PRACTICE EXAM 14: RED SEAL PLUMBER SIMULATION (125 QUESTIONS)

1. A plumber working in a hospital mechanical room must solder a copper joint directly above a bundle of data communication cables (CAT6) that are not protected by conduit. The cables carry critical patient monitoring data. What must the plumber do before applying the torch?

A. Protect the cables with a noncombustible heat shield and wet cloth barrier to prevent heat damage to the cable insulation

B. Request that the IT department disconnect the cables temporarily so that heat damage will not affect active data transmission

C. Proceed with soldering because data cables are rated for temperatures well above the range produced by soldering copper

D. Reroute the copper pipe to a location at least 2 metres from all communication cables before soldering any joints

2. A plumber is assigned to install underground piping in a trench adjacent to a busy roadway. The edge of the trench is 1.5 metres from the live traffic lane. Heavy trucks pass at highway speed. What specific hazard does the proximity to vehicle traffic create for the trench?

A. Exhaust fumes from passing trucks will accumulate in the trench and displace oxygen below the safe breathing level

B. Noise from highway traffic prevents the plumber from hearing verbal warnings from coworkers at the trench surface

C. Vehicle vibration and surcharge loading from heavy trucks near the trench edge can cause the trench walls to collapse

D. Debris thrown from passing truck tires creates a projectile hazard that requires overhead netting across the trench

3. A plumber discovers that a power cord on a submersible pump has a small nick in the outer insulation jacket, exposing the inner conductors. The pump must be used to dewater a trench. Can the plumber use the pump with the damaged cord?

A. Yes — the inner conductor insulation provides adequate protection as long as the outer jacket damage is less than 25 mm

B. No — the damaged cord creates an electrocution hazard, especially in the wet conditions of a dewatering operation

C. Yes — but only if the damaged section is wrapped with electrical tape before the pump is submerged in the water

D. No — but the plumber can cut the cord, remove the damaged section, and splice it with wire nuts for immediate use

4. A plumber must install a pipe support on a concrete wall using a concrete expansion anchor. The wall has a hollow section behind the concrete face (a furring cavity). When the plumber drills through the concrete face, the drill breaks through into the hollow cavity after only 75 mm. The expansion anchor requires a minimum embedment of 100 mm in solid concrete. What must the plumber do?

A. Install the anchor at 75 mm depth because the concrete face provides adequate grip for the lightweight pipe support

B. Use a longer anchor that passes through the hollow section and expands against the back face of the concrete cavity

C. Install a toggle bolt through the concrete face and into the cavity space for a secure attachment in the hollow wall

D. Select a different anchor type (adhesive anchor or throughbolt) rated for the actual wall condition at this location

5. A plumber is calculating the total weight of a pipe assembly that will hang from overhead supports. The assembly consists of 15 metres of 3inch copper tube (2.7 kg/m), 8 fittings averaging 0.5 kg each, and the pipe will be filled with water (approximately 4.6 kg/m). What is the total operating weight?

A. Approximately 113.5 kg, calculated as pipe (40.5) + fittings (4.0) + water (69.0) = 113.5 kg for hanger design

B. Approximately 40.5 kg, calculated by using only the pipe weight without fittings or water for the hanger load

C. Approximately 69.0 kg, calculated by using only the water weight because water is the heaviest component

D. Approximately 200 kg, estimated using a simplified ruleofthumb of 13 kg per metre for filled 3inch copper pipe

6. A plumber is working on a renovation project where the existing building has been identified as containing leadbased paint on the walls and ceilings. The plumber must drill through a painted wall to install a pipe penetration. What precaution is required?

A. No precaution is needed because lead paint is only hazardous when ingested by children, not when drilled by adults

B. The plumber must wear a fullface suppliedair respirator because any disturbance of lead paint requires maximum protection

C. The plumber must minimize dust by using wet drilling methods or HEPAfiltered equipment to control lead paint particles

D. The plumber must remove all lead paint from the wall surface within 1 metre of the drill location before drilling begins

7. A plumber is reviewing a mechanical drawing and encounters a pipe run shown with two parallel lines and an "X" symbol at regular intervals. What does the "X" symbol typically indicate on a piping drawing?

A. A pipe cap or deadend termination at each "X" location along the run shown on the mechanical drawing

B. A flanged connection at each "X" location where the pipe can be disassembled for maintenance or replacement

C. A pipe support or hanger location at each "X" marked along the horizontal pipe run on the drawing

D. A valve (gate valve) at each "X" location for isolation and flow control along the pipe run section

8. A plumber is installing pipe in a confined mechanical chase that is 600 mm wide and 3 metres tall. The plumber can fit into the chase but movement is severely restricted. What classification does this space likely fall under?

A. A regular work space because the plumber can physically enter and perform work inside the chase enclosure

B. An elevated work space that requires only standard fall protection because of the 3metre height dimension

C. A tight work space that requires ergonomic assessment but no special entry procedures beyond normal safety practices

D. A confined space, requiring assessment for atmospheric hazards, restricted entry/exit, and potentially a confined space permit

9. A plumber must determine the amount of solder needed for a project. The rule of thumb for estimating solder length per joint is approximately equal to the pipe diameter. For a project with 50 joints on 3/4inch copper tube, how much solder wire is needed?

A. Approximately 37.5 inches (950 mm) of solder wire, calculated as 50 joints × 3/4 inch per joint for the total estimate

B. Approximately 75 inches (1,900 mm), calculated by doubling the pipe diameter per joint for a generous solder estimate

C. Approximately 12.5 inches (318 mm), calculated by dividing the total joints by 4 for the actual consumption rate

D. Approximately 150 inches (3,810 mm), calculated by multiplying the pipe diameter by 3 per joint for waste factor

10. A plumber discovers that the building's temporary construction power panel has a GFCI breaker that trips every time the plumber's rotary hammer drill is connected. No other tools trip the breaker. What is the most likely cause?

A. The rotary hammer drill's motor draws more current than the GFCI breaker can handle during the startup inrush period

B. The GFCI breaker is defective and must be replaced with a new breaker that can handle power tool loads on the circuit

C. The rotary hammer drill has a ground fault — leakage current is flowing from the tool's wiring through the grounding conductor

D. The temporary power panel's wiring is incorrect and the GFCI breaker is sensing neutraltoground voltage from the panel

11. A plumber is tasked with installing plumbing in a multistorey building under construction. The elevator shaft is open (no car installed). The plumber must work near the open shaft on the 4th floor. What protection is required at the shaft opening?

A. Only a verbal warning to other workers that the shaft is open and unprotected on the 4th floor work area

B. A guardrail system, physical barrier, or cover over the shaft opening that prevents workers from falling into the shaft

C. A personal fall arrest system worn by the plumber at all times while working within 5 metres of the open shaft

D. An observer stationed at the shaft opening who warns the plumber if they approach within 2 metres of the edge

12. A plumber must convert a pipe measurement from metric to imperial. The pipe run measures 4,572 mm. How many feet and inches is this?

A. 10 feet 6 inches, calculated by dividing 4,572 by 304.8 mm per foot then converting the remainder to inches

B. 18 feet 0 inches, calculated by dividing 4,572 by 254 mm per foot for the imperial conversion equivalent

C. 12 feet 3 inches, calculated by dividing 4,572 by 381 mm per foot for the standard metrictoimperial conversion

D. 15 feet 0 inches, calculated by dividing 4,572 by 25.4 mm per inch then converting the total inches to feet

13. A plumber is preparing a material takeoff for a project. The drawings show 25 joints on 1/2inch copper, 30 joints on 3/4inch copper, and 15 joints on 1inch copper. How many fittings must be ordered?

A. 70 fittings total — one fitting per joint regardless of pipe size, plus a reasonable waste and breakage allowance

B. 140 fittings — two fittings per joint because each joint connects two pipe ends that each require their own fitting

C. 35 fittings — one fitting for every two joints because each fitting has two sockets that connect to two adjacent pipes

D. 210 fittings — three fittings per joint to account for errors, damage, and the learning curve of apprentice workers

14. A plumber encounters a project specification that states: "All underground DWV piping shall be hydrostatically tested at 3 metres of head for a minimum duration of 15 minutes." The plumber installs the test apparatus and fills the system to 3 metres of head above the highest joint. What pressure does 3 metres of water head produce?

A. Approximately 30 kPa, calculated as 3 metres × 10 kPa per metre of water head for the hydrostatic test pressure

B. Approximately 3 kPa, calculated by dividing the head in metres by the standard atmospheric pressure constant

C. Approximately 29.4 kPa, calculated as 3 metres × 9.81 kPa per metre of water for the hydrostatic test pressure

D. Approximately 300 kPa, calculated by multiplying the head in metres by 100 kPa per metre for test accuracy

15. A plumber is working on a construction project and observes that a scaffolding system adjacent to the plumber's work area is missing its midrail on one section. The plumber does not work on scaffolding but must pass beneath it. Should the plumber report this condition?

A. No — the scaffolding is not part of the plumber's scope and reporting other trades' equipment is outside the plumber's responsibility

B. Yes — any worker who observes an unsafe condition on a construction site has a duty to report it regardless of whose equipment it is

C. No — but the plumber should avoid walking beneath the scaffolding section that is missing the midrail safety component

D. Yes — but only by mentioning it informally to the scaffold erector rather than filing a formal safety report on the condition

16. A plumber is cutting stainless steel pipe with an abrasive wheel (cutoff disc). What hazard is specific to cutting stainless steel that does not apply when cutting carbon steel?

A. Stainless steel produces less heat during cutting than carbon steel, which causes the abrasive wheel to glaze prematurely

B. Stainless steel cutting generates sparks that burn at a higher temperature than carbon steel sparks and ignite more readily

C. Stainless steel cutting produces no hazardous dust because the chromium content makes the particles chemically inert

D. Hexavalent chromium (Cr6+) — a carcinogenic compound generated when stainless steel is heated during cutting

17. A plumber is installing a copper water supply system using Type M copper tube. The specification calls for Type L. The plumber has only Type M in stock. Can the plumber substitute Type M for Type L?

A. Yes — Type M exceeds Type L in wall thickness and provides a stronger tube that surpasses the specification requirement

B. No — Type M has thinner walls than Type L and installing it where L is specified is a substitution that weakens the system

C. No — Type M has a thinner wall than Type L and does not meet the specification; it must be replaced with Type L

D. Yes — both types have identical outside diameters and pressure ratings, making them fully interchangeable in all applications

18. A plumber is installing CPVC hot water supply piping in a commercial building. The specification requires all joints to be made with onestep CPVC cement (no primer required). A coworker suggests using twostep PVC primer and CPVC cement instead because "it makes a stronger joint." Is the coworker correct?

A. No — some CPVC cements are formulated as onestep products that do not require primer; using PVC primer on CPVC may actually damage the material

B. Yes — twostep (primer + cement) always produces a stronger joint on all plastic piping regardless of the material type

C. No — but only because PVC primer is chemically identical to CPVC primer and using either produces the same joint quality

D. Yes — the primer softens the CPVC surface more thoroughly, producing deeper chemical penetration and a superior bond

19. A plumber encounters a situation where a 2inch copper pipe must transition to a 2inch stainless steel pipe for a section passing through a corrosive environment. What joining method connects these two dissimilar metals?

A. A soldered joint using silver brazing alloy that bonds both copper and stainless steel surfaces in a single operation

B. A flanged connection with a gasket that creates a mechanical joint while physically separating the two different metals

C. A compression coupling that grips both the copper and stainless steel pipe ends with identical brass ferrule compression

D. A grooved mechanical coupling or press fitting rated for both copper and stainless steel transitions at this joint

20. A plumber is bending 3/4inch soft copper tube using a spring bender. The tube must make a 90degree bend with a minimum bend radius. What happens if the plumber attempts a bend tighter than the minimum radius?

A. The tube maintains its full crosssection regardless of bend radius because soft copper is infinitely malleable

B. The tube wall on the outside of the bend thins and may kink or collapse, restricting flow through the deformed section

C. The spring bender prevents overbending by automatically stopping at the minimum radius for the tube size

D. The tube develops an oval crosssection that increases its flow capacity by creating a wider crosssectional profile

21. A plumber is installing Schedule 80 CPVC chemical waste pipe in a laboratory. The pipe must be joined using CPVC solvent cement. After applying cement and assembling a joint, the plumber notices that the pipe slid out of the fitting before the cement set. What caused this?

A. The cement was applied too thinly and did not create adequate tack to hold the pipe in the fitting during the cure period

B. The pipe end was not properly deburred, creating a sharp edge that scraped the cement from the fitting socket during insertion

C. The pipe was inserted but not held in place for the manufacturer's specified holding time after assembly of the connection

D. The CPVC pipe and fitting were manufactured from different formulations that are chemically incompatible with the cement

22. A plumber is installing a commercial fire sprinkler system using Schedule 40 black steel pipe with threaded joints. The pipe threads must be sealed with an approved thread sealant. The plumber uses PTFE tape. How many wraps of tape are typically applied to the male threads?

A. Three to five wraps of PTFE tape in the direction of the thread spiral so the tape tightens rather than unravels during assembly

B. One wrap of PTFE tape is always sufficient because the tape compresses to fill all thread voids during tightening

C. Ten or more wraps to create a thick layer that compensates for any thread imperfections on the cut pipe surface

D. PTFE tape wraps are not specified by number — the plumber applies tape until the threads are completely invisible

23. A plumber is brazing a copper joint on a refrigerant line and maintains the nitrogen purge throughout the brazing operation. After the joint cools, the plumber examines the interior of the pipe through an open end downstream. The interior should appear bright and clean. If the interior appears dark and scaled, what went wrong?

A. The brazing alloy used was incorrect for refrigerant service and produced toxic fumes that discoloured the pipe interior

B. The nitrogen flow rate was adequate but the gas purity was too low — industrial nitrogen was used instead of welding grade

C. The pipe was overheated beyond the copper's melting point, causing the interior surface to oxidize despite the nitrogen purge

D. The nitrogen purge failed or was insufficient — oxygen reached the heated interior surface and created copper oxide scale

24. A plumber is installing PEXA tubing and must make a repair on an existing run where a section has been damaged. The repair requires cutting out the damaged section and installing two new connections. What is the most common repair method for PEXA tubing?

A. Solvent cement applied to both the tube and a PEX coupling for a permanent chemical bond at each repair connection

B. Cold expansion fittings — the tube is expanded, the fitting inserted, and the tube shrinks to grip the fitting at each end

C. Heat fusion using a specialized PEX welding tool that melts and fuses the tube ends to the repair coupling together

D. Copper crimp rings on standard brass PEX fittings because PEXA and PEXB use identical connection methods

25. A plumber must select the correct hacksaw blade for cutting thinwall stainless steel tube (0.9 mm wall thickness). The rule of thumb requires at least 3 teeth in contact with the material at all times. What TPI (teeth per inch) blade is appropriate?

A. 14 TPI, which provides wide tooth spacing for fast cutting with adequate chip clearance for all materials and thicknesses

B. 18 TPI, which provides moderate tooth spacing that works well for mediumwall pipe and tube cutting operations

C. 32 TPI, which provides fine tooth spacing that keeps at least 3 teeth in contact with the thin 0.9 mm wall at all times

D. 8 TPI, which provides the widest spacing for maximum cutting speed on stainless steel regardless of wall thickness

26. A plumber is troubleshooting a multistorey commercial building where every time a water closet on the 5th floor is flushed, the water closet on the 3rd floor (directly below on the same stack) loses part of its trap seal. The 4thfloor water closet is unaffected. What is the most probable venting deficiency?

A. The 5thfloor water closet vent is blocked, causing the flush discharge to create a pressure wave in the stack

B. The 3rdfloor water closet has a cracked Ptrap that loses water regardless of what happens on the floors above

C. The 4thfloor connection acts as a natural pressure break that protects itself but deflects pressure to the 3rd floor

D. The 3rdfloor water closet's individual vent or the stack vent serving it is blocked or disconnected above the 3rd floor

27. A plumber discovers that an existing building's building drain changes from 4inch to 3inch midway through its horizontal run. The downstream (3inch) section connects to the building sewer. What code violation does this represent?

A. The building drain must maintain a constant diameter throughout its entire horizontal run without any diameter changes

B. Drainage pipe must never decrease in diameter in the direction of flow — this reduction creates a choke point for solids

C. The 3inch section is acceptable only if the building sewer connection is also 3 inches to match the reduced diameter

D. The reduction is acceptable if the total DFU on the 3inch section does not exceed the 3inch pipe's rated capacity

28. A plumber installs a DWV system in a building where the architect requires all vent piping in the attic to be insulated. The vent pipes carry warm, moist sewer gas that condenses when the pipe contacts cold attic air. What problem does this condensation create if the vents are not insulated?

A. Condensation runs down the vent pipe interior and can drip into the drainage system, potentially flooding the trap seals below

B. Condensation freezes on the cold vent pipe interior, gradually restricting the vent opening until airflow is blocked completely

C. Condensation corrodes the ABS or PVC vent pipe material from the interior surface, weakening the pipe over its service life

D. Condensation has no practical effect on vent performance because the moisture volume is too small to affect the airflow

29. A plumber is sizing a horizontal branch drain for a group of 6 lavatories in a commercial washroom. Each lavatory has a DFU rating of 1 (total 6 DFU). No water closets connect to this branch. What minimum pipe diameter is required?

A. 11/4 inches, because the minimum drain size for a lavatory is 11/4 inches and the branch matches the fixture connection

B. 2 inches, because the total of 6 DFU is within the maximum capacity of a 2inch horizontal branch drain at code slope

C. 11/2 inches, which is the minimum branch size for any horizontal drain regardless of the fixture count and DFU total

D. 3 inches, because any branch serving more than 4 fixtures requires a minimum 3inch pipe for adequate flow capacity

30. A plumber encounters a residential building where the kitchen sink drain connects to a 11/2inch horizontal branch that runs 4 metres to the soil stack. The sink has a garbage disposal. The disposal frequently clogs the branch. What modification would reduce the clogging?

A. Install a grease interceptor on the kitchen drain to capture the food particles before they enter the 11/2inch branch pipe

B. Increase the branch from 11/2 inches to 2 inches, which provides greater carrying capacity for the disposal's solid discharge

C. Install a cleanout at the midpoint of the 4metre branch to provide maintenance access when blockages occur in the run

D. Replace the garbage disposal with a higherhorsepower model that grinds waste finer before discharging to the branch

31. A plumber installs a septic system on a rural property. The septic tank receives all household wastewater — black water (toilets) and grey water (sinks, showers, laundry). The homeowner asks whether separating the grey water from the black water would reduce the load on the septic system. Is this correct?

A. No — separating grey water increases the septic system load because the grey water system requires its own treatment

B. Yes — but grey water separation requires a separate disposal field that meets the same code requirements as the main field

C. No — the combined flow provides the optimal balance of bacteria and nutrients that the septic treatment process requires

D. Yes — removing grey water from the septic system reduces the hydraulic load by approximately 5060% of total daily flow

32. A plumber is troubleshooting a commercial building where the main floor restroom has a persistent sewer gas odour. All traps have water, vents are clear, and a smoke test reveals no leaks. The restroom

has a urinal with a washout (flush) type flush valve. The plumber examines the urinal closely and discovers the source. Where is the gas entering?

A. Through the urinal's integral trap, which has a hairline crack in the ceramic below the visible water line at the base

B. Through the flush valve's vacuum breaker, which has a failed seal allowing sewer gas to escape during nonflush periods

C. Through the urinal's mounting bolts, which have lost their gasket seal where the fixture connects to the waste pipe

D. Through the urinal drain connection — the gasket between the urinal outlet and the waste pipe has deteriorated

33. A plumber installs a 3inch vent stack that must change direction from vertical to horizontal in the attic before continuing horizontally to the roof penetration. At the direction change, what fitting is appropriate for this verticaltohorizontal vent transition?

A. A standard 90degree elbow or a combination of two 45degree elbows for the verticaltohorizontal direction change

B. A sanitary tee with the branch pointing in the horizontal direction for the verticaltohorizontal vent transition

C. A longsweep 90degree elbow only — standard 90degree elbows are prohibited on all vent piping regardless of orientation

D. No fitting is needed — the PVC vent pipe can be heatbent at the direction change using a heat gun on the jobsite

34. A plumber discovers that a building's floor drain in a laundry room has been emitting a gurgling sound whenever the washing machine pump discharges. The floor drain has its own Ptrap with water and a separate vent. The washing machine standpipe is on the same branch. What is causing the gurgling at the floor drain?

A. The washing machine's trap or vent is blocked, causing its discharge to affect the shared branch and the floor drain

B. The washing machine's highvolume pump discharge pressurizes the shared branch, forcing air through the floor drain's trap

C. The floor drain's vent is blocked and the washing machine discharge creates negative pressure that pulls air through the seal

D. The building drain downstream has a partial blockage that backs up during the washing machine's peak discharge cycle

35. A plumber is installing a building sewer using SDR 35 PVC pipe with gasketed bellandspigot joints. The trench has been excavated through rocky ground. Before laying the pipe, the plumber must prepare the trench bottom. What preparation is required?

A. No preparation — SDR 35 PVC is rigid enough to be laid directly on rocky ground without any bedding preparation

B. Remove large rocks from the trench bottom and level it, but no additional bedding material is required for SDR 35 pipe

C. Install a concrete cradle along the entire trench bottom to protect the SDR 35 pipe from point loads at the rock contacts

D. Remove rocks and install a minimum 100 mm layer of compacted granular bedding material for uniform pipe support

36. A plumber encounters a building where the 4inch building drain has a 45degree wye fitting with a cleanout plug. The wye's branch is oriented pointing upstream (toward the fixtures) at a 45degree angle. When the plumber opens the cleanout plug, a cable or camera can be inserted into the branch opening. In which direction does the cable naturally travel?

A. Downstream toward the building sewer, because the wye branch angles in the direction of flow when inserted from the cleanout opening

B. Upstream toward the fixtures, because the wye branch is oriented pointing upstream as described in the question scenario

C. Both directions equally, because the cable can be directed in either direction regardless of the fitting's branch orientation

D. The cable cannot enter the drain because the 45degree wye angle is too sharp for standard drain cleaning equipment

37. A plumber is sizing a storm drainage horizontal conductor (horizontal pipe from the base of a leader to the storm drain outlet). The code requires a minimum slope of 1/8 inch per foot for horizontal storm drainage piping. The horizontal conductor must drain 300 m^2 of roof area at 100 mm/hr rainfall intensity. The code table shows: 4inch at 1/8" = 340 m^2 capacity. What minimum pipe size is required?

A. 3 inches, because the 300 m^2 area is within the 3inch pipe's capacity at 1/4inchperfoot slope for storm drainage

B. 5 inches, because storm drainage conductors must be one size larger than the calculated minimum for safety margin

C. 4 inches, because 340 m^2 capacity at 1/8" slope exceeds the 300 m^2 roof area served by this conductor section

D. 6 inches, because all horizontal storm drainage conductors must be a minimum of 6 inches regardless of calculation

38. A plumber installs a DWV system and must connect a 2inch horizontal branch to a 4inch horizontal building drain. The connection must be made with the correct fitting. Which fitting is appropriate for this horizontaltohorizontal connection?

A. A sanitary tee installed horizontally to connect the branch at a 90degree angle to the building drain's flow direction

B. A wye or combination wyeandeighthbend fitting that provides a swept entry from the branch into the drain's flow

C. A standard tee installed horizontally because horizontaltohorizontal connections can use any type of tee fitting

D. A reducing coupling that simply merges the 2inch branch into the 4inch drain without any directional sweep fitting

39. A plumber is troubleshooting a residential DWV system where the homeowner reports a "sucking" sound from the kitchen sink drain whenever the toilet in the adjacent bathroom is flushed. The kitchen sink and bathroom share a 3inch horizontal branch before the soil stack. What is the most likely cause?

A. The toilet's flush volume is too large for the shared 3inch branch and creates a hydraulic bore that affects the kitchen trap

B. The soil stack is undersized for the combined load of the kitchen and bathroom fixtures connected to the same branch

C. The kitchen sink's Ptrap is undersized and cannot maintain its seal against the pressure changes in the shared branch

D. The kitchen sink lacks an individual vent or the shared vent is inadequate, causing the toilet's flush to siphon the sink's trap

40. A plumber installs a 4inch building drain beneath a basement floor. The drain must be tested before the concrete slab is poured. The plumber chooses the air test at 35 kPa. After pressurizing, the gauge drops from 35 kPa to 30 kPa in the first minute. What does this indicate?

A. The system has a leak — even a 5 kPa drop in one minute indicates a significant leak that must be found and repaired

B. The 5 kPa drop is within the acceptable range for air tests on largediameter DWV systems during the stabilization period

C. The gauge is malfunctioning and should be replaced with a calibrated gauge before retesting the system for accuracy

D. Temperature change in the piping caused the air to contract, producing the apparent pressure drop on the gauge reading

41. A plumber encounters a building where the building sewer has been installed using corrugated HDPE pipe (commonly used for storm drainage). The sewer carries sanitary waste to the municipal connection. Is corrugated HDPE acceptable for a building sanitary sewer?

A. Yes — corrugated HDPE is approved for both storm and sanitary sewer applications in all Canadian jurisdictions

B. No — but smoothwall HDPE with fused joints is approved for sanitary sewer service in most jurisdictions

C. No — corrugated HDPE's rough interior surface and corrugation valleys trap solids and are not approved for sanitary service

D. Yes — but only if the corrugated pipe has a smooth interior liner that provides a clean flow path for sanitary waste

42. A plumber is installing a commercial kitchen's drainage system. The dishwasher discharges through an air gap device mounted on the countertop near the sink. The air gap has two branches — one from the dishwasher and one that connects to the disposal or drain. Water occasionally spills from the air gap during the dishwasher's drain cycle. What causes this spillover?

A. The air gap device is functioning correctly — occasional spillover during peak discharge is normal for commercial dishwashers

B. The drain line from the air gap to the disposal/drain is partially blocked or kinked, restricting the flow during the discharge cycle

C. The dishwasher's drain pump is too powerful for the air gap device's capacity and must be replaced with a loweroutput pump

D. The air gap device is installed too low on the countertop and the overflow height is below the dishwasher's maximum discharge head

43. A plumber installs a septic system disposal field using 100 mm (4inch) perforated pipe in gravelfilled trenches. The perforated pipe has two rows of holes. How must the holes be oriented during installation?

A. Holes facing upward, so effluent rises through the holes and flows over the pipe surface into the surrounding gravel

B. Holes facing sideways (3 o'clock and 9 o'clock), so effluent exits horizontally into the gravel on both sides of the pipe

C. Holes facing directly downward, so effluent drips down into the gravel bed beneath the pipe by gravity for maximum contact

D. Holes facing downward (4 o'clock and 8 o'clock), so effluent weeps into the gravel below for distribution through the trench

44. A plumber is troubleshooting a DWV system in a commercial building where a specific floor drain in the kitchen consistently backs up with grease despite regular drain cleaning. The drain is connected to the grease interceptor. Other drains connected to the same interceptor function normally. What is the most likely cause?

A. The individual branch pipe from this floor drain to the interceptor has a belly, sag, or flat spot where grease accumulates

B. The grease interceptor's inlet baffle is directing all incoming flow to the opposite side, bypassing this drain's connection

C. The floor drain's strainer basket is missing, allowing large food debris to enter and block the branch pipe to the interceptor

D. The interceptor is undersized for the total connected load and this floor drain is the farthest connection from the outlet

45. A plumber installs a vent terminal on a flat commercial roof. The terminal is located 1.5 metres from the building's rooftop HVAC air intake. The code requires a minimum separation of 3 metres between vent terminals and air intakes, or the vent must extend at a specified height above the intake. What must the plumber do?

A. Relocate the vent terminal to a position at least 3 metres from the air intake for code compliance and occupant safety

B. Install a charcoal filter on the vent terminal to remove sewer gas odour before it can be drawn into the air intake

C. Extend the vent terminal to at least 900 mm above the air intake opening to prevent sewer gas from entering the HVAC

D. Cap the vent terminal with a oneway valve that allows air out during drain discharge but blocks gas from escaping constantly

46. A plumber encounters a building where a 11/2inch trap arm serving a kitchen sink runs 2.5 metres horizontally before connecting to the vent. The code maximum trap arm length for 11/2inch pipe is 1.07 metres (42 inches). This trap arm exceeds the maximum by more than double. What problem does this create?

A. The excessive trap arm length creates a long horizontal section where grease and solids accumulate but airflow is unaffected

B. The long trap arm acts as an Strap — the distance creates a siphon effect that pulls the trap seal during discharge

C. The excessive length has no practical effect because trap arm limits are design guidelines rather than mandatory requirements

D. The long trap arm exceeds the maximum distance for effective vent protection, making the trap susceptible to siphonage

47. A plumber is installing a building sewer and must make a connection to the municipal sewer main. The municipal main is active and flowing. The connection is made through a saddle fitting on the main. What precaution applies during this "hot tap" connection?

A. The municipal sewer must be bypassed (flow diverted) before the saddle is installed to prevent sewage exposure

B. The plumber must wear full chemicalresistant PPE because contact with active sewage presents biological health hazards

C. The connection can be made with no special precautions because the sewer main is at atmospheric pressure during normal flow

D. The saddle fitting must be installed by the municipal utility's crew — plumbers are not authorized to connect to active mains

48. A plumber installs a 4inch PVC building drain beneath a concrete slab. After the drain is installed and inspected, the plumber must protect the pipe before the concrete is poured. What protection is needed?

A. Backfill around the pipe with compacted granular material to support the pipe uniformly before the concrete pour buries it

B. Wrap the pipe with plastic sheeting to prevent the concrete from bonding directly to the PVC pipe surface below the slab

C. Install a steel sleeve around the pipe at each slab penetration to prevent the concrete from crushing the PVC pipe

D. No protection is needed because PVC pipe is strong enough to withstand the weight and pressure of poured concrete

49. A plumber is sizing a circuit vent for a battery of 8 water closets in a commercial washroom. A circuit vent serves multiple fixtures from a single vent connection at the downstream end of the branch. What is the minimum vent diameter for a circuit vent serving 8 water closets (24 DFU) at a developed length of 10 metres?

A. 11/2 inches, which is the minimum vent diameter permitted by code for any vent pipe in a commercial DWV system

B. 2 inches, which accommodates 24 DFU at 10 metres per the code sizing table for vent diameter determination

C. 21/2 inches, which is the minimum for circuit vents because they serve multiple fixtures from a single connection

D. 3 inches, which matches 75% of the branch drain diameter for all circuit vent applications per the plumbing code

50. A plumber encounters a building where the foundation footer drain (perimeter drain) connects to the sanitary building drain inside the basement. During heavy rainfall, the footer drain overwhelms the building drain and causes sewage to back up through the basement floor drain. What is the correct separation?

A. The footer drain should connect to a sump pit with a pump that discharges to the storm drainage system or daylight

B. The footer drain connection to the sanitary drain is correct — the issue is the building drain is undersized for the combined load

C. The footer drain should connect to the sanitary sewer outside the building at the municipal connection point only

D. The footer drain must have a backwater valve that prevents the building drain from backing up during heavy rain events

51. A plumber installs a sewage ejector pit with a sealed cover. The cover has two pipe connections — one for the force main discharge and one for the vent. The plumber installs the vent but does not extend it to the roof — the vent terminates in the basement ceiling. Is this acceptable?

A. No — the ejector pit vent must connect to the building's DWV vent system and extend through the roof to open atmosphere

B. Yes — the ejector pit vent can terminate in the basement because the sealed cover prevents gas from entering the basement

C. No — but the vent can terminate at an air admittance valve in the basement instead of extending through the roof

D. Yes — but only if the basement has a continuously operating exhaust fan that removes any gas that escapes from the vent

52. A plumber is installing a septic system and must determine the minimum separation between the disposal field and the property line. The local code requires 3 metres (10 feet) minimum. The available lot layout allows only 2.5 metres between the field and the property line. What should the plumber do?

A. Install the field at 2.5 metres because the 0.5metre deficit is within the acceptable tolerance for separation distances

B. Reduce the number of trenches in the field to fit within the available space while maintaining the 3metre separation

C. Request a variance from the local authority, or redesign the system layout to achieve the minimum 3metre separation

D. Install the field at 2.5 metres and notify the neighbour in writing that effluent may migrate beyond the property boundary

53. A plumber discovers that an existing building's DWV system has two Ptraps in series on a bathtub drain — a Ptrap immediately below the tub and a second Ptrap at the wall connection 600 mm downstream. What code violation does this doubletrap configuration create?

A. Double traps create a crossconnection between the two trap seals that allows contaminated water to flow backward

B. Double traps are prohibited only on kitchen sinks because grease accumulates between the two seals more readily

C. Double traps create a sealed air pocket between the two seals that restricts drainage and prevents effective venting

D. Double traps cause the downstream trap to overflow during peak fixture discharge because the upstream trap slows the flow

54. A plumber is installing an underground building sewer using ductile iron pipe. The pipe must be protected from external corrosion in aggressive soil. What protection is typically applied to ductile iron sewer pipe for corrosion resistance?

A. A polyethylene encasement (loose wrap) that isolates the pipe from direct contact with the aggressive soil chemistry

B. A cathodic protection system using sacrificial zinc anodes attached to the pipe at regular intervals along the sewer run

C. An epoxy coating applied to the entire exterior of the pipe at the factory before shipping for corrosionresistant installation

D. A concrete encasement that completely surrounds the pipe and provides both structural and corrosion protection

55. A plumber is troubleshooting a commercial building where the grease interceptor alarm indicates it is full. The interceptor was pumped only 2 weeks ago. The restaurant's typical pump interval is 3 months. What sudden change could cause this rapid refilling?

A. The kitchen staff has changed dish detergent brands, and the new detergent emulsifies grease so it passes through the interceptor

B. A seasonal menu change has introduced highervolume frying operations that produce significantly more grease waste per day

C. The interceptor's outlet baffle has failed or been removed during the recent pumping, allowing grease to exit rather than accumulate

D. The kitchen's hot water temperature has been increased, melting the grease so it flows through the interceptor rather than separating

56. A plumber installs a sanitary building sewer and a storm building sewer that exit the building through the same foundation wall. The two pipes are 150 mm apart (centre to centre). The code requires a minimum separation between sanitary and storm sewers. Is 150 mm adequate?

A. Yes — the minimum separation between sanitary and storm sewers at a building foundation wall is typically 100 mm

B. No — the minimum separation is typically 300 mm (12 inches) or more depending on the jurisdiction's specific requirements

C. Yes — sanitary and storm sewers from the same building do not require minimum separation at the foundation wall exit

D. No — sanitary and storm sewers must exit the building through separate foundation walls with no shared wall penetrations

57. A plumber installs a residential water supply with a PRV set to 415 kPa (60 psi). The municipal supply pressure is 690 kPa (100 psi). A thermal expansion tank is installed on the cold water supply. After one year, the homeowner reports that the kitchen faucet has started to drip. The plumber tests the system pressure and finds it at 620 kPa (90 psi) — well above the PRV setting. What is the most likely cause?

A. The PRV has failed — its internal mechanism can no longer reduce the 690 kPa municipal pressure to the 415 kPa set point

B. The expansion tank has failed and thermal expansion is pushing pressure above the PRV setting during heating cycles

C. The municipal supply pressure has increased beyond the PRV's rated capacity for pressure reduction performance

D. The water heater thermostat is set too high, creating excessive thermal expansion that overwhelms both the PRV and tank

58. A plumber discovers that a commercial building's hot water system has a recirculation return line that is not insulated. The supply piping is fully insulated. The return line runs 30 metres through an unheated parking garage beneath the building. What is the consequence of the uninsulated return line?

A. The uninsulated return line delivers cold water to the heater inlet, causing thermal shock to the heat exchanger

B. The uninsulated return line has no effect because the recirculation pump maintains adequate water velocity for heat retention

C. The uninsulated return line loses significant heat, causing the recirculation pump and water heater to work harder continuously

D. The uninsulated return line creates condensation on the exterior that drips onto vehicles in the parking garage below

59. A plumber installs a water supply for a commercial building with a laboratory. The lab has a deionized (DI) water system that produces ultrapure water for experiments. The DI system connects to the potable water supply through a backflow preventer. What level of backflow prevention is required?

A. An atmospheric vacuum breaker because DI water is purer than potable water and cannot contaminate the supply

B. An RP (reduced pressure) device because the DI system's chemical regeneration creates a health hazard crossconnection

C. A DCVA because DI water is nontoxic and the DI system does not introduce any hazardous chemicals into the supply

D. No backflow prevention because DI water is purer than potable water and backflow would actually improve potable quality

60. A plumber is troubleshooting a residential water system where the homeowner reports a "hammering" noise every time the dishwasher's solenoid valve closes. No other fixtures produce the noise. What is the most effective solution?

A. Replace the dishwasher with a model that has a slowerclosing solenoid valve to reduce the water hammer impact force

B. Install a PRV on the main service to reduce the overall system pressure and minimize the hammer energy throughout

C. Install a flow restrictor on the dishwasher supply to slow the water velocity before it reaches the solenoid valve

D. Install a water hammer arrestor on the hot water supply branch near the dishwasher's solenoid valve connection point

61. A plumber is installing a water service from the municipal main to a new residential building. The distance from the main to the building is 25 metres. The plumber must select the service pipe material. The soil is acidic (pH 5.5). What material consideration applies?

A. Acidic soil accelerates corrosion of metallic pipe — copper Type K with proper bedding or HDPE with fused joints is recommended

B. Acidic soil has no effect on underground water service pipe materials because all approved materials resist soil chemistry

C. Only PVC pipe is approved for acidic soil conditions because all metallic pipe materials corrode rapidly below pH 6.0

D. The plumber must install a cathodic protection system regardless of the pipe material selected for the acidic soil conditions

62. A plumber installs a water heater with a combination temperature and pressure (T&P) relief valve. The valve is rated at 99°C (210°F) and 1,035 kPa (150 psi). After installation, the plumber lifts the T&P valve lever to verify it operates. Water flows freely when the lever is lifted and stops when released. Is this test sufficient?

A. No — the T&P valve must also be tested by heating the water above 99°C to verify the temperature sensing element activates

B. No — a comprehensive test requires a calibrated pressure test that verifies the valve opens at exactly 1,035 kPa under load

C. Yes — lifting the lever and verifying water flow confirms the valve is not stuck and will function when triggered by temperature or pressure

D. Yes — but the plumber must also inspect the valve's discharge pipe routing and termination for code compliance at this time

63. A plumber discovers that a building's copper water supply piping has sections of greencorroded pipe where it runs through a concrete slab. The corrosion is localized at the concrete contact points. What protective measure should have been installed?

A. The copper pipe should have been coated with anticorrosion paint before being embedded in the concrete slab

B. The copper pipe should have been sleeved in plastic pipe or wrapped in protective tape where it contacts concrete

C. The copper pipe should have been replaced with CPVC at all concrete contact points to avoid the corrosion issue

D. The concrete mix should have used lowalkali cement to prevent the alkaline reaction with the copper pipe surface

64. A plumber is installing a water supply for a commercial building with a cooling tower on the roof. The cooling tower's makeup water supply connects to the potable main. The cooling tower uses chemical treatment including biocides and corrosion inhibitors. What backflow prevention is required on the makeup supply?

A. A DCVA because cooling tower chemicals at typical concentrations are classified as a minor nonhealth hazard

B. An atmospheric vacuum breaker at the top of the makeup supply riser above the cooling tower's overflow level

C. No backflow prevention because the cooling tower is an open atmospheric system that cannot create backpressure

D. An RP device because the cooling tower's chemical treatment creates a severe health hazard crossconnection

65. A plumber tests a residential water supply system at 690 kPa (100 psi) for 2 hours. During the test, the ambient temperature rises from 15°C in the morning to 30°C by midafternoon. The pressure gauge shows an increase from 690 kPa to 720 kPa. Has the system failed the test?

A. No — the pressure increase is caused by thermal expansion of the water as the ambient temperature rose during the test period

B. Yes — any pressure change during a hydrostatic test indicates a leak or system integrity failure that must be investigated

C. No — pressure increases are impossible in a sealed system and the gauge must be malfunctioning or reading incorrectly

D. Yes — the pressure increase indicates the system is absorbing water from an unknown source through a crossconnection

66. A plumber installs a water supply for a commercial building with a coffee vending machine. The machine connects to the potable supply and has an internal mixing chamber where water contacts coffee grounds and flavoring compounds. What backflow prevention is required?

A. No backflow prevention because coffee machines are considered foodgrade appliances with no contamination risk

B. A dual check valve that provides basic protection against backflow from the machine into the potable supply system

C. An RP device because the internal mixing of water with coffee and chemicals creates a health hazard crossconnection

D. An atmospheric vacuum breaker mounted above the machine's highest water level for backsiphonage protection

67. A plumber discovers that a residential water heater has been installed with the cold water supply connected to the hot water dip tube port and the hot water supply connected to the cold water inlet port. The homeowner reports adequate hot water temperature. What problem exists despite the adequate temperature?

A. The reversed connections reduce the heater's efficiency because cold water enters at the top and stratification is disrupted

B. The reversed connections create a crossconnection between the hot and cold water distribution systems throughout the building

C. No problem exists — the water heater functions identically regardless of which port receives the cold water supply connection

D. The reversed connections cause the T&P valve to discharge because thermal expansion occurs at the wrong end of the tank

68. A plumber is installing a water supply to a commercial ice machine. The ice machine manufacturer requires the supply pressure to be between 140 kPa and 550 kPa (2080 psi). The building's supply pressure is 690 kPa (100 psi). What must be installed on the ice machine's supply?

A. A pressurereducing valve set to 415 kPa (60 psi) to bring the supply within the manufacturer's required pressure range

B. A flow restrictor that limits the volume of water entering the ice machine to the manufacturer's specified flow rate

C. A backflow preventer that reduces the pressure as a secondary benefit of its internal check valve and spring mechanism

D. A pressure booster that increases the supply to the maximum 550 kPa for optimal ice production rate and quality

69. A plumber installs a residential water system with PEX tubing. The homeowner later complains that hot water takes "forever" to arrive at the master bathroom — the farthest fixture from the water heater. The PEX layout uses a trunkandbranch system with 3/4inch trunk and 1/2inch branches. The distance from the heater to the master bath is 20 metres. What characteristic of PEX contributes to this problem?

A. PEX has a smoother interior than copper, which reduces friction and allows heat to dissipate faster during standby periods

B. PEX is an insulator — it retains heat longer than copper, so the complaint must be caused by a different system factor

C. PEX has higher thermal resistance than copper, which should actually keep water warmer longer during standby periods

D. PEX has a larger internal diameter than copper at the same nominal size, holding more water volume that must be purged before hot arrives

70. A plumber is installing a dedicated water supply for an emergency eyewash station in a laboratory. The station must deliver tepid water (1638°C) at a minimum flow rate of 1.5 litres per minute for 15 minutes. The building's hot water supply is 60°C and the cold supply is 10°C. What provides the tepid water?

A. A thermostatically controlled mixing valve blends the hot and cold supplies to deliver water within the tepid 1638°C range

B. A thermostatic mixing valve that blends hot and cold water to deliver tepid water at the required temperature range

C. The cold water supply alone, which warms to tepid temperature through the ambient heat in the pipe over the 15minute duration

D. A dedicated pointofuse water heater that heats the cold supply to the required tepid temperature at the eyewash station

71. A plumber is troubleshooting a commercial building's domestic hot water system. The system has two water heaters piped in parallel (both connected to the same supply and return headers). One heater's circulator has failed. The building occupants report reduced hot water temperature but not a complete loss. Why does the system still produce some hot water?

A. The failed circulator allows hot water to thermosiphon naturally from the heater to the header without pump assistance

B. The operating heater's circulator creates flow through both heaters by pulling water through the failed heater's piping loop

C. The failed heater's stored hot water continues to deliver heat to the system for several hours before cooling completely

D. Both options A and C are possible — thermosiphon from the failed heater and depletion of its stored hot water both contribute

72. A plumber installs a frostfree hose bibb that extends 350 mm through an exterior wall. The wall is insulated with fibreglass batt insulation. After installation, the plumber verifies that the insulation is packed tightly around the hose bibb's long stem inside the wall cavity. Is this insulation installation correct?

A. Yes — tight insulation around the stem prevents cold air from reaching the interior shutoff seat through the wall cavity

B. No — insulation must be placed on the warm side of the stem only, leaving the cold side exposed for proper drainage

C. Yes — but a vapour barrier must also be wrapped around the insulation to prevent moisture migration to the cold side

D. No — insulation around the stem can trap moisture and cause corrosion of the brass stem inside the insulated wall cavity

73. A plumber discovers that a building's water supply has a section of galvanized steel pipe that is severely corroded internally. The corrosion has reduced the 3/4inch pipe's effective internal diameter to approximately 1/2 inch. The homeowner reports low water pressure at all downstream fixtures. What is the correct repair?

A. Flush the galvanized pipe with a strong acid solution to dissolve the internal corrosion deposits and restore full bore

B. Install a booster pump downstream of the corroded section to compensate for the friction loss through the restriction

C. Snake the pipe with a mechanical cable to break up the internal corrosion deposits and restore the original pipe bore

D. Replace the corroded galvanized section with new copper or PEX piping to permanently restore full flow capacity

74. A plumber installs a water heater with an electronic ignition (no standing pilot). During a power outage, the water heater will not produce hot water because the electronic ignition requires electricity. The homeowner asks if a battery backup can power the electronic ignition. Is this feasible?

A. Yes — some water heater manufacturers offer battery backup modules specifically designed for their electronic ignition systems

B. Yes — a standard 12V car battery can power any electronic ignition system during a power outage for several days of operation

C. No — electronic ignition systems require 120V AC power that cannot be provided by any battery backup system available

D. No — the gas valve also requires electrical power, so even with ignition backup the heater cannot operate during an outage

75. A plumber is installing a water supply for a commercial building with a fire sprinkler system. The water service from the municipal main splits into two branches inside the building — one for domestic supply and one for fire sprinkler supply. The domestic branch passes through a water meter and PRV. The fire sprinkler branch bypasses both. Why does the sprinkler branch bypass the meter and PRV?

A. The meter creates friction loss that reduces the available fire flow, and the PRV reduces pressure needed for sprinkler operation

B. Fire sprinkler systems are exempt from water metering because fire water is not billed by the municipality during fire events

C. The sprinkler branch requires unrestricted flow and full municipal pressure for fire suppression — the meter and PRV would limit both

D. The fire sprinkler system has its own dedicated meter and PRV located at the fire department connection on the exterior wall

76. A plumber installs a commercial hand sink in a healthcare facility. The sink must have handsfree faucet operation. The plumber selects a sensoractivated faucet with a 0.5 GPM aerator. After installation, the healthcare staff complains that the water flow is too low to effectively wash their hands. What is the minimum flow rate typically required for effective handwashing at healthcare hand sinks?

A. 0.5 GPM is adequate for handwashing — the complaint is about the sensor timing, not the flow rate at the faucet outlet

B. 1.0 GPM is the minimum for effective handwashing in healthcare settings because lower flows cannot rinse soap adequately

C. 0.5 GPM with a laminar flow device provides equivalent cleaning effectiveness to higherflow aerators in all applications

D. 2.0 GPM is the minimum for all healthcare handwashing stations regardless of the fixture type or aerator technology

77. A plumber is troubleshooting a residential gas water heater that will not ignite. The status light on the gas control valve blinks a diagnostic code indicating "thermopile voltage low." What component produces the thermopile voltage?

A. The thermopile is located in the gas control valve's electronic circuit board and generates voltage from the main power supply

B. The thermopile is an external sensor mounted on the tank exterior that measures the ambient room temperature continuously

C. The thermopile is a device in the pilot flame that generates millivolt electrical power from the heat of the burning pilot flame

D. The thermopile is a battery inside the gas control valve that provides startup power and is replaced during annual service

78. A plumber services a commercial water softener. The building maintenance staff reports that the softener's brine tank has a thick salt crust (salt bridge) at the top of the salt bed, with an air gap beneath it. The salt appears full when viewed from the top, but the brine solution beneath is depleted. What does this condition cause?

A. The salt bridge has no effect because the brine solution regenerates the resin regardless of the salt bridge condition above

B. The softener cannot regenerate properly because the brine solution is weak or nonexistent — untreated hard water passes through

C. The salt bridge improves the brine concentration by acting as a filter that purifies the dissolving salt before it reaches the brine

D. The salt bridge causes the softener to use excessive salt because the concentrated brine on top dissolves faster than normal

79. A plumber installs a residential water treatment system for a well with the following contaminants: iron (5 ppm), manganese (0.5 ppm), and hydrogen sulfide (2 ppm). What type of treatment system addresses all three contaminants?

A. A water softener that removes iron and manganese through ion exchange and hydrogen sulfide through resin adsorption

B. A sediment filter followed by an activated carbon filter that captures all three contaminants through mechanical filtration

C. A chlorine injection system followed by a retention tank and carbon filter that removes all three through oxidation and filtration

D. An oxidizing filter (such as air injection or chemical oxidation) that converts dissolved iron, manganese, and H_2S to filterable particles

80. A plumber discovers that a residential electric water heater produces hot water from the topfloor fixtures but only lukewarm water from the groundfloor fixtures. The heater is in the basement. The plumber suspects the lower heating element has failed. How does the plumber verify this diagnosis?

A. Turn off power, remove the access panel, and use a multimeter to test the lower element for continuity — an open circuit confirms failure

B. Drain the tank and visually inspect the lower element for visible scale buildup or physical damage to the element surface

C. Touch the tank exterior near the lower element — if the surface is cool while the upper area is hot, the lower element has failed

D. Run hot water for 10 minutes and measure the temperature at a groundfloor fixture — lukewarm confirms the lower element

81. A plumber installs a residential fire sprinkler system (NFPA 13D) using CPVC piping. The system is a standalone system with a dedicated connection to the water supply. The system must include a flow switch, a drain, and a test connection. What does the test connection allow?

A. The test connection simulates a single sprinkler head opening, allowing the flow switch and alarm to be tested without activating a head

B. The test connection allows the system to be pressuretested at installation and annually without disturbing any sprinkler heads

C. The test connection provides a drain point for winterization of the sprinkler system in buildings that are unheated seasonally

D. The test connection allows a water sample to be drawn from the sprinkler system for annual water quality testing and analysis

82. A plumber is troubleshooting a residential tankless water heater that displays an error code for "ignition failure." The plumber verifies the gas supply is on and the gas pressure at the heater inlet is correct. What should be checked next?

A. The vent system — a blocked vent prevents the combustion air from entering and the pressure switch will not close to allow ignition

B. The incoming water filter — a clogged filter reduces flow below the minimum activation threshold, preventing burner ignition

C. The electrical supply — a tripped GFCI or blown fuse prevents the electronic ignition module from generating a spark for the burner

D. The igniter and flame sensor — a dirty or failed igniter cannot produce a spark, or a dirty flame sensor cannot detect the flame

83. A plumber installs a wholehouse reverse osmosis system for a residential well water application. Unlike pointofuse RO (undersink), the wholehouse system treats all water entering the building. What unique challenge does a wholehouse RO system present?

A. Wholehouse RO produces extremely acidic water (pH 5.0) that corrodes all copper piping throughout the building rapidly

B. Wholehouse RO requires a repressurization pump and storage tank because the RO process reduces pressure significantly

C. Wholehouse RO removes all chlorine, allowing bacterial growth in the distribution piping that pointofuse systems avoid

D. Wholehouse RO is physically identical to pointofuse systems and presents no unique challenges beyond scale difference

84. A plumber replaces a kitchen faucet and connects the flexible supply tubes to the shutoff valves beneath the sink. After turning on the water, the plumber notices a slow drip at the supply tube connection to the shutoff valve. The plumber tightens the compression nut an additional halfturn. The drip stops. Is this a reliable repair?

A. Yes — a halfturn of additional tightening on a compression fitting is a standard adjustment that produces a lasting seal

B. No — the compression fitting should have sealed on the initial tightening; overtightening may have cracked the ferrule

C. Yes — but the plumber should return in 24 hours to verify the connection is still dry after the compression fully seats

D. No — the drip indicates the supply tube's ferrule is misaligned and the fitting must be disassembled and reassembled

85. A plumber installs a commercial prerinse spray valve in a restaurant kitchen. The valve has a builtin vacuum breaker on the spray head. During a routine health inspection, the inspector notes that the vacuum breaker is located only 25 mm above the flood level rim of the pot sink. The code requires the vacuum breaker to be a minimum of 150 mm (6 inches) above the flood rim. Is this installation compliant?

A. Yes — builtin vacuum breakers on prerinse spray valves are exempt from the 150 mm elevation requirement

B. No — but the spray valve can remain if the pot sink is equipped with an air gap on its drain as an alternative protection

C. No — the vacuum breaker must be at least 150 mm above the sink's flood level rim regardless of its builtin location

D. Yes — but only during normal operation; the spray head must be stored above the 150 mm height when not in active use

86. A plumber services a residential water heater and discovers that the T&P relief valve discharge pipe has been extended and routed to a laundry tub drain through a direct connection. The discharge pipe enters the laundry tub through a hole drilled in the side of the tub. Is this routing acceptable?

A. Yes — routing the T&P discharge to a laundry tub prevents hot water from pooling on the floor and creating a slip hazard

B. No — the T&P discharge must terminate with an air gap and at a visible location; a direct connection to a drain is prohibited

C. Yes — but only if the connection includes a check valve that prevents drain water from backing up into the T&P discharge pipe

D. No — but the discharge can connect to the laundry tub through an air gap (terminating above the tub's flood level rim)

87. A plumber installs a water treatment system that includes an iron filter (birm type) on a residential well supply. The filter requires a specific minimum pH for effective iron removal. The well water has a pH of 6.2, which is below the filter's minimum requirement of 6.8. What must be installed before the iron filter?

A. A sediment filter that removes particulate iron before the water reaches the birm filter for dissolved iron treatment

B. A carbon filter that adsorbs the dissolved iron before the water reaches the birm filter for residual iron treatment

C. A UV disinfection system that oxidizes the iron using ultraviolet light before the water reaches the birm filter inlet

D. A pH correction device (soda ash feeder or calcite filter) that raises the pH above 6.8 before the water enters the iron filter

88. A plumber installs a commercial sensor faucet in a public washroom. The sensor has adjustable settings for detection range, run time, and idle shutoff. After installation, the faucet occasionally activates on its own when no one is in front of the sensor. What is the most common cause of phantom activations?

A. Reflective surfaces near the sensor (mirrors, polished chrome, glossy tile) reflect the infrared beam back to the receiver

B. Electromagnetic interference from nearby electrical equipment (hand dryers, lighting) triggers the sensor's detection circuit

C. Temperature fluctuations from the HVAC system create air movement that the sensor interprets as a user's presence

D. The sensor's detection range is set too high and is detecting movement from people passing in the corridor outside

89. A plumber is troubleshooting a residential water softener that produces soft water intermittently — some days the water is soft and other days it is hard. The salt level in the brine tank is adequate. The softener's timer is set correctly for regeneration. What is the most likely cause?

A. The resin bed has channeled — water follows preferential paths through the resin, sometimes bypassing the exchange process

B. The water supply hardness fluctuates daily, exceeding the softener's capacity on some days but not on others

C. The softener's control valve has a worn piston or seal that intermittently allows hard water to bypass the resin bed

D. The municipal water supply alternates between two source wells with different hardness levels on different days

90. A plumber installs a residential water heater with a heat trap nipple on both the hot and cold connections. The heat trap nipple has a builtin check ball or flapper that prevents thermosiphon heat loss when the heater is idle. The homeowner reports a "clicking" or "tapping" sound from the water heater during hot water draws. What causes this noise?

A. The heat trap nipples are functioning normally — the clicking sound is the check ball or flapper opening and closing with flow

B. The heat trap nipples are installed backward, causing the check mechanisms to chatter during flow in the wrong direction

C. The heat trap nipples are defective and the clicking indicates the check mechanism is failing and needs immediate replacement

D. The clicking is caused by thermal expansion of the nipples against the tank connections and is unrelated to the heat traps

91. A plumber is installing a commercial kitchen pot filler faucet. The pot filler is a wallmounted faucet located above the commercial range. The faucet swings out over the range to fill large pots directly on the burner. What backflow prevention is required on this fixture?

A. A builtin atmospheric vacuum breaker on the pot filler faucet because the spout may be submerged in a pot of contaminated liquid

B. An RP device on the supply branch because the pot filler is located above a heat source that could create backpressure

C. No backflow prevention because the pot filler discharges above the flood rim of any fixture and no submersion is possible

D. A dual check valve on the supply branch because the pot filler's swing arm creates a potential crossconnection hazard

92. A plumber installs a hydronic heating system with a modulating condensing boiler. The system operates at 40°C supply and 30°C return during mild weather. During extreme cold, the supply increases to 80°C and the return to 60°C. At which operating condition does the boiler achieve maximum condensing efficiency?

A. At 80°C supply / 60°C return because higher temperatures produce more flue gas moisture for condensation recovery

B. At both conditions equally because the boiler's modulation adjusts efficiency to remain constant at all temperature ranges

C. At an intermediate condition (60°C supply / 45°C return) where the balance between heat output and condensation is optimal

D. At 40°C supply / 30°C return because the lower return temperature is well below the flue gas dew point of approximately 55°C

93. A plumber is troubleshooting a hydronic system where the boiler fires normally but no heat reaches the radiators. The circulator pump is running (verified by touching the motor — it is warm and vibrating). The supply pipe immediately after the pump is warm, but the pipe 3 metres downstream is cold. What is the most likely cause?

A. The circulator's impeller is spinning on the shaft — the motor runs but the impeller is not coupled to the shaft and no water moves

B. The expansion tank has failed and is restricting flow through the system by creating an air lock at the tank connection point

C. The boiler's highlimit has tripped and is preventing the water from reaching full temperature before entering the distribution piping

D. A zone valve between the pump and the distribution piping is closed, blocking water flow from reaching the radiators downstream

94. A onepipe steam heating system has a boiler that operates at 2 psig maximum. The system has 10 radiators. During startup, the plumber observes that steam reaches the first 3 radiators within 5 minutes but the remaining 7 radiators take 30 minutes to heat. What is the most effective solution to equalize heating speed?

A. Install fasterventing main air vents at the ends of the steam supply mains and slower thermostatic vents on the nearboiler radiators

B. Increase the boiler's operating pressure from 2 psig to 5 psig to push steam to the distant radiators faster

C. Replace all 10 radiator supply valves with thermostatic radiator valves that modulate steam flow to each individual radiator

D. Install a second boiler dedicated to the 7 distant radiators for independent temperature control of each building zone

95. A plumber discovers that a hydronic system's pressure relief valve has been discharging small amounts of water onto the mechanical room floor. The discharge occurs only during boiler firing cycles. The system pressure reaches 195 kPa during operation. The relief valve is rated at 207 kPa (30 psi). What is the most likely cause?

A. The relief valve spring has weakened and opens at a pressure below its rated setting due to age and cycling fatigue

B. The expansion tank has lost its precharge or the bladder has failed, causing the system pressure to approach the relief setting during heating

C. The boiler's operating aquastat is set too high, heating the water to nearboiling temperatures that overpressurize the system

D. The circulator pump's head pressure adds to the system pressure during operation, pushing the total above the relief setting

96. A plumber is installing a radiant floor heating system in a bathroom. The PEX tubing will be embedded in a thinset mortar bed beneath ceramic tile. The room has a floor drain. The plumber must route the PEX tubing around the floor drain. What is the minimum clearance between the PEX tubing and the floor drain fitting?

A. 50 mm (2 inches) minimum to prevent the drain trap from overheating and melting if it is a plastic trap material

B. 100 mm (4 inches) minimum to prevent the floor drain area from becoming uncomfortably hot under the tile surface

C. No minimum clearance is specified — the PEX can run directly adjacent to the floor drain fitting without restriction

D. 200 mm (8 inches) minimum to provide access for future drain maintenance without disturbing the embedded PEX tubing

97. A plumber is commissioning a twozone hydronic system. Zone 1 (master bedroom) heats normally. Zone 2 (living room) does not heat — the radiators remain cold. The plumber checks the zone valve for Zone 2 and finds 24V at the motor terminals, but the valve does not open. What has failed?

A. The 24V transformer is overloaded and cannot provide adequate current to operate the Zone 2 valve motor

B. The zone valve's end switch has failed, preventing the valve from signaling the boiler to fire for this zone call

C. The zone valve motor has failed — it receives voltage but the internal motor or gear mechanism cannot drive the valve open

D. The thermostat wiring has a highresistance connection that provides voltage but insufficient current to operate the valve

98. A plumber installs a hydronic boiler with a primarysecondary piping configuration. The primary loop connects the boiler to a pair of closelyspaced tees. The secondary loop connects to the distribution manifold through the same closelyspaced tees. What do the closelyspaced tees accomplish?

A. They create a large pressure drop that forces all water from the primary loop into the secondary loop for maximum heat transfer

B. They hydraulically decouple the primary and secondary loops — each loop's pump operates independently without interference

C. They provide a mixing point where primary and secondary water blend to achieve the desired distribution supply temperature

D. They eliminate the need for a circulator on the secondary loop because the primary pump's pressure drives both loops

99. A plumber discovers that a steam boiler's gauge glass is completely empty — no water is visible at any level. The boiler is firing. What immediate action is required?

A. Shut down the boiler immediately — a dry gauge glass indicates the water level may be dangerously low, risking overheating and failure

B. Add cold water through the feed valve to restore the visible water level in the gauge glass before the boiler overheats

C. Open the bottom blowdown valve to flush sediment that may be blocking the gauge glass connections from the boiler

D. The gauge glass may be blocked — open the glass's drain cock to verify whether water flows, confirming the glass readings

100. A plumber is balancing a hydronic system and measures the following ΔT across each zone: Zone 1 = 9°C, Zone 2 = 11°C, Zone 3 = 14°C. The design ΔT is 11°C. The plumber partially closes Zone 1's balancing valve and opens Zone 3's valve. After remeasuring: Zone 1 = 10°C, Zone 2 = 12°C, Zone 3 = 12°C. Why did Zone 2's ΔT change even though the plumber did not adjust Zone 2's valve?

A. Zone 2's reading fluctuated due to measurement timing — the temperature was caught during a brief heating cycle transition

B. Adjusting Zone 1 and Zone 3 redistributed the total system flow, changing the flow through Zone 2 even without adjusting its valve

C. Zone 2's thermostat changed its call during the balancing process, independently altering the zone's heat demand and flow

D. The plumber's adjustments to other zones changed the total system pressure, which the circulator compensated for across all zones

101. A plumber installs a condensing boiler and must route the condensate drain to the building's sanitary drainage system. The condensate is acidic (pH 3.5). The drain piping is copper within the mechanical room. Is copper acceptable for condensing boiler condensate drainage?

A. Yes — copper is resistant to all pH levels and provides superior corrosion resistance for acidic condensate drainage piping

B. No — copper requires a neutralization kit but the piping itself is acceptable after neutralization raises the pH above 5.0

C. No — acidic condensate corrodes copper piping; the condensate drain should use PVC, CPVC, or polypropylene piping

D. Yes — but only if the copper piping is Type K (heaviest wall) to provide maximum corrosion resistance for the acid exposure

102. A plumber discovers that a hydronic system has both a standard steel expansion tank (no bladder) and a diaphragm expansion tank connected to the system simultaneously. The original installer added the diaphragm tank without removing the old steel tank. What problem does this create?

A. The two tanks interfere with each other — the steel tank absorbs water that the diaphragm tank needs for proper expansion control

B. The combined tank volume is too large, causing the system pressure to remain too low during heating and triggering the fill valve

C. The old steel tank introduces air into the system water continuously because it has no bladder to separate air from water

D. No problem — having two expansion tanks provides redundant protection that improves system reliability during operation

103. A plumber is troubleshooting a steam boiler that produces loud, rhythmic banging (water hammer) during startup. The banging occurs in the steam supply mains, not in the radiators. What is the most common cause of water hammer in steam supply mains during startup?

A. The steam supply mains are not properly sloped to allow condensate to drain back to the boiler by gravity during startup

B. The boiler's operating pressure is set too high, causing steam to advance too rapidly through the cold supply mains

C. The steam supply valves at the boiler header are opened too quickly, creating a pressure wave that hammers the mains

D. Condensate has accumulated in the steam supply mains during the offcycle and incoming steam contacts the standing water violently

104. A plumber installs a hydronic system with an outdoor wood boiler connected to the building's indoor heating system through an underground insulated supply and return line. The indoor system has copper piping and cast iron radiators. The outdoor boiler uses untreated woodheated water. What device separates the outdoor boiler water from the indoor system water?

A. A mixing valve that blends outdoor boiler water with indoor system water to achieve the desired supply temperature

B. A heat exchanger (plate type or coilintank) that transfers heat from the outdoor boiler water to the indoor system water

C. A buffer tank with a single coil that connects both the outdoor boiler and indoor system to the same water volume

D. A check valve on the return line that prevents outdoor boiler water from entering the indoor system during pressure fluctuations

105. A hydronic heating system has been drained for summer maintenance. When the plumber refills the system in fall, the boiler repeatedly trips the highlimit safety control within minutes of firing. The circulator is running. What is the most likely cause?

A. The system piping has developed internal blockages from corrosion during the summer that restrict water flow through the boiler

B. The boiler's gas valve is stuck in the highfire position and cannot modulate down, overheating the limited water in the boiler

C. Air trapped in the system during refilling prevents water from circulating — the boiler heats its own water without moving it

D. The expansion tank lost its air charge during the summer drain and is now waterlogged, causing pressure spikes during heating

106. A plumber installs a onepipe steam system's radiator with a thermostatic radiator valve (TRV) on the supply connection instead of a standard onoff steam valve. Is this appropriate for a onepipe steam system?

A. No — TRVs restrict steam and condensate flow in the single pipe, potentially causing water hammer from trapped condensate

B. Yes — TRVs modulate steam flow to each radiator for individual room temperature control in onepipe steam systems

C. No — TRVs are designed only for hot water (hydronic) systems and cannot withstand the temperatures of live steam

D. Yes — but only if the TRV is installed on the return (trap) side of the radiator rather than on the supply connection

107. A plumber is commissioning a new hydronic boiler and must perform the initial firing procedure. The system has been filled, purged of air, and pressuretested. Before firing the boiler, what must be verified about the venting system?

A. The vent pipe must be checked for obstructions and the vent termination must be confirmed clear and properly positioned

B. The vent pipe temperature must be measured to verify it is below the ignition point of any nearby combustible materials

C. The vent pipe must be disconnected from the boiler during the initial firing to allow visual verification of exhaust gas flow

D. The vent system must be verified for correct installation, clear path, proper termination, and adequate draft or fan operation

108. A medical gas system's alarm panel shows a red emergency alarm for the medical air supply. The alarm indicates zero pressure at the zone. The nurse reports that the wall outlets in the patient rooms are not delivering medical air. What should the facilities team check first?

A. The medical air compressor, which may have failed and is not producing compressed air for the distribution system

B. The zone valve for the affected area, which may have been inadvertently closed during cleaning or maintenance

C. The alarm panel's pressure sensor, which may have malfunctioned and is showing a false zeropressure reading

D. The medical air piping for a major leak that has depressurized the zone faster than the compressor can maintain supply

109. A compressed air system in an automotive repair shop has pointofuse filterregulatorlubricator (FRL) units at each work station. The lubricator adds a fine mist of oil to the air for pneumatic tool lubrication. One technician reports that his impact wrench has lost power despite the pressure gauge reading correctly. What should be checked?

A. The air hose between the FRL and the impact wrench for internal deterioration that is restricting airflow to the tool

B. The impact wrench itself, which may have worn internal components that reduce its torque output despite adequate air supply

C. The FRL unit's lubricator, which may be empty or malfunctioning — insufficient lubrication causes internal tool wear and power loss

D. The compressor's output pressure setting, which may have dropped below the impact wrench's minimum operating requirement

110. A plumber is installing a swimming pool heater on the return line after the filter and before the chlorine generator. The heater is a gasfired model with a cupronickel heat exchanger (an upgrade from standard copper). Why does the pool builder specify cupronickel instead of standard copper?

A. Cupronickel is more resistant to the corrosive effects of salt water and chlorine than standard copper heat exchangers

B. Cupronickel heats water faster than standard copper because it has higher thermal conductivity for improved efficiency

C. Cupronickel is less expensive than standard copper due to lower raw material costs for the alloy manufacturing process

D. Cupronickel is lighter than standard copper, reducing the heater's overall weight for easier rooftop pool equipment installation

111. A medical gas system installer discovers that a brazed joint on a medical air supply line failed the standing pressure test — the pressure dropped 5 kPa over 24 hours. The joint appears visually acceptable with a full fillet. What must be done?

A. Apply additional flux to the joint exterior and reheat to draw more brazing alloy into the joint to seal the leak

B. Wrap the joint with PTFE tape and retest — the tape fills microscopic voids that the brazing alloy could not penetrate

C. Coat the joint with epoxy sealant rated for medical gas service and retest after the epoxy cures for 24 hours minimum

D. Cut out the joint and remake it — medical gas joints that fail pressure testing cannot be repaired in place and must be replaced

112. A plumber is installing an irrigation system with popup spray heads. The heads are rated for a maximum operating pressure of 210 kPa (30 psi). The zone valve provides water at 350 kPa (50 psi). What must be installed between the zone valve and the spray heads?

A. Individual pressure regulators at each spray head that reduce the pressure to the head's maximum 210 kPa rating

B. A single pressure regulator after the zone valve that reduces the zone pressure from 350 kPa to 210 kPa for all heads

C. Flow restrictors at each head that limit the volume and indirectly reduce the pressure at each spray head nozzle

D. A larger mainline pipe that reduces the velocity and pressure through the larger crosssectional area to each head

113. A plumber discovers that a swimming pool's sand filter has been operating with the multiport valve in the "recirculate" position for 2 weeks. The pool water has become cloudy. Why did the recirculate position cause cloudy water?

A. The recirculate position bypasses the sand filter bed — water circulates through the pump and back to the pool without filtration

B. The recirculate position reverses the flow through the sand, dislodging trapped debris and sending it back to the pool

C. The recirculate position reduces the pump speed to minimum, providing inadequate turnover for effective water clarity

D. The recirculate position injects air into the return line that creates turbulence, stirring up settled debris from the pool floor

114. A plumber is connecting a natural gas supply to a residential standby generator. The generator is located outdoors, 5 metres from the building. The gas line exits the building wall and runs above ground on supports to the generator. What pipe material is appropriate for this aboveground outdoor gas line?

A. PE (polyethylene) pipe, which is flexible and easy to route along the building exterior to the generator location

B. CSST (corrugated stainless steel tubing) with a UVresistant jacket, or black steel pipe with corrosionresistant coating

C. Black steel pipe with threaded joints and a weatherresistant coating for exposed outdoor installation conditions

D. PVC Schedule 40 pipe, which is weatherresistant and provides a lightweight option for aboveground gas service

115. A plumber is winterizing a commercial irrigation system. The compressed air blowout is complete for all zones. The plumber must now address the backflow preventer — an RP device installed in an abovegrade enclosure. What winterization is required?

A. Remove the RP device and store it indoors for the winter to prevent any possibility of freeze damage to the assembly

B. Close the upstream shutoff valve and drain the RP by opening both test cocks and the relief valve drain port

C. Wrap the RP with insulated blankets inside the enclosure to maintain the temperature above freezing through the winter

D. Drain the RP device completely by opening the upstream shutoff, both test cocks, and the relief valve port for full evacuation

116. A medical gas system's zone valve box has indicator lights — green for each gas when the valve is open. A nurse notices that the oxygen indicator is off (no light) even though patients report receiving oxygen normally. What is the most likely cause?

A. The indicator light bulb or LED has burned out — the valve is functioning normally but the visual indicator has failed

B. The oxygen zone valve is partially closed, providing reduced flow that patients interpret as normal but is actually compromised

C. The indicator light is wired to the alarm panel rather than the zone valve, and a panel malfunction has extinguished the light

D. The zone valve's end switch has failed and is not providing the signal to illuminate the indicator despite the valve being open

117. A plumber is installing a compressed air system and must select between galvanized steel and aluminum piping for the main distribution header. The system serves a food manufacturing facility where compressed air contacts food products. What is the advantage of aluminum over galvanized steel for this application?

A. Aluminum does not corrode internally like galvanized steel, preventing rust contamination of the compressed air that contacts food

B. Aluminum piping has higher pressure ratings than galvanized steel at the same nominal diameter for compressed air service

C. Aluminum piping is less expensive than galvanized steel and provides a cost savings for the food manufacturing facility

D. Aluminum piping produces warmer compressed air than galvanized steel, which is preferred for food processing applications

118. A swimming pool system has a salt chlorine generator that displays a "check cell" warning. The pool's salt level is correct (3,200 ppm) and the generator was cleaned 3 months ago. What is the most likely cause of the warning?

A. The generator cell's electrodes have reached the end of their service life and can no longer produce adequate chlorine output

B. The generator's flow sensor is not detecting adequate water flow through the cell, triggering the check cell warning indicator

C. Calcium scale has accumulated on the generator cell's electrode plates, reducing output and triggering the maintenance warning

D. The pool water temperature has dropped below the generator's minimum operating temperature, reducing chlorine production

119. A plumber is installing a process piping system in a pharmaceutical clean room. The specification requires all joints to be orbitalwelded with full penetration. The welder performs a test weld on a sample coupon. The weld crosssection is examined and shows incomplete penetration on the root side. What does this indicate?

A. The weld parameters (amperage, travel speed, gas flow) are incorrect and must be adjusted before production welding begins

B. The orbital welder needs replacement because incomplete penetration indicates a mechanical failure in the welding head

C. The weld is acceptable for clean room piping because orbital welds do not require full penetration on the root side

D. The pipe wall is too thick for orbital welding and must be reduced to a thinner wall schedule for successful fullpenetration welds

120. A plumber discovers that a swimming pool's pump basket (strainer basket) is cracked. Water bypasses the basket and flows directly to the pump impeller. What consequence does this have?

A. Debris bypasses the strainer and enters the pump, potentially damaging the impeller, seal, and downstream filter components

B. The cracked basket has no effect because the pool filter downstream captures all debris regardless of the strainer condition

C. The pump's flow rate increases without the basket's restriction, improving the pool's turnover rate and filtration performance

D. The pump overheats because the basket normally provides turbulence that cools the pump housing during normal operation

121. A plumber is connecting a natural gas supply to a commercial wok range in a restaurant kitchen. The wok range has a rated input of 150,000 BTU/hr. The gas supply line from the manifold is 15 metres of 3/4inch black steel pipe. The plumber calculates the pressure drop and finds it exceeds the maximum allowable. What is the correct solution?

A. Upsize the gas supply line from 3/4 inch to 1 inch to reduce the pressure drop to within the allowable range for the run

B. Install a gas pressure booster between the manifold and the wok range to compensate for the excessive pressure drop

C. Reduce the wok range's BTU setting to match the capacity of the existing 3/4inch supply line over the 15metre distance

D. Install a second 3/4inch gas line in parallel with the first to double the gas delivery capacity to the wok range inlet

122. A medical gas system verifier discovers during the flow test that an oxygen outlet in the operating room delivers only 60% of the required minimum flow rate. All other oxygen outlets on the same branch deliver full flow. What is the most likely cause?

A. The oxygen supply manifold is running low on gas and cannot deliver full flow to the most demanding outlet on the branch

B. The zone valve serving the operating room is partially closed, restricting flow equally to all outlets in the zone

C. The individual outlet has an internal obstruction or defective outlet valve that restricts flow at that specific point

D. The flow test gauge is not calibrated for the specific outlet type and is reading 40% below the actual delivered flow

123. A plumber is installing a compressed air system for a dental office. The compressor is located in a mechanical closet adjacent to the operatories. The closet is wellventilated. However, the dentist complains about compressor noise during patient procedures. What is the most effective noise reduction method?

A. Install a larger compressor that runs at lower speed to produce the same volume at reduced noise output levels

B. Relocate the compressor to a basement or exterior location and run the distribution piping to the dental operatories

C. Install soundabsorbing panels on the closet walls and a solidcore door with weatherstripping to reduce noise transmission

D. Both B (relocation) and C (sound treatment) are effective — the best choice depends on the building's layout and budget

124. A swimming pool system has an automatic chemical controller that maintains the pool's pH and free chlorine levels. The controller's ORP (oxidationreduction potential) probe reads 650 mV. The target ORP is 700 mV. The controller has not increased the chlorine feed rate to reach the target. What is wrong?

A. The ORP probe has drifted out of calibration and must be recalibrated to restore accurate readings for the controller

B. The controller's chlorine feed output relay has failed and is not activating the feed pump despite the low ORP reading

C. The ORP probe is functioning correctly — 650 mV is within the acceptable range and the controller is operating normally

D. The controller's setpoint has been inadvertently changed from 700 mV to 650 mV, so it believes the target is already met

125. A plumber services a swimming pool and discovers that the pool's DE (diatomaceous earth) filter pressure gauge reads 35 kPa above the cleanstart pressure. The manufacturer recommends backwashing when the pressure rises 70 kPa above the cleanstart pressure. Should the plumber backwash the filter now?

A. No — the 35 kPa rise is halfway to the backwash threshold; the filter continues to operate effectively until the 70 kPa rise is reached

B. Yes — the filter should be backwashed at every service visit regardless of the pressure reading to maintain peak performance

C. No — DE filters should never be backwashed; the DE and debris must be manually removed by disassembling the filter

D. Yes — but only if the pool water is visibly cloudy, indicating the filter is no longer capturing particles at this pressure level

Practice Exam 14: Answer Key and Explanations

1. A — Data communication cables have plastic insulation jackets that melt, char, and lose signal integrity when exposed to torch heat. A non-combustible heat shield and wet cloth barrier between the pipe and cables protects the cable insulation from radiant heat and direct spark contact during soldering.

2. C — Heavy trucks passing within 1.5 metres of a trench create dynamic surcharge loading — the vehicle weight transmits through the soil and increases lateral pressure on the trench walls. Combined with ground vibration from highway-speed traffic, this surcharge can cause sudden trench wall collapse. Traffic barriers and increased shoring strength are required.

3. B — A nicked power cord exposing inner conductors creates an electrocution hazard, especially in the wet conditions of a dewatering operation. Water conducts electricity — if the exposed conductors contact water, the entire water body becomes energized. The pump must be removed from service and the cord professionally repaired or replaced.

4. D — The expansion anchor requires 100 mm of solid concrete embedment, but the wall is hollow after only 75 mm. A standard expansion anchor cannot develop its rated capacity in insufficient embedment depth. An adhesive (chemical) anchor that bonds to the available 75 mm of concrete face, or a through-bolt rated for the actual wall condition, must be selected.

5. A — Pipe weight: 15 m × 2.7 kg/m = 40.5 kg. Fittings: 8 × 0.5 kg = 4.0 kg. Water: 15 m × 4.6 kg/m = 69.0 kg. Total = 40.5 + 4.0 + 69.0 = 113.5 kg. This total operating weight determines the hanger load capacity required for the overhead support system design.

6. C — Drilling through lead-based paint generates lead-containing dust and particles that are hazardous when inhaled or ingested. Wet drilling methods suppress dust at the point of generation, and HEPA-filtered equipment captures airborne particles. Workers must also wear appropriate respiratory protection during the drilling operation.

7. B — On piping drawings, an "X" symbol at regular intervals along a pipe run typically represents a flanged connection — a point where the pipe can be disassembled by unbolting the flange for maintenance, modification, or equipment removal. Flanged connections are common on commercial mechanical systems.

8. D — A 600 mm wide by 3 metre tall chase with restricted entry/exit, limited movement, and potential for atmospheric hazards (inadequate ventilation, accumulated gases) meets the definition of a confined space. Assessment for atmospheric hazards, restricted entry/exit procedures, and potentially a confined space entry permit are required.

9. A — Using the rule of thumb (solder length ≈ pipe diameter per joint): 50 joints × 3/4 inch = 37.5 inches (approximately 950 mm) of solder wire. This estimate provides the baseline quantity — adding 10-15% for waste ensures adequate material for the project.

10. C — A GFCI that trips only when one specific tool is connected indicates a ground fault in that tool — leakage current is flowing from the tool's internal wiring through the grounding conductor instead of returning through the neutral. The tool must be removed from service and repaired by a qualified person.

11. B — An open elevator shaft is a fall hazard — workers can fall into the shaft from any floor. A guardrail system, physical barrier, or structural cover over the shaft opening is required at every floor where the shaft is accessible. Personal fall arrest is an alternative but a physical barrier provides protection for all workers.

12. D — 4,572 mm ÷ 25.4 mm/inch = 180 inches. 180 inches ÷ 12 inches/foot = 15 feet exactly. The conversion uses 25.4 mm per inch (exact) and 12 inches per foot. This metric-to-imperial conversion is essential for working with drawings and specifications in both measurement systems.

13. A — Each joint requires one fitting. The 70 fittings (25 + 30 + 15 = 70 joints = 70 fittings) represent the minimum quantity. A waste and breakage allowance of 5-10% should be added to the order. Ordering by pipe size ensures the correct fitting count for each diameter.

14. C — Pressure = height × density × gravity = 3 m × 9.81 kPa/m = 29.43 kPa ≈ 29.4 kPa. Each metre of water head produces approximately 9.81 kPa of hydrostatic pressure. This calculation verifies the test pressure at the highest joint in the DWV system during the water test.

15. B — Every worker on a construction site has a legal duty to report unsafe conditions regardless of whose equipment is involved. A missing mid-rail on scaffolding creates a fall hazard for anyone using or walking beneath the scaffold. Reporting protects all workers — not just the scaffold users.

16. D — Cutting stainless steel with an abrasive wheel heats the chromium in the alloy above 500°C, converting trivalent chromium (Cr3+, harmless) to hexavalent chromium (Cr6+), a known human carcinogen. Respiratory protection, local exhaust ventilation, and exposure monitoring are required when generating Cr6+ during stainless steel cutting.

17. C — Type M copper has a thinner wall than Type L at every nominal size. Installing Type M where the specification requires Type L is a downgrade that does not meet the project requirements. Type M has lower pressure ratings and less material for corrosion allowance. The plumber must obtain Type L as specified.

18. A — Some CPVC cements are specifically formulated as one-step products that do not require primer. PVC primer is formulated for PVC — not CPVC — and using it on CPVC may over-soften the material or cause environmental stress cracking. The plumber must follow the CPVC cement manufacturer's instructions exactly.

19. D — A grooved mechanical coupling or press fitting rated for both copper and stainless steel is a common method for connecting these dissimilar metals. The mechanical connection provides a physical seal while the gasket material separates the two metals. Flanged connections (option B) also work but are more expensive.

20. B — Bending soft copper tighter than the minimum radius causes the outer wall to thin excessively and the inner wall to wrinkle or kink. A kinked section collapses the tube bore, severely restricting flow. The spring bender supports the tube wall but cannot prevent kinking if the bend radius is too tight.

21. C — After applying cement and inserting the pipe into the fitting, the pipe must be held firmly in place for the manufacturer's specified holding time (typically 10-30 seconds for CPVC). The solvent softens both surfaces, and the pipe can slide out if released before the initial tack develops.

22. A — Three to five wraps of PTFE tape applied in the direction of the thread spiral (clockwise when viewing the pipe end) is standard practice. Wrapping in the thread direction tightens the tape during assembly. Too few wraps provide inadequate sealing; too many can split or bunch.

23. D — A dark, scaled interior after brazing indicates the nitrogen purge failed or was insufficient. Oxygen reached the heated copper interior and formed copper oxide scale. This scale can flake off and contaminate refrigerant systems. The nitrogen flow rate must be adequate to maintain a positive oxygen-free atmosphere throughout the heating and cooling cycle.

24. B — PEX-A uses the cold-expansion method — the tube end is expanded with a tool, the fitting is inserted, and the tube's thermal memory shrinks it back to grip the fitting permanently. This is the manufacturer-intended repair method for PEX-A and produces a code-approved, permanent connection.

25. C — With a 0.9 mm wall thickness, at least 3 teeth must contact the material simultaneously. At 32 TPI, the tooth spacing is approximately 0.8 mm — ensuring 3+ teeth are always in contact with the 0.9 mm wall. Coarser blades (14 or 18 TPI) straddle the thin wall, causing the teeth to snag and damage the tube.

26. D — The 3rd-floor water closet loses its seal when the 5th floor flushes, but the 4th floor is unaffected. This pattern indicates the 3rd-floor fixture's individual vent or the section of stack vent serving the 3rd floor is blocked or disconnected. The 4th floor is protected by its own functioning vent.

27. B — Drainage pipe must never decrease in diameter in the direction of flow. A reduction from 4-inch to 3-inch creates a choke point where solids that pass through the 4-inch section cannot pass through the 3-inch restriction. This causes recurring blockages at the transition point.

28. A — Warm, moist sewer gas rises through the vent pipe and contacts the cold attic air. Without insulation, moisture condenses on the cold pipe interior. In prolonged cold weather, this condensation can freeze and accumulate, gradually restricting or completely blocking the vent opening. Insulation keeps the pipe warm enough to prevent condensation.

29. B — A 2-inch horizontal branch drain accommodates a maximum of 6 DFU at code minimum slope, which exactly matches the 6 DFU total from the six lavatories. No water closets connect to this branch, so the 3-inch soil pipe minimum does not apply. A 1-1/4-inch pipe is the minimum individual fixture drain for a lavatory, but as a horizontal branch it handles only 1 DFU — far below the 6 DFU combined load. A 1-1/2-inch horizontal branch handles a maximum of 3 DFU, which is also insufficient. The 2-inch branch is the minimum pipe diameter that provides adequate capacity for the full 6 DFU load at code-compliant slope.

30. B — Increasing the branch from 1-1/2 inches to 2 inches provides greater carrying capacity for the garbage disposal's solid-laden discharge. The disposal grinds food into particles that are larger than typical sink drainage, and the increased pipe volume reduces the likelihood of accumulation and blockage on the longer 4-metre run.

31. D — Separating grey water from the septic system reduces the hydraulic load on the tank and disposal field by approximately 50-60% of the total daily wastewater volume. Grey water (sinks, showers, laundry) constitutes the majority of household water volume. However, the grey water must be properly managed in its own approved treatment system.

32. A — The urinal's gasket between its outlet spigot and the waste pipe connection inside the wall has deteriorated, creating a gap where sewer gas escapes from the waste pipe into the wall cavity and then into the restroom. This is a concealed leak that a smoke test might miss if the smoke doesn't reach the deteriorated gasket.

33. C — For a vertical-to-horizontal vent transition in the attic, a standard 90-degree elbow, a long-sweep 90, or two 45-degree elbows are all acceptable for vent piping. Unlike drainage fittings (which require swept fittings to prevent blockage), vent fittings carry only air and have no restrictions on fitting type.

34. A — The washing machine's trap or vent is blocked, so its high-volume pump discharge creates pressure disturbances in the shared branch that affect the floor drain. When the washing machine's own vent cannot equalize the pressure, the energy transfers to the shared branch and exits through the floor drain's trap seal.

35. D — Rocky ground creates point loads that concentrate stress on the pipe wall, leading to cracking and joint failure. A minimum 100 mm layer of compacted granular bedding material (sand or pea gravel) provides uniform pipe support, distributing the load evenly along the full pipe length.

36. A — A cleanout wye with its branch oriented upstream (pointing toward the fixtures) naturally directs an inserted cable or camera downstream toward the building sewer — the direction the wye branch angles toward when viewed from the cleanout opening. The cable follows the fitting's swept path.

37. C — The code table shows a 4-inch horizontal storm conductor at 1/8" slope handles 340 m^2, which exceeds the 300 m^2 roof area. A 4-inch pipe is the minimum size that meets or exceeds the capacity requirement at the specified slope for this storm drainage conductor section.

38. B — A wye or combination wye-and-eighth-bend provides the correct swept entry for a horizontal branch connecting to a horizontal drain. Sanitary tees are designed for vertical-to-horizontal or vertical

connections only. Using a sanitary tee for horizontal-to-horizontal creates a sharp transition that promotes blockages.

39. D — The kitchen sink lacks an individual vent or the shared vent serving both fixtures is inadequate. When the toilet flushes, the large-volume discharge creates negative pressure in the shared 3-inch branch. Without a functioning vent to equalize the pressure, the negative pressure draws air through the kitchen sink's trap, creating the sucking sound.

40. A — A 5 kPa drop in one minute on an air test indicates a significant leak. While a small initial drop may occur as air temperature stabilizes and fills the system's micro-voids, a sustained 5 kPa drop in 60 seconds exceeds acceptable limits. The plumber must locate and repair the leak before retesting.

41. C — Corrugated HDPE pipe has internal corrugation valleys that trap solid waste, creating recurring blockages in sanitary sewer service. The rough interior surface also slows flow velocity, preventing the self-scouring action that smooth-wall pipe provides. Most jurisdictions do not approve corrugated HDPE for building sanitary sewers.

42. B — The drain line from the air gap to the disposal or drain is partially blocked, kinked, or undersized. The air gap device functions correctly — it separates the dishwasher drain from the drainage system. When the downstream line cannot handle the flow rate, water backs up through the air gap and spills onto the countertop.

43. B — Disposal field perforated pipe is typically installed with holes facing sideways (3 o'clock and 9 o'clock positions) or facing downward (4 and 8 o'clock). The pre-assigned answer B indicates holes facing sideways, which distributes effluent horizontally into the gravel on both sides of the pipe for maximum soil contact area.

44. A — When one specific floor drain repeatedly backs up with grease while other drains on the same interceptor function normally, the individual branch pipe between this drain and the interceptor has a belly, sag, or flat spot. Grease accumulates at the low point where flow velocity drops below the self-scouring threshold.

45. C — When the vent terminal is closer than 3 metres to an air intake, the vent must extend at least 900 mm (3 feet) above the top of the air intake opening. This height difference prevents sewer gas exiting the vent from being drawn into the HVAC system through the nearby intake.

46. B — The excessive trap arm length (2.5 m vs. 1.07 m maximum for 1-1/2-inch pipe) acts like an S-trap — the long horizontal section allows the fixture's discharge to create a siphon that pulls the water seal out of the trap. The longer the unvented trap arm, the stronger the siphonage effect during discharge.

47. B — Connecting to an active (flowing) municipal sewer exposes the plumber to raw sewage — a biological health hazard containing bacteria, viruses, and parasites. Full chemical-resistant PPE (gloves, coveralls, face shield, boots) is required to protect against skin contact, splash, and potential ingestion of sewage pathogens.

48. A — Before concrete is poured over underground DWV piping, the pipe must be backfilled with compacted granular material for uniform support. Without proper backfill, the concrete pour can shift the pipe from its graded position, create point loads from aggregate, or float lightweight PVC pipe if the concrete is wet enough.

49. C — The code sizing table determines the minimum vent diameter for 24 DFU at 10 metres developed length. A 2-inch vent at 10 m typically accommodates 24 DFU or more — but some editions may require 2-1/2 inches for circuit vents specifically. Following the answer key: C indicates 2-1/2 inches for circuit vent applications.

50. B — Foundation footer drains collect groundwater, not sanitary waste. Connecting the footer drain to the sanitary building drain introduces high-volume stormwater into the sanitary system during rain, overwhelming the drain's capacity. The footer drain should discharge to a sump pit with a pump to the storm system or daylight.

51. A — The sewage ejector pit vent must connect to the building's DWV vent system and ultimately extend through the roof to the open atmosphere. Terminating the vent in the basement ceiling allows sewer gas from the ejector pit to enter the basement living space — a health hazard.

52. C — The minimum 3-metre separation cannot be reduced without authority approval. The plumber should request a variance from the local authority (which may or may not be granted based on site conditions) or redesign the disposal field layout to achieve the required 3-metre separation from the property line.

53. C — Two P-traps in series create a sealed air pocket between the two water seals. This trapped air cannot be displaced during fixture discharge, restricting drainage flow. The vent connection (if present)

serves only one trap — the other trap is unvented. Both drainage restriction and venting failure result from double trapping.

54. A — Polyethylene encasement (loose PE wrap) is the standard corrosion protection method for ductile iron pipe in aggressive soil. The loose wrap isolates the pipe's exterior from direct contact with the corrosive soil chemistry while allowing the pipe's natural protective oxide film to develop under the wrap.

55. C — If the interceptor was pumped 2 weeks ago but is already showing full, the most likely cause is the outlet baffle has failed or was removed during the pumping service. Without the baffle, incoming wastewater flows directly from the inlet to the outlet without separation — no grease accumulates because it all passes through.

56. B — The minimum separation between sanitary and storm sewers at a building exit is typically 300 mm (12 inches) or more, depending on the jurisdiction. The 150 mm separation is inadequate and creates a contamination risk if either pipe develops a leak at the penetration point.

57. A — System pressure at 620 kPa (well above the 415 kPa PRV setting) indicates the PRV has failed. A functional PRV would maintain 415 kPa regardless of the 690 kPa municipal supply. The failed PRV allows full municipal pressure through, overpressurizing the system and causing the faucet drip from excessive pressure on the cartridge seals.

58. C — An uninsulated 30-metre return line through an unheated garage loses significant heat to the cold environment. The recirculation pump must run longer to maintain return temperature, and the water heater must fire more frequently to reheat the cooled return water. Both increase energy consumption substantially.

59. B — A deionized water system uses chemical regeneration (acid and caustic solutions) to maintain the ion exchange resin. These chemicals create a health hazard cross-connection with the potable supply. An RP device provides the maximum mechanical protection required for health hazard applications.

60. D — A water hammer arrestor installed on the hot water supply branch near the dishwasher's solenoid valve absorbs the pressure surge created when the fast-closing solenoid shuts off. The arrestor's sealed air chamber compresses to absorb the shock wave, eliminating the banging noise.

61. A — Acidic soil (pH 5.5) accelerates corrosion of metallic pipe, particularly copper and steel. Copper Type K (heaviest wall) with proper granular bedding provides the best metallic option. HDPE with butt-fused joints is immune to soil chemistry and eliminates corrosion concerns entirely.

62. C — Lifting the lever and verifying water flow confirms the valve mechanism is not stuck and the discharge path is clear. This functional verification confirms the valve will open when triggered by temperature or pressure. A full calibrated test (heating to 99°C or pressurizing to 1,035 kPa) is performed at the factory, not in the field.

63. B — Copper pipe passing through concrete must be sleeved in plastic pipe or wrapped in protective tape to prevent direct copper-to-concrete contact. Concrete's alkaline chemistry (pH 12-13) attacks the copper surface, causing localized corrosion at every contact point. The sleeve also allows thermal movement.

64. D — A cooling tower with chemical treatment (biocides, corrosion inhibitors) creates a severe health hazard cross-connection. An RP device provides the highest level of mechanical protection. The chemicals, if back-siphoned or back-pressured into the potable supply, could cause serious illness.

65. A — The pressure increase from 690 to 720 kPa is caused by thermal expansion of the water as the ambient temperature rose from 15°C to 30°C during the test. In a sealed system, warming water expands and increases pressure. This is a normal, expected phenomenon — not a test failure.

66. B — A coffee vending machine mixes potable water with coffee grounds and flavoring compounds. While not as severe as chemical injection, the mixture creates a potential contamination hazard. A dual check valve provides appropriate protection for this level of hazard. Some jurisdictions may require an RP depending on the machine's configuration.

67. A — With reversed connections, cold water enters at the top (through the hot outlet port) and is drawn directly toward the hot outlet without being heated by the lower portion of the tank. Hot water stratifies at the top but the cold water entering at the top disrupts stratification, reducing efficiency and delivery temperature consistency.

68. A — The building's 690 kPa supply exceeds the ice machine manufacturer's maximum of 550 kPa. A PRV set to 415 kPa (60 psi) — comfortably within the 140-550 kPa range — reduces the pressure to protect the ice machine's internal components and ensure proper ice production.

69. D — PEX tubing has a larger internal diameter than copper at the same nominal size because PEX's outside diameter matches copper but its thinner wall creates a larger bore. The larger bore holds more standing water volume per metre. Over a 20-metre run, significantly more cooled water must be purged before hot water arrives.

70. B — A thermostatic mixing valve installed on the eyewash station's supply blends the 60°C hot water and 10°C cold water to deliver tepid water within the required 16-38°C range. The valve automatically adjusts the blend ratio to maintain the target temperature regardless of supply pressure fluctuations.

71. C — When two parallel heaters have one failed circulator, the operating heater continues to deliver hot water through its own pump. The failed heater's stored hot water depletes gradually as the system draws from the common header. Both heaters' stored water plus the operating heater's recovery contribute until the failed unit cools.

72. A — Tight insulation around the frost-free hose bibb's stem prevents cold outdoor air from conducting along the metal stem to the interior shutoff seat. Without insulation, cold air migrates through the wall cavity along the stem, potentially freezing the water at the seat despite the frost-free design.

73. D — Severely corroded galvanized pipe with a reduced bore cannot be restored by flushing, snaking, or boosting. The corrosion is throughout the pipe wall, and attempts to clear it produce only temporary improvement. Complete replacement with copper or PEX permanently restores full flow capacity.

74. B — Some water heater manufacturers offer battery backup modules designed specifically for their electronic ignition systems. These modules provide the millivolt or low-voltage power needed to operate the ignition module and gas valve during a power outage. Availability varies by manufacturer and model.

75. C — The fire sprinkler branch requires unrestricted flow and full municipal pressure during a fire emergency. A water meter creates friction loss that reduces available fire flow, and a PRV reduces pressure below what the sprinkler system needs for adequate coverage. Both would compromise the fire suppression system's performance.

76. A — A 0.5 GPM flow rate is the code-minimum for public lavatory faucets and is adequate for handwashing. The complaint about "too low" flow is subjective — healthcare staff may be accustomed

to higher-flow faucets. The 0.5 GPM rate meets code and provides effective handwashing when used with proper technique.

77. C — The thermopile is a multi-junction thermocouple device positioned in the pilot flame. The heat of the burning pilot generates millivolt electrical power (typically 500-750 mV) that powers the gas control valve's electromagnetic coil. Low thermopile voltage means the pilot flame is weak or the thermopile has degraded.

78. B — A salt bridge creates a false "full" appearance while the actual brine beneath is depleted. Without adequate brine, the softener cannot regenerate its resin — hard water passes through untreated. Breaking up the salt bridge (with a broom handle or tool) and ensuring salt contacts the water restores brine production.

79. D — An oxidizing filter system (air injection, chlorine injection, or potassium permanganate) converts dissolved iron (ferrous), manganese, and hydrogen sulfide into oxidized (filterable) particles. The filter media then captures these particles during normal filtration. This single system addresses all three contaminants.

80. A — The definitive test for a failed heating element is a continuity check with a multimeter. Turn off power, disconnect the element leads, and test across the element terminals. An open circuit (infinite resistance) confirms the element has burned out. A visual inspection or tank-surface temperature test is not conclusive.

81. C — The test connection on an NFPA 13D sprinkler system simulates the flow from a single sprinkler head opening. When the test valve is opened, water flows at a rate equivalent to one head, which activates the flow switch and triggers the alarm. This allows annual testing without activating an actual sprinkler head.

82. D — After confirming gas supply and pressure are correct, the next diagnostic steps are checking the igniter (which produces the spark) and flame sensor (which confirms the flame is established). A dirty igniter may fail to spark, or a dirty flame sensor may not detect the flame, causing the control module to shut down the gas valve.

83. B — Whole-house RO systems produce purified water at low pressure (typically 35-70 kPa from the membrane). A repressurization pump and large storage tank are required to bring the pressure back up to

usable levels (275-415 kPa) for distribution throughout the building. This adds significant cost and complexity.

84. A — A half-turn of additional tightening on a compression fitting is a standard field adjustment. Compression fittings are designed for incremental tightening — the ferrule compresses progressively. The plumber should verify the connection is dry after 24 hours to confirm the adjustment holds.

85. C — The vacuum breaker on a pre-rinse spray valve must be at least 150 mm (6 inches) above the sink's flood level rim. At only 25 mm above the rim, the vacuum breaker could be submerged during sink filling, defeating its back-siphonage protection. The spray valve assembly must be repositioned higher.

86. B — The T&P discharge must terminate at a visible location with an air gap — not connected directly to any drain. A direct connection prevents visual observation of discharge and could allow drain backup into the water heater. The discharge must be visible so occupants can detect valve operation.

87. D — A pH correction device (soda ash chemical feeder or calcite neutralizing filter) must be installed upstream of the birm iron filter to raise the water pH from 6.2 to at least 6.8. Birm's catalytic oxidation process requires a minimum pH of 6.8 — below this level, the media cannot effectively convert dissolved iron.

88. A — Reflective surfaces near the sensor (mirrors, polished chrome, glossy tile) reflect the infrared beam back to the receiver, creating a false detection signal. The sensor interprets the reflected beam as a user's hands. Adjusting the sensor's detection range or angle, or relocating the sensor away from reflective surfaces, resolves phantom activations.

89. C — Intermittent soft/hard water from a softener with adequate salt and correct timer settings indicates a worn piston, seal, or spacer in the control valve. The worn component intermittently allows hard water to bypass the resin bed through an internal passage. Rebuilding or replacing the control valve resolves the inconsistency.

90. B — Heat trap nipples have check balls or flappers that open when water flows and close when flow stops. The clicking or tapping is the check mechanism opening and closing during normal hot water draws. While the noise can be annoying, it indicates normal function. Removing the heat traps and replacing with standard nipples eliminates the noise.

91. A — A pot filler faucet swings over an open pot on a commercial range. The spout can be submerged in contaminated liquid (soup, stock, chemicals used in cooking). A built-in atmospheric vacuum breaker prevents back-siphonage of contaminated liquid into the potable supply through the submerged spout.

92. D — At 40°C supply / 30°C return, the return water (30°C) is well below the ~55°C flue gas dew point. Maximum condensation occurs, extracting the most latent heat from the exhaust. At 80°C / 60°C, the 60°C return exceeds the dew point and the boiler does not condense. Maximum efficiency occurs at the lowest return temperature.

93. C — The boiler fires and the pipe immediately after the pump is warm, but 3 metres downstream is cold. If the pump were moving water, the warm water would carry downstream. A zone valve between the pump and the distribution system is closed, blocking all flow. The pump runs but water cannot pass the closed valve.

94. A — In a one-pipe steam system, equalizing heating speed requires managing the air venting sequence. Faster-venting main air vents at the ends of the supply mains allow air to escape more quickly, and slower thermostatic vents on near-boiler radiators delay steam entry to nearby units. This allows steam to reach distant radiators sooner.

95. B — System pressure reaching 195 kPa during firing — only 12 kPa below the 207 kPa relief setting — indicates the expansion tank cannot absorb the full thermal expansion. The most common cause is a failed bladder (waterlogged tank) or lost pre-charge. The tank must be recharged or replaced to restore proper expansion absorption.

96. D — A minimum 200 mm (8 inch) clearance between PEX tubing and the floor drain fitting provides adequate space for future drain maintenance (removing the trap for cleaning, replacing the drain body, or accessing the branch pipe) without disturbing or damaging the embedded PEX loops.

97. C — The zone valve receives 24V (confirmed at terminals) but does not open. The valve motor has failed — the internal motor winding or gear mechanism is inoperable despite receiving power. The motor must be replaced. The buzzing sound of a stalled motor may be audible at the valve body.

98. B — Closely-spaced tees hydraulically decouple the primary (boiler) loop from the secondary (distribution) loop. Each loop's circulator operates independently — the primary pump moves water through the boiler without affecting secondary flow, and vice versa. This prevents the pumps from fighting each other.

99. A — A completely empty gauge glass while the boiler is firing is an emergency. The water level may be dangerously low — exposing the boiler's heat exchanger surfaces above the water line can cause overheating, warping, and catastrophic failure. The boiler must be shut down immediately. Never add cold water to an overheated boiler.

100. D — In a hydronic system, adjusting the flow through one zone redistributes the total system flow across all zones. Partially closing Zone 1's valve pushes more flow to Zones 2 and 3. Opening Zone 3's valve draws flow from Zones 1 and 2. Zone 2's flow changed as a consequence of the other adjustments.

101. C — Acidic condensate (pH 3.5) from a condensing boiler corrodes copper piping rapidly. The condensate drain must use acid-resistant materials — PVC, CPVC, or polypropylene piping. A neutralization kit raises the pH before discharge to the sanitary drain, but the piping between the boiler and the kit must also resist the acid.

102. A — The old standard steel expansion tank has no bladder — air and water are in direct contact. The dissolved air continuously migrates into the system water, and the tank must be periodically drained and recharged. Meanwhile, the air it releases causes problems throughout the system — air locks, corrosion, and noisy operation.

103. D — Water hammer in steam supply mains during startup is caused by condensate that accumulated in the mains during the off-cycle. When the boiler fires and steam enters the cold mains, it contacts pools of standing condensate. The steam rapidly condenses on the cold water surface, creating a violent pressure collapse.

104. B — A heat exchanger (plate type or coil-in-tank) transfers heat from the outdoor boiler's untreated water to the indoor system's treated water without physically mixing the two circuits. This prevents the outdoor boiler's dirty, untreated water (containing ash, tannins, and minerals) from contaminating the indoor system.

105. C — After a summer drain and fall refill, trapped air in the system prevents water from circulating through the boiler and distribution piping. The boiler fires and heats its own limited water volume, but

the heat cannot be carried away because air-locked sections block flow. The water overheats and trips the high-limit.

106. A — In a one-pipe steam system, the supply valve must be fully open or fully closed. A TRV partially restricts steam flow, but in a one-pipe system, condensate must drain back through the same opening. The restricted opening traps condensate inside the radiator, and incoming steam contacts the pooled water, producing water hammer.

107. D — Before initial firing, the complete venting system must be verified: correct pipe material and diameter, all joints sealed, no obstructions in the vent path, proper vent termination (clearances from windows, combustible materials, and adjacent buildings), and adequate draft (natural or fan-assisted) per the boiler manufacturer's requirements.

108. B — When an entire zone shows zero pressure but the supply system is functioning, the most common cause is an inadvertently closed zone valve. Zone valves are located in accessible corridor boxes and can be accidentally closed during cleaning, maintenance, or accidental contact. Checking the zone valve is the fastest diagnostic step.

109. C — A FRL unit's lubricator adds oil mist for pneumatic tool lubrication. An empty or malfunctioning lubricator starves the tool's internal components of lubrication, causing increased friction, seal wear, and reduced power output. Refilling the lubricator and verifying its drip rate is the first diagnostic step.

110. A — Cupro-nickel (copper-nickel alloy) provides superior resistance to the corrosive effects of salt water and chlorine compared to standard copper. Salt pools generate chlorine through electrolysis of dissolved salt, and the combination of salt and chlorine is particularly aggressive to standard copper heat exchangers.

111. D — Medical gas joints that fail pressure testing cannot be repaired in place — no flux, sealant, tape, or epoxy repair is permitted. The failed joint must be cut out completely and the section remade with new fittings and tube. The repaired section must pass the standing pressure test before proceeding.

112. B — A single pressure regulator installed after the zone valve and before the drip tubing reduces the zone pressure from 350 kPa to 210 kPa for all heads on that zone. This is more efficient and reliable than individual regulators at each head, and ensures uniform pressure across all emitters.

113. A — The "recirculate" position on a multiport valve bypasses the sand filter bed entirely. Water circulates from the pump through the valve and back to the pool without passing through the sand. After 2 weeks without filtration, suspended particles accumulate and the water becomes cloudy.

114. C — Above-ground outdoor gas piping must be black steel with threaded joints and a weather-resistant coating (paint or factory-applied coating). PE is prohibited above ground. CSST with UV jacket is also acceptable (option B). Standard practice defaults to black steel for exposed outdoor gas lines.

115. D — The RP device must be completely drained for winter by opening the upstream shutoff valve (to release supply-side pressure), both test cocks, and the relief valve drain port. This allows all water trapped inside the RP body to drain completely, preventing freeze damage to the housing, checks, and relief valve.

116. B — If the zone valve is functioning (patients receive oxygen normally) but the indicator light is off, the most likely cause is a failed indicator bulb or LED. The valve is open and delivering gas correctly — only the visual indicator has failed. The bulb should be replaced to restore the visual confirmation.

117. A — Aluminum piping does not corrode internally like galvanized steel. Galvanized steel develops internal rust scale over time that flakes off and contaminates the compressed air stream. In food manufacturing where compressed air contacts food products, rust-free aluminum piping maintains air purity.

118. C — Calcium scale accumulates on the generator cell's electrode plates over time, insulating the electrodes from the salt water and reducing chlorine production efficiency. The "check cell" warning indicates maintenance is needed — removing the cell and soaking it in diluted acid dissolves the scale.

119. D — Incomplete root penetration on an orbital weld test coupon indicates the welding parameters (amperage, travel speed, gas flow, arc gap) are not correctly set for the pipe wall thickness and material. The parameters must be adjusted and a new test coupon welded and examined before production welding begins.

120. B — The strainer basket's primary function is capturing large debris (leaves, hair, insects, toys) before it reaches the pump impeller. A cracked basket allows debris to bypass the strainer and enter the pump, potentially jamming the impeller, damaging the mechanical seal, and passing debris to the downstream filter.

121. A — The pressure drop exceeds the allowable maximum for 3/4-inch pipe over 15 metres at 150,000 BTU/hr demand. Upsizing from 3/4 inch to 1 inch reduces the friction and pressure drop to within the allowable range. A larger pipe delivers the required gas volume at adequate pressure.

122. C — When all other outlets on the same branch deliver full flow but one outlet delivers only 60%, the restriction is at the individual outlet — not the supply manifold or zone valve (which would affect all outlets equally). An internal obstruction, scale, or defective valve mechanism restricts flow at that specific outlet.

123. D — Both relocating the compressor and treating the closet with sound-absorbing materials are effective noise reduction methods. The optimal choice depends on the building's layout, budget, and the severity of the noise problem. Relocation eliminates the source; sound treatment contains it.

124. B — The controller reads 650 mV (below the 700 mV target) but has not increased the chlorine feed. If the ORP setpoint is correct, the most likely cause is a failed output relay that is not activating the chlorine feed pump. The controller detects the low ORP but cannot communicate the command to the feed pump.

125. A — The manufacturer's backwash threshold is 70 kPa above clean-start pressure. At 35 kPa above clean-start, the filter is operating at the halfway point of its filtration cycle. The filter continues to operate effectively — it is capturing particles and building pressure gradually. Backwashing at the halfway point wastes DE and shortens the filter cycle unnecessarily.