demand without rapid cycling. It does not raise pressure above the compressor's output. The reservoir smooths delivery and reduces compressor wear.

9. B — A trap failed closed holds back condensate, which backs up ahead of the trap causing water hammer and reduced heat output as coils flood. Live steam blowing through would instead indicate a failed-open trap. Recognizing the symptom guides correct trap diagnosis.

10. B — Cut length = centre-to-centre − both take-outs + both thread engagements (threads run into the fittings): 800 − 35 − 35 + 16 + 16 = 762 mm. The thread engagement is added back because that length is consumed inside the fitting beyond the take-out. Accurate take-out math prevents mis-cut pipe.

11. A — Each metre of water column is about 9.8 kPa, so 12 m of rise reduces pressure by roughly 118 kPa: 240 − 118 ≈ 122 kPa at the top floor. Static head falls as elevation rises in a filled system. This is why tall buildings need adequate fill pressure to keep high points full.

12. A — Globe valves are directional and normally installed so flow enters below the disc and seat, allowing the disc to be maintained under no flow and easing closure against pressure. Reverse installation impairs operation. Following the body flow arrow is essential.

13. D — A boiler relief valve must have a relieving capacity at least equal to the boiler's maximum steam generating capacity at its maximum allowable working pressure, so it can vent all the steam the boiler can produce. Undersizing risks dangerous overpressure. This is a core boiler-safety requirement.

14. D — When the pump runs and other zones heat but one does not, the fault is local to that circuit — most likely an air pocket or a closed valve blocking its flow. A boiler or pump fault would affect all zones. Isolating the symptom to one zone points to the cause.

15. C — A root gap permits full penetration of the root pass so the weld fuses completely through the joint from the inside. Without the gap, the root may be left unfused. Correct root opening is fundamental to a sound, full-penetration weld.

16. B — Schedule 80 has a thicker wall and smaller bore than Schedule 40 of the same nominal size, giving it a higher pressure rating. Outside diameter stays the same across schedules for a given NPS. Heavier schedules are chosen as service pressure increases.

17. D — Intermittent relief-valve discharge on a heating system typically signals a waterlogged or failed expansion tank: with no air cushion, pressure spikes as water heats and lifts the valve. Restoring the tank's air charge solves the problem. The relief valve is only reacting to the real fault.

18. C — Travel = set × offset constant: 400 mm × 2.613 = 1045 mm. The constant for a given offset angle multiplies the set to give the diagonal travel. Using the correct constant ensures the fabricated offset matches the layout.

19. B — Yellow, lazy, sooting flames signal incomplete combustion from insufficient air, which produces carbon monoxide and soot deposits. A correct flame is sharp and blue. This condition is hazardous and demands air-fuel adjustment and venting checks.

20. D — Copper-plated or isolated hangers prevent galvanic corrosion where copper pipe would otherwise contact bare steel in the presence of moisture. Direct dissimilar-metal contact sets up a corrosion cell. Isolation protects the pipe at every support point.

21. A — Under the ASHRAE classification, A1 denotes lower toxicity (class A) and no flame propagation (class 1) — the safest combination. This is why many traditional refrigerants are A1. The class informs handling, charge limits, and machinery-room requirements.

22. D — A dial indicator reading a difference across the coupling faces checks angular misalignment, where the shafts meet at an angle rather than parallel. Face readings reveal angular error; rim readings reveal offset. Correct alignment protects seals, bearings, and couplings.

23. C — A swing check valve uses a hinged disc that swings open with forward flow and closes against reverse flow, preventing backflow when the pump stops. It needs no operator action. It is a common choice on pump discharge lines.

24. A — Absolute pressure = gauge + atmospheric ≈ 700 + 101 = 801 kPa. Gauge pressure reads zero at atmosphere, so atmospheric must be added to obtain absolute. This conversion matters for thermodynamic and vacuum calculations.

25. C — High-pressure refrigerant joints require a silver-bearing brazing alloy that forms a strong, high-temperature joint. Soft solders melt too low and lack strength for the service. Proper filler selection ensures the joint withstands operating pressure.

26. C — During warmup, drip legs and traps must be open so condensate formed as the cold main heats is removed before steam flow can drive it into a damaging water-hammer slug. Slow, drained warmup protects the piping. This is standard steam start-up practice.

27. D — Velocity equals flow divided by cross-sectional area, so installing a larger-diameter pipe lowers velocity for the same flow rate. Larger bore means more area and slower, quieter, less-erosive flow. Correct sizing prevents erosion and noise.

28. B — A Y-type strainer has its screen element set in a branch angled off the main flow path, resembling the leg of a Y. Debris collects in the screen, which is removed for cleaning. The shape allows compact installation and easy blowdown.

29. C — Excessive motor current usually means the pump is running far out on its curve at high flow, which increases the power demand and can overload the motor. Throttling the discharge back toward the design point reduces the load. Operating near the BEP protects the motor.

30. A — Arc strikes outside the weld joint create localized hardened spots that act as crack-initiation sites under stress and fatigue. They are a recognized defect and are prohibited. Welders strike only within the joint to avoid these hard zones.

31. B — A backflow preventer on boiler make-up water stops treated or contaminated boiler water from siphoning back into the potable supply, protecting drinking water. Cross-connection control is a code requirement. It guards public health, not system pressure.

32. D — FNPT designates Female National Pipe Taper threads — the internal tapered threads that receive a male (MNPT) pipe end. The taper provides the wedging seal. Reading thread designations correctly prevents mismatched connections.

33. C — A deadheading pump runs against a closed discharge, churning the same trapped liquid and rapidly overheating it, which can flash to steam and destroy the pump. It is a dangerous condition. A minimum-flow path or relief prevents it.

34. A — A deaerator removes dissolved oxygen and other gases from boiler feedwater, greatly reducing corrosion of the boiler and piping. Oxygen is a primary cause of pitting. Deaeration is essential to boiler longevity and water treatment.

35. D — Torn, rough threads usually result from insufficient or wrong cutting oil, which causes the dies to tear rather than shear the metal cleanly. Proper thread-cutting oil lubricates and cools the dies. Correct lubrication produces clean, sealing threads.

36. B — A relief valve downstream of a PRV protects the low-pressure main in case the reducing valve fails open and passes full upstream pressure. It safeguards equipment rated only for the reduced pressure. This is standard practice on reducing stations.

37. A — A compressed non-asbestos fibre or spiral-wound gasket is rated for the temperature and pressure of 200 °C steam and seals reliably. Rubber, cork, and paper gaskets would fail under steam conditions. Matching the gasket to service is essential.

38. D — Water hammer on pump stop is best controlled with a slow-closing check valve or surge arrestor that manages the momentum change and prevents the sudden pressure surge. Removing the check valve would allow damaging reverse flow. Controlled deceleration solves the problem.

39. A — Area = πr^2; with a 50 mm radius, $\pi \times 50^2 \approx 7854$ mm². The radius, not the diameter, is squared in the formula. Correct area calculation underlies flow and velocity work.

40. B — A float and thermostatic (F&T) trap handles varying condensate loads and vents air, making it well suited to modulating heat exchangers. Its float responds continuously to load while the thermostatic element removes air. This matches the trap to the service.

41. C — A trapped air pocket is compressible, so it stores energy and falsifies the pressure-hold reading during a hydrostatic test, masking leaks or causing a misleading drop. Purging air ensures the test reflects true integrity. Air-free filling is essential for a valid test.

42. D — A firestop system at a floor penetration must restore the fire-resistance rating of the assembly for its rated time. It blocks fire and smoke, not just water. Maintaining the rated barrier is a life-safety code requirement.

43. D — Low superheat (2 °C versus an 8 °C target) means the metering device is overfeeding refrigerant, risking liquid floodback to the compressor. Too little superheat leaves liquid in the suction line. Correcting the charge or valve protects the compressor.

44. A — Flange bolts are tightened in a crossing star pattern so gasket compression is distributed evenly around the joint, preventing flange distortion and leaks. Sequential adjacent tightening cocks the flange. Even, progressive torque is the correct method.

45. B — Constant pressure loss requiring repeated refilling points to a leak or a relief valve weeping from excess pressure. Water is physically leaving the closed loop. Finding and correcting the loss restores stable operation.

46. C — The 6G position fixes the pipe at a 45° inclined angle without rotation, forcing the welder to work in all positions around the joint, making it the most demanding qualification. Passing 6G qualifies a welder broadly. It tests all-position skill at once.

47. B — A feedwater pump must develop a discharge pressure exceeding the boiler pressure plus piping losses so water can be forced into the pressurized drum. Matching only boiler pressure would not overcome losses. Adequate margin ensures reliable feed.

48. D — A spectacle blind positively isolates a line by swinging a solid blank between two flanges, giving a visible, verifiable seal. The open ring is used when flow is restored. It provides positive isolation for safe maintenance.

49. D — Heating zinc-coated galvanized pipe by cutting or grinding releases zinc oxide fumes that cause metal fume fever, so respiratory protection is a key concern. Ventilation and a proper respirator are required. This hazard is specific to galvanized coatings.

50. B — A framing or combination square checked against the two faces of the elbow verifies it is truly 90° during fit-up. The square directly measures the angle between the legs. Accurate squaring prevents misaligned welded assemblies.

51. D — Rapid short-cycling on the operating control usually means the differential setting is too narrow, so the burner cuts in and out over a small pressure band. Widening the differential reduces cycling. Excessive cycling wastes fuel and wears components.

52. C — Valve-stem lubricant must be compatible with the service fluid and rated for the operating temperature so it performs without degrading or contaminating the system. The wrong lubricant fails or reacts. Correct selection ensures smooth, lasting operation.

53. A — Arc length for a 90° bend is one quarter of the circumference: $\frac{1}{4} \times 2\pi \times 300 = \frac{1}{4} \times 1885 \approx 471$ mm. A quarter circle of radius 300 mm gives the developed length. Correct arc length is needed for accurate bend layout.

54. B — A thermowell lets a temperature sensor be removed or replaced without draining or depressurizing the line, since the well penetrates the pipe while the sensor sits inside it dry. It isolates the sensor from the process. This allows safe service of instruments.

55. C — 15 psi × about 6.9 kPa/psi ≈ 103 kPa. The conversion factor of roughly 6.9 converts psi to kPa. Knowing the factor allows quick movement between imperial and metric pressure units.

56. D — A dielectric union or fitting electrically isolates copper from a steel valve, preventing the galvanic corrosion that occurs when dissimilar metals are joined in the presence of moisture. The insulating barrier breaks the corrosion cell. It protects the joint long-term.

57. C — Gagging a relief valve shut with a clamp is an extremely dangerous, prohibited practice because it defeats the system's overpressure protection. Nothing then prevents a catastrophic pressure failure. Relief valves must always remain free to lift.

58. B — Flow rate = volume ÷ time = 5000 L ÷ 50 min = 100 L/min. Dividing the required volume by the available time gives the needed rate. This basic calculation sizes fill lines and pumps.

59. B — Purging gas piping removes air so a stable, ignitable gas mixture reaches the burner safely, preventing erratic ignition or a pocket of unburned air-gas mixture. Purging is done to a safe location. It is a required commissioning step.

60. A — A globe valve's disc-and-seat design is built for controllable throttling, making it the appropriate choice for frequently regulating steam flow. Gate and ball valves are isolation devices, not throttling valves. Matching valve type to function prevents seat damage.

61. B — A valve symbol with a spring above it represents a spring-loaded relief or safety valve, the spring denoting the set-point mechanism that determines lift pressure. Reading P&ID symbols correctly is essential. It identifies the overpressure-protection device.

62. A — Between anchors, a steam line should rest on roller or sliding supports that let it move axially as it heats and cools, directing expansion into loops or joints. Rigid clamps would cause buckling. Allowing controlled movement protects the system.

63. C — An inverted bucket trap normally discharges condensate in cyclic, intermittent bursts as the bucket sinks and rises, so slug discharge is normal operation. This distinguishes it from a continuous-discharge trap. Recognizing normal behaviour avoids misdiagnosis.

64. D — As required pressure rises for a given material and diameter, the wall thickness must increase, calling for a higher schedule number to contain the pressure. Outside diameter stays fixed per NPS. Schedule selection follows the pressure requirement.

65. A — Removing a Hartford loop risks the boiler losing its water through a return-line failure, exposing it to dangerous dry-firing. The loop maintains a safe minimum water level by its connection height. It is a genuine safety device, not mere labelling.

66. A — Total head = friction + static lift + residual = 8 + 4 + 3 = 15 m. All three components must be summed to find the required pump head. Omitting any one undersizes the pump.

67. B — Medical compressed-gas systems require specially cleaned, capped tubing brazed under a nitrogen purge to keep the interior contamination-free. Patient safety demands oxygen-clean piping. Standard refrigeration practice and ordinary solvents are not acceptable.

68. A — A steadily leaking mechanical seal has failed or worn, so the correct response is to identify the cause and replace the seal. Over-tightening or ignoring it worsens damage. Mechanical seals are designed to run essentially leak-free.

69. B — Superheated steam has been heated above its saturation temperature at a given pressure and contains no liquid moisture. The extra heat raises its temperature beyond the boiling point for that pressure. Dry superheated steam is preferred for turbines and long mains.

70. B — Air vents belong at the highest point of a hydronic system, where air collects because it rises above the circulating water. Venting there removes trapped air that causes noise and poor circulation. Correct placement keeps the system air-free.

71. A — Undercut is a groove melted into the base metal at the weld toe that reduces the cross-section and concentrates stress, acting as a defect. It weakens the joint and can initiate cracks. Proper technique avoids undercut.

72. D — Repeated low-water cutoff trips point to a feedwater supply problem or a leak letting the level fall to the cutoff setpoint. The cutoff is correctly protecting the boiler from a real low-water condition. Finding the water-loss cause is the fix.

73. B — A relief valve set at 1000 kPa that does not lift when the system reaches 1050 kPa has failed or is stuck, since it should open at or just above its set pressure. A stuck valve is a serious safety hazard. It must be tested and replaced.

74. B — To service a strainer, the system must first be isolated and depressurized so the cap and screen can be removed safely. Opening a pressurized strainer is hazardous. Safe isolation is mandatory before maintenance.

75. C — A diaphragm or bladder expansion tank uses a flexible membrane to positively separate air from water, preventing the air charge from being absorbed into the system water. Plain tanks lose their cushion over time. The membrane maintains reliable pressure control.

76. A — ERW means electric resistance welding, where the longitudinal seam is fused by resistance heating of the rolled edges. It is distinct from seamless pipe. Knowing the manufacturing method informs inspection and service suitability.

77. C — Blowdown is the difference between the set pressure at which the valve opens and the lower pressure at which it reseats. Adequate blowdown prevents rapid chattering. It is a defined relief-valve characteristic, not a volume or time.

78. A — A condensate pump set is located below the lowest condensate source so condensate gravity-drains into the receiver before being pumped onward. Gravity must fill the receiver. Correct elevation ensures reliable collection.

79. C — Flash steam forms when hot condensate at high pressure is released to a lower pressure, where part of it re-evaporates because it holds more heat than saturation allows at the lower pressure. Recovering this steam saves energy. It is a key efficiency measure.

80. B — A flare fitting is tightened with two wrenches — one holding the fitting body while the other turns the nut — so the tube and flare are not twisted or damaged. A pipe wrench would crush the soft fitting. Backing up the body protects the joint.

81. B — Uneven radiator heating, hot at the inlet and cold at the far end, typically means a failed or plugged air vent or trap is trapping air so steam cannot fill the radiator. The trapped air blocks steam from the far sections. Restoring venting evens the heat.

82. C — Total supported weight = (pipe 12 kg/m + water 8 kg/m) × 6 m = 20 × 6 = 120 kg. Both the pipe and its water contents must be included. Correct load calculation ensures adequately sized hangers.

83. A — A trap station with isolation valves and a test valve lets the trap be isolated, tested, and serviced without shutting down the equipment it drains. This supports maintenance and verification. It improves reliability and reduces downtime.

84. A — A small steady pressure drop with no visible leak most likely indicates a very small leak or a temperature change cooling the test medium and reducing its volume. Temperature effects are common during long holds. Both must be evaluated before passing or failing the test.

85. D — Bull-heading a tee feeds both branches toward each other and takes off the run, creating turbulence and uneven flow where the opposing streams collide. This causes erosion and poor distribution. A proper branch arrangement avoids the colliding flows.

86. B — Bellows expansion joints require proper anchoring and guiding so pipe movement is directed axially into the bellows and not as damaging lateral or angular strain. Without guides the bellows can distort and fail. Correct anchoring is critical to their function.

87. B — When available NPSH falls below the pump's required NPSH, the liquid flashes to vapour at the impeller eye and the bubbles collapse violently — cavitation. This erodes the impeller and causes noise and vibration. Maintaining adequate suction head prevents it.

88. D — A typical minimum steam-line pitch is about 1 in 240 (roughly 40 mm per 10 m) downward in the direction of flow so condensate drains to drip legs. Adequate slope prevents condensate accumulation. Correct pitch reduces water-hammer risk.

89. D — Subcooling is the cooling of liquid refrigerant below its saturation temperature after it leaves the condenser. It confirms the condenser has fully condensed the charge and provides solid liquid to the metering device. It is a key charging indicator.

90. C — When pump and pipe flanges do not align, the piping must be corrected so the pump is not stressed by pipe strain. Forcing or shimming the joint transmits load to the pump, damaging seals and bearings. The pipe must support itself.

91. D — Blowing down the water column clears sediment from the column and its connecting lines so the gauge-glass level reading stays accurate. Sediment can plug the lines and give a false level. Daily blowdown maintains a reliable indication.

92. C — Brazing is chosen over soldering for a 1000 kPa system because it produces a stronger, higher-temperature joint suitable for the higher pressure. Soft solder lacks the strength for the service. Filler choice follows the pressure and temperature demands.

93. B — Flame lifting off the burner ports indicates excessive gas or air velocity at the ports, lifting the flame so it burns unstably. This can cause incomplete combustion or flameout. Correcting the gas pressure or air setting reseats the flame.

94. C — Flow area scales with the square of diameter, so two equal areas require a diameter about $\sqrt{2}$ (1.41) times larger: $25 \times 1.41 \approx 35$ mm. Doubling area does not double diameter. Correct scaling avoids undersizing the combined line.

95. D — A fill (PRV) valve maintains a minimum system pressure that keeps the highest point filled and prevents air from being drawn in. Adequate fill pressure ensures circulation to the top of the system. It also keeps the system primed.

96. D — Porosity is caused by gas trapped in the molten weld pool that forms cavities as the metal solidifies, often from contamination, moisture, or lost shielding. These voids weaken the weld. Clean joints and proper shielding prevent porosity.

97. A — The proper first step in shutting down a boiler is to reduce the firing rate and turn off the burner so steam generation stops before any further steps. Draining under pressure or removing the relief valve would be dangerous. Orderly shutdown protects the boiler.

98. A — A vacuum breaker admits air to break the vacuum that forms as steam condenses on shutdown, allowing condensate to drain freely and preventing the shell from collapsing. Without it, the vacuum holds condensate and can damage the vessel. It protects the heat exchanger.

99. C — Grade = drop ÷ run = 150 mm ÷ 30 000 mm = 0.005 = 0.5%. Both measurements must be in the same units before dividing. Correct grade calculation ensures proper drainage slope.

100. C — Orbital or fusion butt welding produces a smooth, flush internal bore with no crevices, making it the best choice for high-purity service where product must not collect. Threads, grooves, and slip joints all create crevices. Crevice-free joints protect purity.

101. A — Connecting the pump suction at the expansion-tank connection places the point of no pressure change at the suction, the preferred arrangement that keeps positive pressure throughout the loop and protects against cavitation. This is the classic "pumping away" configuration. It improves system stability.

102. D — When a worker is overcome in a confined space, the first action is to call for rescue and use the retrieval system — never enter without proper equipment and backup. Untrained entry creates additional victims. Trained, equipped rescue is the only safe response.

103. C — An anchor at the midpoint fixes the pipe so expansion is forced outward into the loop on each side, splitting the movement between the two loops. This controls where the pipe grows. Proper anchoring directs thermal movement safely.

104. A — Lapping a valve means grinding the disc and seat together with a fine abrasive to restore a tight, matched sealing surface. It removes minor pitting and wear. Lapping renews the seal without replacing the valve.

105. D — A steam trap should be sized to exceed the condensate load by a safety factor so it handles startup loads and pressure variations, not just the steady 200 kg/h. Sizing exactly to the running load leaves no startup margin. A safety factor ensures reliable drainage.

106. B — Dissimilar-metal welds raise concerns of differing thermal expansion and metallurgy, which can cause cracking or weak zones at the joint. Special filler metals and procedures manage these differences. Correct procedure ensures a sound, durable joint.

107. A — No visible water in the gauge glass must be treated as a low-water condition: stop firing and verify the level before any refiring. Forcing cold water into a hot dry boiler can crack it. Assuming the worst protects against catastrophic failure.

108. C — A balancing valve is set to achieve the design flow rate through its branch so each zone receives its intended share of total flow. Without balancing, near zones overflow and far zones starve. Proper setting delivers designed comfort.

109. A — Admitting full steam at once causes severe water hammer and thermal shock as cold pipe suddenly meets hot steam and the resulting condensate is driven into slugs. Slow warmup with drainage prevents this. Gradual heating protects piping and equipment.

110. B — A siphon (pigtail) loop traps a plug of condensate that protects the gauge mechanism from direct live-steam heat, keeping the Bourdon tube cooler. The water seal isolates the instrument from steam temperature. It extends gauge life.

111. A — A zone valve that fails to open electrically usually has no power reaching the actuator — a failed transformer or an open thermostat circuit. Without power the actuator cannot drive the valve. Checking the control circuit isolates the fault.

112. B — Flow area scales with the square of diameter, so halving the diameter from 50 mm to 25 mm reduces the area to one quarter. The bore area, not the diameter, determines flow capacity. This sharp reduction affects velocity and pressure drop.

113. B — A steam separator removes entrained water droplets from the steam, improving its dryness before it reaches equipment. Wet steam reduces heat transfer and erodes components. Drier steam improves efficiency and protects downstream equipment.

114. C — A corrosive outdoor environment calls for corrosion-resistant bolts such as stainless or coated steel rated for the exposure. Plain carbon steel would rust and fail. Matching fastener material to the environment ensures joint integrity.

115. B — Operating far from the best efficiency point increases vibration, radial thrust, and bearing load, reducing pump reliability and life. Pumps are designed to run near the BEP. Staying close to it protects the equipment.

116. D — Fit-up gap and bevel are specified by the qualified welding procedure specification (WPS) for the material, thickness, and service. The WPS, not the welder's preference or the electrode, governs joint preparation. Following it ensures a code-compliant weld.

117. C — An inverted bucket trap loses prime when a sudden pressure drop or superheat flashes its water seal, letting the bucket sink and blow through live steam. The water seal is essential to its operation. A check valve ahead of the trap helps preserve prime.

118. B — A drip leg at the base of a riser collects condensate draining down the riser and directs it to a trap for removal. This keeps condensate out of the steam flow. Proper drip legs prevent water hammer at risers.

119. D — The margin between an 800 kPa operating pressure and a 1000 kPa set pressure prevents nuisance lifting of the relief valve during normal pressure fluctuations. Too small a margin causes frequent weeping and wear. Adequate margin ensures the valve lifts only on genuine overpressure.

120. C — A long-radius elbow provides smoother flow with less turbulence and pressure drop, improving suction conditions and reducing the risk of cavitation at the pump inlet. Short-radius elbows disturb the flow more. Smooth suction piping protects the pump.

121. B — On smelling gas, the first action is to eliminate ignition sources, shut off the gas supply, and ventilate, then find and repair the leak. Switching on a fan or striking a flame could ignite the gas. Removing ignition risk comes first.

122. A — Steam systems experience far greater temperature differences than cold-water systems, producing much larger pipe expansion that must be accommodated with loops and joints. The bigger temperature swing means bigger dimensional change. This makes expansion management critical in steam work.

123. D — Trimming (reducing) a centrifugal pump's impeller diameter reduces both the flow and the head it produces, moving its curve downward. This is a common way to match a pump to a lower duty. The affinity laws describe the reduction.

124. C — A buried gas line must pass a pressure test holding a specified pressure for a set duration before backfilling, confirming there are no leaks. A flame test is never acceptable. Pressure testing verifies integrity before the line is covered.

125. C — A steam quality of 0.95 means the steam is 95% dry vapour and 5% entrained liquid water by mass — slightly wet. Lower quality reduces heat content and can erode components. High quality is desirable for efficient, safe operation.

126. D — Reverse rotation of a centrifugal pump greatly reduces flow and head because the impeller is shaped to move liquid efficiently in one direction only. The pump still moves some liquid but well below design. Verifying rotation at startup is essential.

127. A — Returning condensate saves energy and treated water because the hot condensate is already purified and partly heated, reducing fuel and chemical costs. Discarding it wastes both heat and treated water. Condensate recovery is a core efficiency practice.

128. A — A smaller 25 mm pipe needs closer support spacing because it is less rigid and sags more easily under load than larger pipe. Support tables give maximum spans by size. Correct spacing prevents sagging and stress.

129. D — Thermal shock occurs when cold water suddenly contacts hot boiler metal, causing rapid uneven contraction that can crack the metal. Avoiding sudden temperature changes protects the boiler. This is why feedwater is preheated and warmup is gradual.

130. C — A repaired steam line is returned to service by warming it up slowly with drains open to remove condensate, then bringing it up to pressure gradually. This prevents water hammer and thermal shock. Controlled startup protects the repair and the system.