

PRACTICE EXAM 6: RED SEAL PLUMBER SIMULATION (125 QUESTIONS)

1. A plumber is preparing to cut a section of asbestocement pipe found in an older building during a renovation. Before cutting, what must the plumber determine first?

- A. Whether the pipe can be cut with a standard reciprocating saw or requires a diamondgrit blade
- B. Whether asbestos is present, as cutting asbestoscontaining materials requires specialized abatement procedures
- C. Whether the pipe is connected to the potable water supply or the drainage system before handling it
- D. Whether the building owner has provided written authorization to remove and dispose of the pipe material

2. A plumber is using a pneumatic nailer in a damp crawl space to secure pipe straps. The tool is powered by a small air compressor located outside the crawl space. What electrical safety measure is required for the compressor?

- A. The compressor motor must be a dualvoltage model capable of operating on either 120V or 240V circuits
- B. The compressor must be plugged into a dedicated 20amp circuit with no other loads on the same breaker
- C. The compressor's power cord must be rated for outdoor use and have a minimum 12gauge wire conductor
- D. The compressor must be connected through a GFCIprotected outlet because the work is in a damp location

3. A plumber's personal gas monitor alarms for hydrogen sulfide at 15 ppm while working near an open sewer manhole at street level (not inside the confined space). What is the correct action?

- A. Move upwind from the manhole immediately, as 15 ppm exceeds the H₂S shortterm exposure limit
- B. Continue working because 15 ppm is below the dangerous concentration level for outdoor exposure
- C. Put on a half-face respirator with organic vapour cartridges and return to the work position near the manhole
- D. Cap the manhole opening with a steel plate to contain the H₂S and prevent further gas release to the surface

4. A plumber working on a roof installs a vent terminal flashing. The work area is 2 metres from the unguarded roof edge on a flat roof. The roof is 5 metres above grade. Is fall protection required?

- A. No, because the work area is more than 1 metre from the roof edge, which provides adequate setback
- B. No, because flat roofs do not require fall protection regardless of height or distance from the edge
- C. Yes, because the height exceeds 3 metres and the proximity to the unguarded edge creates a fall hazard
- D. Yes, but only a safety warning line is required at 2 metres from the edge — no harness or guardrails needed

5. A plumber must calculate the weight of water required to fill a 4inch pipe for a 50foot water test. The internal crosssectional area of 4inch pipe is approximately 12.57 square inches. What is the approximate volume of water needed?

- A. 50 gallons (Imperial), calculated by multiplying the pipe area by the length and converting to gallons
- B. Approximately 2.72 Imperial gallons, calculated as $(12.57 \text{ in}^2 \times 600 \text{ in}) \div 277.42 \text{ in}^3$ per Imperial gallon
- C. Approximately 27.2 litres, calculated by converting the cubic inch volume to metric litres directly
- D. Approximately 10 Imperial gallons, estimated using a rule of thumb of 0.2 gallons per foot of 4inch pipe

6. A plumber receives a delivery of copper fittings. Several fittings have green discoloration on the contact surfaces inside the sockets. What does this discoloration indicate and what should the plumber do?

- A. The fittings have oxidized — the contact surfaces must be cleaned to bright copper before soldering
- B. The green colour indicates the fittings are prefluxed by the manufacturer and are ready for assembly
- C. The fittings are contaminated with flux residue from the factory and must be returned to the supplier
- D. The discoloration is a factoryapplied anticorrosion coating that must not be removed before soldering

7. A plumber is reading a project specification that states: "Provide and install backflow prevention in accordance with CSA B64." What does "CSA B64" refer to?

- A. The National Plumbing Code of Canada's section on backflow prevention device installation procedures

- B. A provincial building code amendment that supersedes the National Plumbing Code for backflow protection
- C. The manufacturer's installation manual for a specific brand of reduced pressure backflow preventer device
- D. A Canadian Standards Association standard that defines backflow preventer selection, installation, and testing

8. A plumber is working with a product whose SDS lists the primary hazard as "aspiration hazard." What does this mean?

- A. The product can cause skin irritation if it remains in contact with unprotected skin for extended periods
- B. The product releases flammable vapour at temperatures below its flash point in normal working conditions
- C. The product can be drawn into the lungs during swallowing or vomiting, causing chemical pneumonia or death
- D. The product generates toxic fumes when heated above its decomposition temperature during torch operations

9. A plumber must install a horizontal pipe run 3.5 metres above the floor. No scaffold is available. A 4metre extension ladder is being considered. Why is this ladder unsuitable for this task?

- A. The 4metre ladder exceeds the maximum height allowed for extension ladders on construction jobsites

- B. A ladder does not provide a stable working platform for twohanded pipe installation work at height
- C. The ladder's aluminum construction creates an electrical shock hazard when used near copper piping
- D. Extension ladders may not be used indoors — they are rated for outdoor use against building exteriors only

10. A plumber discovers that the threading oil in a power threading machine has not been changed in six months. The oil is dark, thick, and contaminated with metal chips. What is the consequence of using contaminated oil?

- A. Contaminated oil reduces cutting performance, produces rough threads, and accelerates die wear
- B. Contaminated oil increases the machine's operating temperature but has no effect on thread quality
- C. Contaminated oil causes the pipe to slip in the chuck during the threading operation creating a safety risk
- D. Contaminated oil produces threads that are cosmetically discoloured but are structurally sound and seal properly

11. A plumber must perform work in a building that has been damaged by flooding. The basement has 300 mm of standing water. Before entering the basement, what hazard must be assessed first?

- A. Structural damage to the building's foundation that could cause a collapse during the repair work
- B. Biological hazards from mould growth on the walls and ceiling surfaces in the flooded basement space
- C. Chemical contamination of the flood water from household cleaning products stored in the basement

D. Electrical hazard from submerged outlets, panels, or equipment that could energize the standing water

12. A plumber is fabricating a pipe assembly in a shop and needs to make six 90degree bends in soft copper tube. After the fourth bend, the tube cracks at the bend point. What caused the failure?

A. The tube wall was too thick for bending and should have been reamed thinner before the bending operation

B. The bending tool was too large for the tube diameter and overstressed the copper at the bend point radius

C. Work hardening from repeated bending operations exhausted the copper's ductility, causing it to crack

D. The tube was manufactured from a defective copper alloy that cannot withstand more than three bends

13. A plumber must install a pipe hanger on a steel beam using a beam clamp. The beam clamp slides onto the beam flange and secures with a set screw. What must be verified before loading the hanger?

A. The beam clamp must be installed on the top flange of the beam, never on the bottom flange surface

B. The beam clamp's rated capacity must meet or exceed the total loaded weight of the pipe it will support

C. The beam clamp must be welded to the beam flange in addition to the set screw for permanent attachment

D. The beam clamp must be installed with the set screw facing downward to allow gravityassisted tightening

14. A plumber is working on a project where the drawings show pipe locations in metric dimensions (millimetres) but the pipe is ordered in imperial sizes (inches). What is the conversion factor for inches to millimetres?

A. 1 inch = 25.4 millimetres, which is the precise and exact conversion between the two measurement systems

B. 1 inch = 30.48 millimetres, which is the metric equivalent commonly used on Canadian construction projects

C. 1 inch = 2.54 millimetres, which is the standard decimal conversion for smallscale precision measurements

D. 1 inch = 10 millimetres, which is the simplified metric rounding used for field estimation and layout work

15. A plumber is planning a pipe run that must pass through a loadbearing wall. Before drilling or cutting into the wall, what must the plumber determine?

A. The wall's paint colour, to ensure the patch material matches after the pipe penetration is completed

B. Whether the pipe material is flexible enough to be routed around the wall instead of through it

C. The wall's exact thickness, to select the correct pipe sleeve length for the penetration installation

D. Whether the structural integrity of the wall will be compromised, consulting structural drawings or an engineer

16. A newly hired apprentice arrives on a jobsite without safety boots, wearing only running shoes. The journeyperson plumber is the apprentice's mentor. What is the correct response?

- A. Allow the apprentice to work in a tool storage area away from the active construction zone for the day
- B. Provide the apprentice with temporary toe caps that clip over the running shoes for basic protection
- C. Do not allow the apprentice to work until proper CSAapproved safety footwear is obtained and worn
- D. Allow the apprentice to begin work if they sign a waiver acknowledging the risk of foot injury today

17. A plumber is joining stainless steel pipe in a commercial kitchen using press fittings. Compared to welding stainless steel, what is the primary advantage of press fittings in this application?

- A. Press fittings are faster, require no hot work permit, and eliminate fire risk in an occupied food service area
- B. Press fittings create a stronger joint than welded stainless steel connections under all pressure conditions
- C. Press fittings are significantly less expensive per connection than stainless steel welding materials and labour
- D. Press fittings allow the stainless steel pipe to be reused if the system layout must be reconfigured later

18. A plumber discovers that a roll of PEX tubing has been stored outdoors in direct sunlight for several months. The tubing appears discoloured along the sunexposed side. Is this tubing safe to install?

- A. Yes, PEX is resistant to UV radiation and can be stored outdoors indefinitely without any degradation
- B. Yes, but only if the discoloured section is cut off and the remaining tubing is inspected for flexibility
- C. No, but the tubing can be salvaged by painting the discoloured section with a UVresistant sealant
- D. No — PEX degrades when exposed to prolonged UV radiation and the affected tubing should be discarded

19. A plumber is installing copper pipe supports and selects Jhooks for 1/2inch PEX tubing running along floor joists. The Jhooks are made of bare steel. Is this support material acceptable for PEX?

- A. No, because steel Jhooks will corrode the PEX material through a chemical reaction at the contact point
- B. Yes — PEX is a plastic material and does not require dielectric isolation from steel support hardware
- C. No, because PEX tubing must be supported only by continuous channel strut, never by individual hooks
- D. Yes, but only if the PEX is wrapped in a protective sleeve at every point where it contacts the Jhook

20. A plumber is soldering a horizontal copper joint. The solder is applied to the bottom of the joint but does not travel to the top, leaving an incomplete ring. What technique corrects this problem?

- A. Apply more solder to the bottom of the joint until gravity pulls it downward and fills the remaining gap
- B. Direct the torch flame to the top of the fitting to draw the solder upward by heating the coolest area

- C. Heat the entire joint uniformly and apply the solder at the top, letting gravity help it flow downward
- D. Increase the torch flame intensity to melt the solder faster so it reaches the top before the flux burns

21. A plumber must install an expansion loop on a long straight run of CPVC hot water supply piping. The expansion loop must absorb 30 mm of thermal movement. Why is the expansion loop necessary on CPVC when it might not be required on a copper pipe of the same length?

- A. CPVC has approximately 4 times the thermal expansion rate of copper, requiring dedicated expansion provisions
- B. CPVC pipe joints are weaker than copper solder joints and cannot withstand any lateral stress from expansion
- C. CPVC requires expansion loops at every change of direction, regardless of the pipe run length or temperature
- D. Copper pipe is rigid enough to absorb all thermal expansion internally without any external accommodation

22. A plumber cuts a length of 6inch cast iron pipe using a snap cutter (soil pipe cutter). The cut produces a rough, uneven edge with several large chips missing from the pipe end. What is the most likely cause?

- A. The snap cutter's chain was too loose and slipped during the cutting operation, scoring multiple lines
- B. The cast iron pipe has an internal defect from the manufacturing process that caused it to fracture unevenly

C. The snap cutter's cutting wheels were worn or damaged, applying uneven pressure around the circumference

D. The pipe was scored with the cutting wheels and then struck with a hammer to complete the break prematurely

23. A plumber installs a copper water supply system and must provide a union fitting at the water heater connection. What is the purpose of the union in this location?

A. The union provides a transition from copper to steel pipe at the water heater's inlet connection point

B. The union allows the water heater to be disconnected for service or replacement without cutting the pipe

C. The union acts as a dielectric fitting to prevent galvanic corrosion between the copper pipe and the heater

D. The union serves as a check valve that prevents backflow from the water heater into the supply piping

24. A plumber is installing a largediameter (6inch) copper DWV system in a commercial building. The specification calls for brazed joints rather than soldered joints. Why might brazing be specified for largediameter DWV copper?

A. Soldering is prohibited by code on all copper DWV piping regardless of diameter or application

B. Brazing is faster than soldering on largediameter pipe, saving significant labour costs on the project

C. Brazed joints are stronger and more reliable on largediameter joints where solder may not fill the gap completely

D. Brazing uses less flux than soldering, reducing the risk of interior pipe corrosion from excess flux residue

25. A plumber is fabricating a pipe offset using two 45degree elbows and a travel piece. The offset distance is 10 inches. After cutting the travel piece at 14.14 inches (10×1.414), the plumber discovers the completed offset measures 11.5 inches instead of 10 inches. What error was made?

- A. The fitting makeup (takeoff) dimensions were not subtracted from the travel piece length calculation
- B. The wrong offset multiplier was used — the 22.5degree constant of 2.613 should have been applied instead
- C. The pipe was cut 14.14 inches between the fitting centres rather than between the fitting end faces
- D. The 1.414 multiplier applies only to the offset, not to the travel — the travel should equal the offset exactly

26. A plumber is installing a vent terminal through the roof of a singlestorey building in a location where the vent will be within 1.5 metres of a window that opens. What additional requirement applies?

- A. The vent terminal must be painted a bright colour to make it visible to the building occupants near the window
- B. The vent terminal must be fitted with a charcoal filter that removes sewer gas odour before atmospheric release
- C. The vent terminal must be relocated to a position at least 3 metres from the window opening horizontally
- D. The vent terminal must extend at least 900 mm (3 feet) above the top of the window opening

27. A plumber discovers a residential DWV system where every fixture's individual vent connects to a single 1 1/4 inch branch vent before reaching the vent stack. The branch vent serves 15 DFU total over a developed length of 12 metres. The plumber consults the code sizing table and determines that a 1 1/4 inch vent is undersized for this load and length. What must be done?

- A. The branch vent must be upsized to the diameter required by the sizing table for 15 DFU at 12 metres
- B. The branch vent is acceptable because 1 1/4 inches is the code minimum and overrides the sizing table
- C. Each individual vent must be disconnected from the branch and run independently through the roof
- D. An air admittance valve must be added to the branch vent to supplement the undersized pipe's capacity

28. A plumber is installing a building drain in a crawl space. The crawl space has a dirt floor and a ceiling height of only 600 mm (24 inches). What classification does this work space most likely fall under?

- A. A standard work area that requires no special procedures beyond normal plumbing safety practices
- B. An elevated work area requiring fall protection because the plumber must work from an elevated position
- C. A confined space or restricted space that requires assessment for atmospheric hazards and limited egress
- D. A hazardous materials area requiring full chemical protective clothing for all workers in the crawl space

29. A plumber installs a septic system with a distribution box and four disposal field trenches. After backfilling the trenches, the plumber must ensure that the distribution box is level. Why is leveling the box critical?

A. An unlevel box causes the septic tank to overflow because the effluent cannot exit through the tilted outlet

B. An unlevel box sends disproportionate flow to lower trenches, overloading them while starving upper trenches

C. An unlevel box allows tree roots to enter the distribution piping through gaps created by the tilted connections

D. An unlevel box causes the disposal field to freeze in winter because effluent pools at the lowest trench

30. A plumber is installing DWV piping in a threestorey building. The soil stack passes through the secondfloor fire-rated floor assembly. What must be installed at this penetration?

A. A standard pipe sleeve with silicone caulk filling the annular space between the pipe and the sleeve

B. An expansion joint that allows the stack to move vertically through the floor during thermal cycling

C. A riser clamp that anchors the stack to the floor structure and prevents any vertical or lateral movement

D. An approved firestop system that maintains the fire rating of the floor assembly at the pipe penetration

31. A plumber is troubleshooting a commercial kitchen where the three-compartment sink drains progressively slower over several weeks, then is cleared by a drain cleaning service, and the cycle repeats. The grease interceptor was pumped three months ago. What is the most likely underlying cause?

- A. The drain piping between the sink and the interceptor is undersized for the volume of greaseladen wastewater
- B. The interceptor was not pumped thoroughly and residual grease is blocking the outlet baffle passage
- C. Grease is accumulating in the drain piping between the sink and the interceptor faster than the interceptor processes it
- D. The building sewer downstream of the interceptor is partially blocked by a root intrusion at a joint

32. A plumber installs a floor drain in a mechanical room that contains a gasfired boiler with a relief valve discharge pipe. The relief valve's discharge terminates at the floor drain through an air gap. What secondary function does this floor drain serve?

- A. It collects condensate from the boiler's vent connector that drips during coldstart combustion cycles
- B. It receives the boiler relief valve discharge safely, preventing hot water from pooling on the floor
- C. It acts as an emergency overflow for the hydronic system if the expansion tank fails during operation
- D. It provides a connection point for the boiler's automatic drain valve during seasonal system maintenance

33. A plumber is sizing a horizontal branch drain that will serve a residential laundry room with a clothes washer (3 DFU) and a laundry sink (2 DFU). What is the minimum branch drain diameter?

- A. 2 inches (50 mm), which accommodates the combined 5 DFU load within the pipe's rated capacity
- B. 1 1/2 inches (38 mm), which matches the minimum trap size for the laundry sink at 2 DFU rating
- C. 3 inches (75 mm), which is required because the clothes washer's highvolume pump demands larger pipe
- D. 4 inches (100 mm), which is the minimum for any branch carrying more than 3 DFU of drainage load

34. A plumber encounters a scenario where the building drain must pass beneath a structural footing to reach the building sewer exit point. The footing is 300 mm thick reinforced concrete. What method is used to route the pipe beneath the footing?

- A. Drill a core hole through the reinforced concrete footing and pass the pipe directly through the opening
- B. Route the pipe over the top of the footing using two 90degree elbows to clear the footing's top surface
- C. Reduce the pipe diameter by two sizes to fit through the existing weep holes in the footing's base panel
- D. Tunnel beneath the footing and install the pipe through the tunnel, with proper bedding and support

35. A plumber is testing a DWV system using the water test method. After filling the system to the top of the highest vent stack, the plumber notices the water level dropping slowly. All visible joints appear dry. Where should the plumber look for the leak?

- A. At the test plugs, which may not be inflated sufficiently or may have a slow leak around the seal edge
- B. At the vent terminal on the roof, where the water may be escaping through a gap in the roof flashing

- C. At the joints that are concealed inside walls or above ceilings, where a slow drip would not be visible
- D. At the building drain cleanout, where the cleanout cap may not be fully tightened against the gasket

36. A plumber is installing a new septic tank on a rural property. The excavation is complete and the precast concrete tank is being lowered into the hole by crane. Before backfilling, what must the plumber verify about the tank's installation?

- A. The tank's outlet must be at least 300 mm higher than the inlet to ensure effluent flows by gravity
- B. The tank must be level, the inlet and outlet pipes aligned, and all connections watertight before backfill
- C. The tank must be filled with water immediately to prevent flotation if groundwater rises around the empty tank
- D. The tank's access risers must extend to grade level and be secured with tamperproof locking covers

37. A building has a DWV system where the building drain connects to a combined municipal sewer system. During heavy rain, the fixtures on the lowest floor occasionally back up with water. What device prevents this backup?

- A. A backwater valve installed on the building drain that closes when reverse flow from the sewer is detected
- B. A sump pump installed at the lowest point of the building drain to pump wastewater during surcharge events
- C. A larger building drain pipe that provides additional capacity to handle the combined sewer surcharge flow

D. A vent stack extension that increases the air supply to the drainage system during heavy rainfall periods

38. A plumber is installing a 4inch PVC building sewer with gasketed bellandspigot joints. The trench is 1.5 metres deep. After laying the pipe, the plumber must verify the slope before backfilling. What tool is most appropriate for checking the slope?

A. A plumb bob suspended from a string stretched between the high and low ends of the pipe run

B. A chalk line snapped along the crown of the pipe to verify that the line is straight and uniformly pitched

C. A tape measure used to check the pipe invert elevation at the inlet and outlet against the design drawing

D. A digital level placed on the pipe crown that displays the slope as a percentage or inches per foot

39. A plumber discovers that a building's 3inch vent stack terminates inside the attic instead of penetrating through the roof. The building has reported recurring sewer gas odours on the upper floor. What is the code violation?

A. The vent stack must penetrate the roof and terminate in the open air above the roof surface

B. The vent stack may terminate in the attic provided an air admittance valve is installed at the termination

C. The vent stack must terminate in the open air — the attic termination is allowing sewer gas into the building

D. The vent stack's attic termination is acceptable if the attic has ridge vents that provide natural ventilation

40. A plumber installs a cleanout fitting on a horizontal 4inch building drain at a point where the drain changes direction by 90 degrees. The cleanout cover faces upstream (toward the fixtures). Can the cleanout be used to clean in both directions?

A. Yes, all cleanouts provide access for cleaning in both upstream and downstream directions simultaneously

B. No — the cleanout faces upstream and provides access in that direction only; a second cleanout facing downstream is needed for full access

C. Yes, but only if the cleanout is a twoway type with removable covers on both the upstream and downstream sides

D. No — cleanouts are not required at direction changes of 90 degrees; they are required only at 135degree changes

41. A plumber sizes a vent for a 4inch soil stack serving 80 DFU in a threestorey building. The vent must be at least half the stack diameter. What is the minimum vent diameter?

A. 2 inches (50 mm), which is exactly half the 4inch soil stack diameter and meets the code requirement

B. 1 1/2 inches (38 mm), which is the absolute minimum vent size for any vent serving a soil stack

C. 3 inches (75 mm), which provides a threequarter ratio for enhanced air circulation in multistorey stacks

D. 4 inches (100 mm), which matches the full stack diameter as required for buildings over two storeys

42. A plumber is investigating a sewer gas complaint in a recently completed building. All traps have water, all vents are clear, and the smoke test shows no leaks in the DWV piping. However, the plumber notices that the building's main floor drain cleanout cap is a standard twistoff type without a gasket. Could this be the source?

A. No, cleanout caps are not airtight by design and allow minor air exchange that does not cause odour issues

B. Yes, but only if the cleanout is located in an enclosed space where gas accumulates before reaching occupants

C. No, cleanout caps on the building drain are below the trap seal and gas cannot escape upward past the traps

D. Yes — a cleanout cap without a gasket can allow sewer gas to bypass the drainage system's trap seals

43. A plumber installs a wetvented bathroom group on the second floor of a twostorey house. The group includes a water closet, lavatory, and bathtub. The wet vent section is 2inch pipe. What is the maximum DFU load that this 2inch wet vent section may carry?

A. 1 DFU, because only the lavatory's drainage is permitted to flow through the wet vent section of pipe

B. 3 DFU, because the bathtub (2 DFU) and lavatory (1 DFU) combined drainage flows through the vent section

C. The answer depends on the specific code edition and the fixture combinations permitted for wet venting

D. 6 DFU, because the entire bathroom group's drainage flows through the wet vent section simultaneously

44. A plumber discovers that a building's underground storm sewer has developed a belly — a sag in the pipe where water collects and stands permanently. During heavy rain, the storm drainage backs up through the parking garage floor drains. What is the permanent repair?

- A. Excavate the bellied section, reestablish correct slope with proper bedding, and replace the sagging pipe
- B. Install a sump pump in the parking garage to handle the overflow during heavy rainfall storm events
- C. Increase the diameter of the storm sewer pipe from 4 inches to 6 inches to increase its flow capacity
- D. Install additional floor drains in the parking garage to distribute the backup water over a larger floor area

45. A plumber is roughing in a bathroom and must install the shower drain. The shower floor will be tiled with a custom mud bed sloped to the drain. What component creates the waterproof seal between the mud bed and the drain body?

- A. A layer of thinset mortar applied directly between the top of the drain body and the bottom of the tile surface
- B. A bead of silicone caulk applied around the drain perimeter after the tile installation has been completed
- C. The grout between the tiles surrounding the drain, which provides the primary waterproof barrier at the drain
- D. A waterproof membrane (sheet or liquidapplied) compressed between the drain body's clamping ring and the base

46. A plumber is installing a grease interceptor for a large commercial restaurant. The interceptor is an inground gravity grease interceptor (GGI) with a capacity of 3,000 litres. How frequently must this interceptor be pumped?

A. Annually, which is the standard pumping interval for all gravity grease interceptors regardless of restaurant size

B. On a schedule based on accumulation rate and local regulations — typically monthly to quarterly for highvolume restaurants

C. Only when the restaurant staff observes slow drainage from the kitchen fixtures indicating the interceptor is full

D. Every five years, coinciding with the typical service life of the interceptor's internal baffles and gaskets

47. A plumber is installing underground PVC sewer pipe and encounters a large rock in the trench bottom directly beneath the proposed pipe location. The rock protrudes 75 mm above the trench bottom. What must be done?

A. Lay the pipe directly over the rock, as PVC is flexible enough to bridge the obstruction without damage

B. Place additional granular bedding over the rock to level the trench bottom and provide uniform support

C. Remove the rock and fill the void with compacted granular bedding material to provide uniform pipe support

D. Route the pipe around the rock using fittings to change direction and bypass the obstruction entirely

48. A plumber is installing a building sewer that will pass beneath an existing concrete driveway. Open cut excavation through the driveway is not feasible. What trenchless method can be used to install the pipe beneath the driveway?

- A. Horizontal directional drilling (HDD) or pipe jacking to bore a path beneath the driveway without surface disruption
- B. CIPP lining, which inserts a liner into the existing pipe beneath the driveway and cures it in place
- C. Pipe bursting, which fractures the existing pipe and pulls new pipe through the path simultaneously
- D. Hydroexcavation, which uses pressurized water to dissolve the concrete and create a trench for the pipe

49. A plumber is sizing a 4inch building drain that serves a residential building with 25 DFU at a slope of 1/8 inch per foot. The code table shows that a 4inch pipe at this slope handles 180 DFU. The building drain also connects to the storm drainage through a combined sewer connection. Does the storm water load affect the building drain sizing?

- A. No, because storm drainage and sanitary drainage are always sized independently regardless of connection type
- B. No, because the 180 DFU capacity of the 4inch drain far exceeds the 25 DFU sanitary load plus any storm load
- C. Yes, the storm water flow must be converted to equivalent DFU and added to the sanitary DFU for total sizing
- D. Yes — in a combined system, both storm and sanitary loads must be considered when sizing the building drain

50. A plumber is replacing a section of underground building sewer and must splice new PVC pipe into the existing cast iron pipe at both ends. The cast iron pipe is hubless on one end and has a hub on the other end. What coupling types are needed?

- A. A solvent cement coupling on the hubless end and a lead and oakum joint poured into the hub end
- B. A nohub coupling with neoprene gasket on the hubless end and a transition coupling on the hub end
- C. A grooved mechanical coupling on both ends, with grooves cut into the PVC and the cast iron pipe
- D. A compression fitting on the hubless end and a pushfit gasketed adapter into the cast iron hub end

51. A plumber installs a 3 inch vent pipe that runs horizontally for 4 metres in an attic before turning vertically to exit through the roof. The horizontal section must be sloped. In which direction and what is the minimum slope?

- A. Sloped toward the vent terminal on the roof so that any moisture exits at the highest point of the run
- B. Level with zero slope, because vent piping in attic spaces does not carry water under any conditions
- C. Sloped back toward the nearest drain connection at a minimum of 1/4 inch per foot (same as drainage piping minimum)
- D. Sloped toward the wall penetration at a minimum of 1/8 inch per foot to prevent water accumulation

52. A plumber is investigating a situation where a basement floor drain emits sewer gas intermittently — the smell appears in the morning, dissipates during the day, and returns overnight. The trap has water when checked during the day. What is the most likely cause?

- A. Diurnal pressure changes cause back pressure that temporarily forces gas through the trap seal at night
- B. The building's HVAC system creates negative pressure overnight that pulls gas through the weakened trap seal
- C. The floor drain trap is evaporating overnight when no fixtures are used and refilling from condensation during the day
- D. Temperature changes cause the trap water level to fluctuate, temporarily exposing the gas passage at night

53. A plumber is installing a residential sewage ejector system. The code requires the ejector's force main to connect to the gravity drainage system above the flood level rim of the highest fixture served. If the highest fixture is a basement lavatory with a flood rim at 850 mm above the floor, where must the force main connect?

- A. At any point above 850 mm from the basement floor, measured at the gravity system connection point
- B. At the building drain level, because the force main pressure can overcome any elevation difference
- C. At the vent stack connection point on the second floor, regardless of the basement fixture's flood rim height
- D. Above the flood level rim of the highest fixture served by the ejector — which is the lavatory at 850 mm

54. A commercial building has a laboratory with acid waste drainage that must be neutralized before entering the building sewer. The neutralization tank contains limestone chips. The tank has an inlet from the laboratory drains and an outlet to the building sewer. What happens inside the tank?

- A. The limestone filters suspended acid particles from the wastewater before they reach the building sewer
- B. Acidic wastewater reacts with the limestone (calcium carbonate), raising the pH toward neutral before discharge
- C. The limestone absorbs the acid through an ion exchange process similar to a water softener's resin bed
- D. The acid dissolves the limestone completely, leaving only purified water that exits to the building sewer

55. A plumber is installing a 2inch Ptrap on a shower drain. The trap arm extends 1,200 mm (approximately 47 inches) horizontally before connecting to the vent. The code maximum trap arm length for 2inch pipe is 1,525 mm (60 inches). Is this installation codecompliant?

- A. No, because the trap arm exceeds the maximum length by 325 mm and must be shortened or rerouted
- B. No, because shower drains require the vent connection within 300 mm of the trap regardless of pipe size
- C. Yes — the 1,200 mm trap arm is within the 1,525 mm maximum permitted for 2inch pipe
- D. Yes, but only if the trap arm slope does not exceed the code's maximum slope for a 2inch trap arm

56. A plumber discovers during a renovation that a building's soil stack has a 4inch to 3inch reducer installed midway up the stack between the second and third floors. Above the reducer, the stack continues as 3inch pipe to the roof. Below the reducer, the stack is 4 inches. Is this reduction codecompliant?

- A. Yes — reducing the stack above the highest branch connection is permitted because only vent air flows above
- B. No — a soil or waste stack must never be reduced in size as it ascends; it must remain at least 4 inches throughout
- C. Yes — reducing the stack at any point is acceptable if the reduced section still meets the minimum vent sizing requirements
- D. No — the stack must increase in size from bottom to top to accommodate increasing air volume at higher elevations

57. A plumber installs a water service for a new building. The municipal main pressure is 690 kPa (100 psi). The plumber installs a PRV set to 415 kPa (60 psi). Downstream of the PRV, the plumber installs a water heater but no expansion tank. What will happen when the water heater fires?

- A. The system pressure will remain at 415 kPa because the PRV regulates pressure in both directions
- B. The water heater's T&P relief valve will discharge periodically as thermal expansion raises the pressure
- C. The water meter will spin backward as expanded water flows back through the service to the main
- D. The system pressure will rise due to thermal expansion with no relief path, eventually triggering the T&P valve

58. A plumber is installing a potable water supply system in a medical office building. The building includes a dental suite with chemical sterilization equipment, a physician's office with an autoclave, and a general washroom. Which connections require the highest level of backflow prevention?

- A. Only the autoclave connection, because steam autoclaves operate at the highest pressure in the building
- B. The dental suite and autoclave connections, because both involve chemicals or processes that pose health hazards
- C. All three connections require identical RP backflow prevention as standard practice in medical buildings
- D. Only the general washroom, because the toilet flushometer valves create the highest backsiphonage risk

59. A plumber troubleshoots a residential water system where the cold water pressure is excellent but the hot water pressure at every fixture is noticeably lower. The water heater is a tanktype gas model. What is the most likely cause?

- A. A partially closed valve on the hot water outlet of the water heater or mineral buildup inside the heater restricting flow
- B. The gas supply to the water heater is inadequate, causing the heater to produce hot water at lower pressure
- C. The hot water distribution piping is a different material than the cold piping and has a higher friction factor
- D. The T&P relief valve is discharging continuously from the hot water side, reducing the available pressure

60. A plumber discovers that a building's PRV has been installed backward — the inlet and outlet are reversed. What symptom would this cause?

- A. The PRV would function normally because the internal mechanism works in both flow directions equally
- B. The PRV would reduce the pressure excessively, delivering far lower pressure than the set point downstream
- C. The PRV would not regulate — full unregulated municipal pressure would pass through to the building
- D. The PRV would block all flow completely, delivering zero water pressure to any fixture in the building

61. A plumber installs a tankless water heater for a residential bathroom renovation (one shower, one lavatory). The incoming cold water temperature in winter is 5°C . The desired delivery temperature is 49°C . What temperature rise must the heater provide?

- A. 49°C , calculated by using the delivery temperature as the temperature rise directly without subtraction
- B. 54°C , calculated by adding the incoming temperature to the delivery temperature for the total heat input
- C. 22°C , calculated by dividing the delivery temperature by 2 to account for the mixing effect at the fixture
- D. 44°C , calculated by subtracting the incoming water temperature (5°C) from the desired delivery temperature (49°C)

62. A commercial building has two identical water heaters piped in parallel to share the hot water load. One heater fails and must be taken offline for repair. Can the remaining heater serve the building alone during the repair?

- A. No — the remaining heater's capacity is exactly half the design load and cannot meet peak demand
- B. Yes, but with reduced capacity — the building will experience lower hot water availability during peak demand
- C. Yes — each heater is sized to carry the full building load independently as a redundancy design feature
- D. No — taking one heater offline requires shutting down the entire hot water system for the duration of repair

63. A plumber installs a residential water supply system using 3/4inch PEX trunkandbranch layout. The homeowner later complains that the shower pressure drops significantly when the washing machine fills. What is the cause?

- A. The 3/4inch trunk is too small for simultaneous demand — when both fixtures draw water, the shared trunk cannot deliver adequate flow to both
- B. The PEX material creates more friction than copper, causing pressure drops that would not occur in copper piping
- C. The washing machine's fill valve is defective and is creating water hammer that temporarily reduces the supply pressure
- D. The shower's pressurebalanced valve is overcompensating for the pressure change caused by the washing machine

64. A plumber discovers that a building's hot water recirculation system has been set to run the pump 24 hours a day, 7 days a week. The homeowner's energy bills are high. What control modification reduces energy consumption while maintaining hot water availability?

- A. Install a check valve on the return line to prevent thermosiphon circulation when the pump is off
- B. Replace the circulator with a larger model that moves water faster and runs for shorter durations per cycle
- C. Install a timer or aquastat control that operates the pump only during peak demand hours or based on temperature
- D. Reduce the water heater's thermostat setting to 49°C so the recirculation system has less heat to maintain

65. A plumber is installing a pressure booster pump for a 12storey commercial building. The pump takes suction from the municipal main. What device prevents the booster pump from creating negative pressure on the municipal main?

- A. An automatic shutoff valve that closes when the suction pressure drops below a preset minimum level
- B. A pressure relief valve on the pump's discharge that opens if the pump generates excessive pressure
- C. A variable frequency drive (VFD) on the pump motor that adjusts speed to maintain constant suction pressure
- D. A break tank or suctionside backflow preventer that isolates the pump from the municipal main supply

66. A plumber tests a reduced pressure (RP) backflow preventer during annual testing. The first check holds, the second check holds, and the relief valve opens at the correct differential pressure. The device passes. How should the test results be documented?

- A. The plumber records the results in a personal notebook and files it with the company's project records
- B. The certified tester completes a standardized test report filed with the local authority having jurisdiction
- C. The building owner receives a verbal confirmation from the tester that the device passed the annual test
- D. No documentation is required if the device passes — documentation is only required for failed devices

67. A plumber is installing an air gap for a commercial dishwasher drain. The dishwasher drain hose terminates 50 mm above the flood level rim of the floor sink receptor. The drain pipe diameter is 38 mm (1 1/2 inches). Is this air gap adequate?

- A. Yes — the 50 mm gap exceeds twice the drain pipe diameter ($2 \times 38 \text{ mm} = 76 \text{ mm}$ minimum) and meets code
- B. No — the minimum air gap is twice the drain pipe diameter (76 mm), and the 50 mm gap is insufficient
- C. Yes — a 25 mm minimum air gap is required for all indirect waste connections regardless of pipe diameter
- D. No — commercial dishwasher air gaps must be a minimum of 150 mm regardless of the drain pipe diameter

68. A plumber discovers that a building's water service has been connected to the municipal main using a saddle tap without the knowledge or approval of the municipality. What is the primary concern with this unauthorized connection?

- A. The saddle tap may not be rated for the municipal main's pressure and could fail catastrophically
- B. The unauthorized connection bypasses the water meter, resulting in unmetered and unbilled water consumption
- C. The unauthorized connection may not include required backflow prevention at the main connection point
- D. All of the above — unauthorized taps raise pressure rating, metering, and backflow prevention concerns

69. A plumber installs a water supply to a commercial espresso machine. The machine's specifications require a maximum inlet pressure of 275 kPa (40 psi). The building's supply operates at 415 kPa (60 psi). What must be installed on the dedicated supply branch?

- A. An expansion tank to absorb the excess pressure before it reaches the espresso machine's inlet valve
- B. A check valve to prevent backflow from the espresso machine into the building's potable water supply
- C. A flow restrictor that limits the volume of water reaching the machine without reducing the line pressure
- D. A dedicated pressure-reducing valve set to 275 kPa on the branch supplying the espresso machine

70. A plumber is troubleshooting a water distribution system where hot water arrives at the kitchen faucet in approximately 10 seconds but takes over 2 minutes to reach the master bathroom shower on the opposite end of the house. There is no recirculation system. What is the cause?

- A. The water heater is failing and cannot maintain adequate temperature for the longer pipe run to the shower
- B. The long pipe run between the water heater and the master bathroom contains a large volume of cooled water that must run off
- C. The shower's mixing valve is restricting the hot water inlet and should be replaced with a new cartridge
- D. The building's PRV is set too low and cannot maintain adequate pressure to push hot water to the far end

71. A plumber installs a dedicated PRV on a branch supply to a commercial dishwasher that requires a maximum 275 kPa inlet pressure. The main building PRV is set to 415 kPa. Is the dedicated PRV installation correct?

- A. Yes — a second PRV on the branch reduces the pressure further for the specific equipment requirement
- B. No — two PRVs in series cause pressure oscillation that damages equipment and creates noise in the piping
- C. Yes — but the branch PRV creates a closed system on the branch that requires its own expansion tank
- D. No — the main PRV should be adjusted down to 275 kPa to serve the dishwasher and all other fixtures equally

72. A plumber discovers that a building's copper water supply piping has developed pinhole leaks in several locations over a period of 5 years. The water is from a municipal supply. What is the most likely cause?

- A. The pipe was manufactured from defective copper alloy that does not meet ASTM B88 specifications
- B. The solder used on the joints was acidic and has corroded the pipe wall from the outside at each joint
- C. Aggressive water chemistry (low pH, high chlorine, or high dissolved oxygen) is causing pitting corrosion
- D. The pipe support spacing is too wide, causing stress at the support points that leads to fatigue cracking

73. A residential plumbing system has a well pump, a pressure tank, and a water treatment system. The water treatment includes a sediment filter, a water softener, and a UV disinfection unit. What is the correct order of these components from the well to the fixtures?

- A. UV → softener → sediment filter, so that sterilized water is softened and then filtered for final polishing
- B. Sediment filter → water softener → UV disinfection, removing particles first, then hardness, then killing bacteria last
- C. Water softener → UV → sediment filter, so that softened water is sterilized before the final filtration step
- D. UV → sediment filter → softener, because UV must treat the water before any chemical treatment occurs

74. A plumber tests a PVB (pressure vacuum breaker) on an irrigation system. The test reveals that the air inlet valve opens at the correct pressure but the check valve does not hold — water drips steadily past the seat. What must be done?

- A. Adjust the check valve spring tension by turning the adjustment screw clockwise one full revolution
- B. Clean the check valve seat with vinegar to remove mineral deposits that prevent the valve from sealing
- C. Leave the PVB in service because a dripping check valve does not affect backsiphonage protection
- D. Repair or replace the PVB's internal components — a leaking check valve fails the annual test requirements

75. A plumber installs a potable water supply connection to a cooling tower makeup line in a commercial building. The cooling tower water contains biocidal chemicals. The plumber installs a DCVA (double check valve assembly) on the supply. The building inspector rejects the installation. Why?

- A. The chemically treated cooling tower water is a severe health hazard requiring an RP device, not a DCVA
- B. The DCVA was installed in the wrong orientation — the check valves face the wrong direction for proper function
- C. The DCVA requires test ports that were not installed, making the device nontestable and noncompliant
- D. Cooling tower supply connections do not require any backflow prevention because the water is nonpressurized

76. A plumber is installing a pedestal lavatory in a residential bathroom. Despite the pedestal column extending from the floor to support the basin, the plumber must also secure the basin to the wall. Why?

- A. The pedestal is purely decorative — it conceals piping but does not provide primary structural support
- B. The pedestal provides primary support, but the wall attachment prevents the basin from rotating on the column
- C. Building codes prohibit pedestal lavatories that rely solely on the column for support in any application
- D. The wall attachment provides earthquake resistance that the pedestal column alone cannot offer safely

77. A plumber installs a highefficiency condensing tankless water heater. The unit requires a condensate drain. The condensate is acidic (pH 3–4). How must the condensate be handled?

- A. Discharge directly to any floor drain without treatment because the small volume is negligible in the drain system
- B. Discharge to a sanitary drain only — never to a storm drain — without any treatment or neutralization
- C. Collect in a sealed container for disposal as hazardous waste by a licensed waste management company
- D. Discharge to an approved drain, typically through a condensate neutralization cartridge to raise the pH

78. A plumber is troubleshooting a residential water closet that clogs frequently despite normal use with standard toilet paper. The water closet is a newer 4.8litre (1.28 GPF) highefficiency model. The 3inch drain has a slope of 1/4 inch per foot. What should the plumber investigate?

- A. The drain's slope, vent configuration, and whether the reduced flush volume is sufficient for the drain length
- B. The municipal sewer pressure, which may be creating backpressure that prevents the toilet from flushing
- C. The water supply pressure to the toilet, which may be too high and filling the tank faster than designed
- D. The wax ring, which may have shifted and is partially obstructing the toilet's outlet horn at the flange

79. A plumber services a residential water softener. The homeowner reports that the water has been hard for several weeks despite adequate salt in the brine tank. The plumber lifts the salt and discovers a void beneath the solid salt surface — the salt is bridged. What is the fix?

- A. Increase the regeneration frequency to compensate for the salt bridge until it dissolves on its own
- B. Add hot water to the brine tank to dissolve the salt bridge and allow the salt to contact the water below
- C. Break the salt bridge by pushing a broom handle through the solid crust to allow salt to fall into the water below
- D. Replace all the salt in the brine tank with a different brand that is less likely to form bridges during storage

80. A plumber installs a new electric water heater. The homeowner reports a strong "rotten egg" smell in the hot water only — the cold water smells normal. The water supply is from a well with elevated sulfate levels. What is the most likely cause?

- A. The electric heating elements are overheating the sulfate in the water and converting it to hydrogen sulfide gas
- B. The magnesium anode rod is reacting with sulfatereducing bacteria in the tank to produce hydrogen sulfide
- C. The well pump is drawing water from a deeper aquifer that contains naturally occurring hydrogen sulfide gas
- D. The water heater's dip tube has deteriorated and is releasing a sulfurbased chemical into the hot water supply

81. A plumber is installing a commercial urinal with an automatic sensoractivated flushometer valve. The water supply pressure at the urinal location is 120 kPa (17 psi). The minimum required pressure for the flushometer is 170 kPa (25 psi). What must be done?

- A. Install a smallerorifice flushometer that operates at lower pressure to match the available supply conditions
- B. Install a manual flush handle instead of the automatic sensor to reduce the valve's pressure requirement
- C. Reduce the supply pipe size to increase the velocity and compensate for the low pressure at the valve
- D. Increase the supply pressure to the urinal location — through upsizing the supply pipe, adjusting the PRV, or adding a booster

82. A plumber installs a residential kitchen faucet with an integrated soap dispenser. The soap dispenser's reservoir is mounted beneath the countertop. Does this installation create a crossconnection concern?

- A. No — the soap dispenser reservoir is not connected to the potable water supply and cannot contaminate it
- B. Yes — the soap reservoir must have a backflow preventer because it is installed adjacent to the potable supply
- C. No — but only if the soap dispenser has a check valve between the pump head and the reservoir below
- D. Yes — the soap dispenser creates an indirect crossconnection through the countertop penetration

83. A plumber is replacing the fill valve on a gravityflush toilet. After installation, the tank fills but the water level is 25 mm above the top of the overflow tube. What adjustment is needed?

- A. The overflow tube must be extended higher to accommodate the fill valve's factory water level setting
- B. The fill valve's shutoff point must be adjusted so the tank fills to a level slightly below the overflow tube top
- C. The fill valve's float height must be lowered to reduce the tank's water level below the overflow tube top
- D. The flapper must be replaced because a leaking flapper is causing the fill valve to run continuously higher

84. A plumber installs a water heater and connects the T&P relief valve discharge pipe. The discharge pipe runs 4 metres horizontally along the wall before turning down to terminate 150 mm above the floor. Is this installation correct?

- A. No, because the total discharge pipe length must not exceed 1 metre from the T&P valve to the termination
- B. Yes — the discharge pipe may run any length necessary provided it pitches continuously downward and is not trapped
- C. No, because the horizontal section may create a water trap that restricts the T&P valve's relief capacity
- D. Yes, but only if the horizontal section is increased by one pipe size to compensate for the additional friction

85. A residential reverse osmosis system includes a prefilter, a carbon prefilter, an RO membrane, a storage tank, and a postfilter. The homeowner notices a chlorine taste in the purified water that was not present before. What component has most likely failed?

- A. The RO membrane, which normally removes chlorine along with dissolved solids through the filtration process
- B. The storage tank's bladder, which has ruptured and is introducing untreated water into the purified water side
- C. The postfilter, which is designed to polish the taste of the water but does not remove chlorine compounds
- D. The carbon prefilter, which normally removes chlorine before the water reaches the RO membrane

86. A plumber is installing a shower receptor (preformed shower base) in a residential bathroom. The receptor has a preformed drain opening at the lowest point. Before connecting the drain, the plumber must test the receptor for leaks. How is this test typically performed?

- A. Fill the receptor with water to the height of the threshold dam and hold for a specified period, checking for leaks
- B. Apply compressed air to the drain opening and check for air leaks around the receptor's edges and seams
- C. Spray water on the exterior of the receptor and check for water penetrating through the material from outside
- D. Install the drain connection and conduct a full DWV air test that includes the receptor in the pressurized system

87. A plumber installs a water treatment system for a rural home on a well. The well water test shows elevated iron (3 ppm) and hardness (25 grains per gallon). What treatment combination addresses both issues?

- A. A sediment filter followed by an activated carbon filter, which removes both iron and hardness minerals
- B. A reverse osmosis system at the point of entry, which removes all dissolved contaminants in a single step
- C. An iron removal filter (oxidizing filter or greensand filter) followed by a water softener for hardness removal
- D. A UV disinfection unit followed by a water softener, treating the biological hazard before softening the water

88. A plumber installs a gasfired storage water heater in a basement mechanical room. The room has no windows and the only access is through a door from the basement hallway. The water heater is an atmospheric draft model. What critical requirement applies to this installation?

- A. The room must have adequate combustion air supply — through openings to adjacent spaces or through ducts to outdoors
- B. The mechanical room must have adequate combustion air — typically provided through louvers, grilles, or ducts to the building exterior or adjacent spaces
- C. The water heater must not be installed in a room without windows because atmospheric draft requires natural light
- D. The mechanical room must have a fire suppression sprinkler head installed directly above the water heater unit

89. A plumber is troubleshooting a residential dishwasher that is not draining completely after the wash cycle. Water remains in the bottom of the tub. The kitchen sink drains normally. What should be checked first?

- A. The dishwasher's drain hose for kinks, blockages, or a failed highloop/airgap connection at the sink
- B. The kitchen sink's Ptrap for a partial blockage that is causing backpressure against the dishwasher drain
- C. The building drain downstream of the kitchen, which may have a partial blockage affecting only the dishwasher
- D. The dishwasher's water supply connection, which may be delivering insufficient water for the drain pump to prime

90. A plumber discovers that a residential water heater's anode rod has been completely consumed — only the steel core wire remains. The tank is 8 years old. What does the absence of the anode rod mean for the tank?

- A. The tank will continue to function normally because the glass lining provides permanent corrosion protection
- B. The tank has adequate remaining corrosion protection from the factory-applied glass lining for another 8 years
- C. The tank's steel shell is now exposed to the corrosive effects of the water and will begin to deteriorate rapidly
- D. The tank is now unprotected — without the sacrificial anode, corrosion transfers to the steel tank and failure accelerates

91. A plumber is installing a commercial handfree sensor faucet in a public washroom. The faucet requires a 120V electrical connection for the sensor and solenoid valve. Who makes this electrical connection?

- A. The plumber makes all connections for plumbing fixtures, including the electrical connection for the sensor
- B. A low-voltage wiring technician, because sensor faucets operate on low-voltage DC power from a transformer
- C. A licensed electrician must make the 120V connection because it exceeds the plumbing trade's electrical scope
- D. The faucet manufacturer's authorized service technician must make the connection during commissioning

92. A plumber is filling a new hydronic boiler for the first time. The automatic fill valve is set to 103 kPa (15 psi). As the system fills, air purges through the automatic air vents. After the system is full and all air is purged, the gauge reads 103 kPa. The plumber starts the boiler. As the water heats from 15°C to 77°C, the gauge rises to 170 kPa. The relief valve is set at 207 kPa. Is the system operating correctly?

- A. No — the pressure rise is excessive and indicates a waterlogged expansion tank that must be replaced
- B. Yes — a pressure rise from 103 kPa to 170 kPa during heatup is normal with a properly sized expansion tank
- C. No — the relief valve should open at 170 kPa to prevent the pressure from approaching the 207 kPa maximum
- D. Yes — but only if the circulator is running, because the pump adds the pressure differential to the system

93. A plumber is troubleshooting a hydronic system where the boiler fires and reaches operating temperature, but the supply water temperature at the distribution manifold is significantly lower than the boiler supply. The primary circulator is running. What is the most likely cause?

- A. The closely spaced tees are installed too far apart, creating mixing between primary and secondary returns
- B. The zone valves on the secondary loops are all closed, preventing any hot water from reaching the manifold
- C. The expansion tank has failed, absorbing heat energy instead of thermal expansion from the heated water
- D. The boiler's heat exchanger has developed internal scale that reduces the heat transfer to the circulating water

94. A plumber installs a hydronic system with a condensing boiler serving only radiant floor heating zones. The system operates at 35°C supply and 25°C return. During a cold snap, the zones cannot maintain the set temperature. What adjustment should be considered?

- A. Increase the circulator speed to move water through the radiant loops faster for improved heat distribution
- B. Add supplemental baseboard emitters to the coldest rooms to increase the total heat output capacity
- C. Reduce the radiant loop lengths by adding more loops with shorter runs to increase heat density per zone
- D. Increase the supply water temperature gradually, monitoring to ensure the floor surface temperature remains safe

95. A plumber is commissioning a twozone hydronic system with baseboard convectors. After balancing, Zone 1 (living room) heats to 21°C as desired, but Zone 2 (bedroom) only reaches 18°C. The thermostat is set to 21°C. The balancing valves are correctly adjusted. What else should be checked?

- A. The boiler's firing rate, which may be insufficient to maintain supply temperature when both zones call simultaneously
- B. The Zone 2 circulator or zone valve, which may not be fully open and is restricting flow through the circuit
- C. Zone 2's heat loss calculation — the baseboard may be undersized for the room's actual heat loss in cold conditions
- D. The expansion tank's precharge, which may be incorrect and is causing the system to lose pressure in Zone 2

96. A plumber is installing a lowpressure steam boiler in a commercial building. The boiler's maximum operating pressure is 103 kPa gauge (15 psig). What safety device must be installed to prevent the pressure from exceeding this limit?

- A. A temperature-limiting high-limit control that shuts off the burner when the water temperature approaches boiling
- B. A pressure relief valve sized for the boiler's maximum steam output and set at the maximum working pressure
- C. A low-water cutoff that shuts off the burner when the water level drops below the minimum safe level
- D. A modulating gas valve that reduces the burner input proportionally as the pressure approaches the maximum

97. A plumber discovers that a cast iron hydronic radiator in an older building has a small pinhole leak at one of the section joints. The leak is slow and only visible when the system is at operating pressure. What is the most appropriate repair?

- A. Replace the leaking section of the cast iron radiator, or replace the entire radiator if sections are not available
- B. Apply a two-part epoxy patch over the pinhole and allow it to cure for 24 hours before repressurizing the system
- C. Inject a liquid leak-sealer product into the hydronic system that will find and seal the pinhole automatically
- D. Increase the system pressure to compress the cast iron sections more tightly and seal the leaking joint

98. A plumber is installing a mixing valve on a radiant floor heating zone to reduce the supply temperature from the 75°C boiler output to 40°C for the floor. The mixing valve has three ports: hot inlet, cold inlet, and mixed outlet. Where does the "cold" inlet water come from?

- A. From the domestic cold water supply, which provides the tempering water for the mixing valve blend
- B. From a separate chilled water system that produces cold water specifically for the radiant floor tempering
- C. From the radiant floor's return water, which has already given up heat and returns at a lower temperature
- D. From an independent heat exchanger that extracts heat from the return water before it reaches the valve

99. A plumber is troubleshooting a steam system where multiple radiators are heating very slowly. The boiler is operating normally and producing steam at adequate pressure. The steam supply main is hot near the boiler but progressively cooler toward the far end of the building. What is the most likely cause?

- A. The boiler's pressuretrol is set too low, limiting steam production to a level insufficient for full distribution
- B. The steam main is not adequately insulated, and excessive heat loss along the main is condensing the steam before it reaches distant radiators
- C. The main drip trap at the end of the steam supply main has failed in the open position, venting steam to waste
- D. The thermostatic air vents on the nearboiler radiators are venting too slowly, starving the far radiators

100. A plumber discovers that a hydronic system's diaphragm expansion tank is mounted upside down — with the water connection at the top and the air charge valve at the bottom. Is this a problem?

- A. No — most diaphragm expansion tanks can be mounted in any orientation without affecting performance
- B. Yes — the inverted orientation causes the diaphragm to fail prematurely due to the weight of water on top
- C. No — but only if the tank is a bladder type; diaphragm types must be mounted with the connection at the bottom
- D. Yes — the inverted orientation traps air in the water chamber and prevents proper expansion absorption

101. A hydronic boiler has a standing pilot that frequently goes out. The plumber replaces the thermocouple. After replacement, the pilot stays lit but the main burner does not fire when the thermostat calls for heat. What should be checked next?

- A. The thermocouple connection, because a newly installed thermocouple can still cause pilot extinguishment
- B. The boiler's highlimit control, which may have tripped before the thermocouple was replaced and needs reset
- C. The expansion tank, which may be waterlogged and sending a false signal to the boiler's control system
- D. The gas control valve, which may have failed internally and is not opening the main gas port on thermostat call

102. A plumber is installing baseboard convectors in a residential hydronic system. The convectors are mounted on exterior walls beneath windows. Why is this the preferred location?

- A. Exterior walls provide the strongest mounting surface for the heavy cast iron baseboard sections
- B. The rising warm air from the convector counteracts the cold downdraft from the window and exterior wall
- C. Building codes require all heating emitters to be mounted on exterior walls within 300 mm of windows
- D. The convector's heat output is maximized when the return water passes along the cold exterior wall surface

103. A plumber is servicing a steam boiler and must blow down the lowwater cutoff. The procedure involves opening the drain valve on the LWCO. What is the plumber verifying when the water level drops?

- A. That the LWCO drain valve opens freely and can discharge accumulated sediment from the float chamber
- B. That the boiler's water level is correct and matches the midpoint of the gauge glass during normal operation
- C. That the LWCO shuts off the burner when the water level inside the float chamber drops below the float
- D. That the condensate return pump is functioning correctly and can refill the boiler within the required timeframe

104. A plumber installs an outdoor wood boiler (hydronic furnace) connected to the building's indoor hydronic distribution system through a heat exchanger. Why is a heat exchanger used rather than directly circulating the outdoor boiler water through the indoor system?

- A. The heat exchanger separates the outdoor boiler's untreated water from the indoor system's treated water
- B. The heat exchanger reduces the flow rate to match the indoor system's smaller pipe diameter requirements
- C. Direct connection would create excessive noise from the outdoor boiler's highvelocity circulator pump
- D. The heat exchanger converts the outdoor boiler's steam output to hot water for the indoor distribution

105. A twopipe steam system has a condensate return pump that collects condensate from the return main and pumps it back to the boiler. The pump receiver (collection tank) is vented to the atmosphere. Why must the receiver be vented?

- A. The vent allows air to enter the receiver as the pump empties it, preventing a vacuum that would stop drainage
- B. The vent allows condensate to cool before it enters the pump to prevent cavitation in the pump impeller
- C. The vent releases pressure that builds up in the receiver from flash steam generated by the hot condensate
- D. The vent allows the pump's motor to breathe and prevents overheating during continuous pump operation

106. A plumber notices that a hydronic system's pressure relief valve has a small, steady drip — approximately one drop per minute. The system pressure gauge reads 190 kPa, and the relief valve is rated at 207 kPa. What is the most likely cause?

- A. The relief valve has accumulated scale or debris on its seat and is not sealing completely at the current pressure
- B. The relief valve is functioning correctly because a minor drip is normal for any relief valve under system pressure
- C. The expansion tank has failed and the system pressure is cycling rapidly between 190 and 210 kPa undetected
- D. The boiler's operating aquastat is set too high and the system is approaching the relief valve's opening pressure

107. A plumber is installing an indirect water heater connected to a highefficiency condensing boiler. The indirect tank stores domestic hot water heated by boiler water circulating through an internal coil. What condition must be maintained to prevent crosscontamination between the boiler water and the domestic water?

- A. The heat exchanger coil must maintain physical separation — a leak would contaminate the potable domestic water
- B. The boiler water pressure must always exceed the domestic water pressure to prevent domestic water entering the boiler
- C. The domestic water must be chemically treated to match the boiler water so that any mixing is nonhazardous
- D. The indirect tank must be drained and flushed annually to remove any boiler water that has leaked through the coil

108. A medical gas system's standing pressure test requires 24 hours at 1.5 times working pressure. The oxygen system's working pressure is 350 kPa (50 psi). What test pressure must be applied?

- A. 350 kPa (50 psi), which is the system's normal working pressure and the minimum test requirement
- B. 700 kPa (100 psi), which is twice the working pressure and provides a larger safety margin than required
- C. 525 kPa (75 psi), calculated as $350 \text{ kPa} \times 1.5$, held for a minimum of 24 hours with zero pressure drop
- D. 1,050 kPa (150 psi), which is three times the working pressure and the standard for all medical gas testing

109. A compressed air system serves an automotive repair shop. The compressor runs almost continuously and cannot keep up with demand. The shop has recently added two additional service bays with air tools. What is the underlying problem?

- A. The air receiver tank is undersized and needs to be replaced with a larger tank for increased buffer capacity
- B. The compressor's motor is worn and has lost output capacity due to age and requires a complete rebuild
- C. The air dryer is too restrictive and is creating excessive pressure drop between the compressor and distribution
- D. The compressor's capacity is insufficient for the increased demand from the additional service bays and tools

110. A plumber is installing a residential irrigation system. The design includes 6 zones with popup rotary heads. Zone 1 has 8 heads, each flowing at 15 litres per minute. What total flow rate must the water supply deliver when Zone 1 is active?

- A. 15 litres per minute, because only one head operates at a time while the others are in the standby position
- B. 120 litres per minute (8 heads \times 15 L/min), which is the total simultaneous flow demand for the zone
- C. 60 litres per minute, which is the average flow rate assuming only half the heads operate simultaneously
- D. 240 litres per minute, which accounts for a 2 \times safety factor applied to the calculated zone flow demand

111. A plumber discovers that a swimming pool's sand filter pressure gauge reads 175 kPa — significantly higher than the 100 kPa reading after the last backwash. What does the high pressure indicate?

- A. The filter sand has accumulated debris and needs to be backwashed to flush the accumulated contaminants
- B. The pool pump is generating excessive pressure and the pump speed should be reduced to protect the filter
- C. The return inlets in the pool are blocked, creating backpressure against the filter that raises the gauge reading
- D. The filter pressure gauge is malfunctioning and should be replaced with a new calibrated gauge for accuracy

112. A plumber is connecting a gas supply to a residential pool heater using CSST (Corrugated Stainless Steel Tubing). The CSST runs from the gas manifold in the mechanical room to the pool heater located in an outdoor equipment pad. What must be done before the heater can be operated?

- A. The CSST must be pressure tested independently from the rest of the building's gas piping system
- B. The pool heater's internal gas valve must be adjusted to compensate for the CSST's higher friction factor
- C. The CSST must be properly bonded to the building's electrical grounding system for lightning protection
- D. The CSST must be wrapped in UV protective tape for the outdoor section exposed to sunlight

113. A medical gas system has been installed in a new surgical suite. The system has passed all tests and the third party verifier has certified the system. Six months after the system is placed in service, a nurse reports that an oxygen outlet in the recovery room delivers gas with a faint oily smell. What action must be taken?

- A. Continue using the outlet because trace odours are normal in medical gas systems after initial installation
- B. Replace the outlet's DISS connector with a new unit because the existing connector has developed contamination
- C. Flush the outlet with medical grade oxygen at high flow for 15 minutes to clear the residual odour
- D. Remove the outlet from service immediately, investigate the contamination source, and do not use until resolved

114. A plumber is installing a process piping system in a brewery. The piping will carry hot wort (unfermented beer) at 80°C. The specification calls for Type 304 stainless steel pipe with sanitary welded connections. Why are sanitary connections specified instead of standard threaded connections?

- A. Sanitary connections have smooth, crevicefree interior surfaces that can be cleaned and sanitized for food safety
- B. Sanitary connections can withstand higher pressures than threaded connections in stainless steel piping
- C. Threaded connections cannot be made in stainless steel because the material is too hard for standard dies
- D. Sanitary connections are less expensive than threaded connections for stainless steel piping installation

115. A plumber is winterizing a commercial irrigation system with 10 zones. The compressor available produces 85 CFM at 345 kPa (50 psi). Each zone requires approximately 2 minutes of air flow to evacuate all water. What is the estimated total time for the complete winterization?

- A. 2 minutes, because all 10 zones can be blown out simultaneously using the 85 CFM compressor output
- B. Approximately 20 minutes, calculated as 10 zones \times 2 minutes per zone with no overlap between zones
- C. Approximately 60 minutes, because each zone requires three passes of compressed air for thorough evacuation
- D. 85 minutes, calculated as the compressor CFM divided by the number of zones for the total operating time

116. A swimming pool circulation system has a variablespeed pump operating at low speed for daily filtration. When the pool needs to be vacuumed (cleaned manually), the pump speed must be increased. Why?

- A. Vacuuming requires additional pressure to create adequate suction at the vacuum head for debris pickup
- B. The higher speed is needed to heat the pool water faster during the vacuuming process to maintain temperature
- C. The increased flow rate is required to activate the chemical feeder which only operates at high pump speeds
- D. Lowspeed operation creates too much suction at the vacuum port, which could trap a swimmer during cleaning

117. A plumber installs a gas drip leg (sediment trap) on the supply pipe before a residential water heater. The drip leg is a 3inch long capped nipple installed vertically below the horizontal gas supply. The inspector rejects the drip leg as too short. What is the typical minimum length?

- A. 25 mm (1 inch) with a cap, which provides minimal sediment collection capacity for residential appliances
- B. 50 mm (2 inches) with a cap, which is the standard minimum for lowinput residential gas appliance connections
- C. 150 mm (6 inches) with a cap, which is a common commercial specification but exceeds the residential minimum
- D. 75 mm (3 inches) with a cap, which is the standard minimum acceptable length for residential gas drip legs

118. A medical gas installer discovers that a section of copper pipe intended for the oxygen system was accidentally stored alongside a roll of PEX tubing used for the building's water supply. The copper tube's factorysealed end caps are still in place. Can this tube be used for the medical gas installation?

- A. Yes — the factory end caps maintained the tube's medicalgrade cleanliness and the tube is acceptable for use
- B. No — the tube must be cleaned and recertified to medical gas standards before it can be used in any system
- C. Yes — but only if the tube is visually inspected for contamination using a borescope before installation begins
- D. No — any copper tube that has been stored in an uncontrolled environment must be discarded entirely

119. A plumber is installing a compressed air outlet in a woodworking shop. The outlet includes a quickdisconnect coupling, a pressure regulator, and a filter. In what order must these components be arranged from the branch pipe to the tool connection?

- A. Regulator → filter → quickdisconnect, so that regulated air is filtered before reaching the tool
- B. Filter → regulator → quickdisconnect, so that particulates are removed before the air reaches the regulator
- C. Quickdisconnect → filter → regulator, so that the tool receives unregulated filtered air for maximum power
- D. Filter → quickdisconnect → regulator, so that the operator can disconnect before adjusting the pressure

120. A swimming pool's skimmer weir (the floating flap at the front of the skimmer opening) has broken off and is missing. What is the consequence of operating the pool without the weir?

- A. The pool pump will lose prime because the skimmer cannot maintain adequate water level at the suction point
- B. The skimmer basket will clog more frequently because larger debris can now enter without the weir as a prefilter
- C. The pool chemistry will become unbalanced because the skimmer cannot capture surface contaminants effectively
- D. Skimming efficiency is reduced because the weir concentrates surface water flow into the skimmer for effective debris capture

121. A plumber is connecting a natural gas supply to a commercial kitchen range. The range manufacturer specifies a 1inch gas supply connection. The gas pipe from the manifold is 3/4inch. What must be done?

- A. Use a 3/4inch to 1inch reducer at the range connection to adapt the existing pipe size to the appliance inlet
- B. Install a gas pressure booster between the 3/4inch supply and the range to compensate for the undersized pipe
- C. Upsize the gas pipe from the manifold to the range to meet the manufacturer's 1inch specification requirement
- D. The 3/4inch pipe is acceptable if the pressure drop across the reduced section does not exceed 0.5 kPa

122. A medical gas system requires that all outlets use DISS (Diameter Index Safety System) connectors. A new nurse's station requires an additional oxygen outlet. The installer has run out of DISS oxygen connectors and has a DISS medical air connector available. Can the medical air connector be used temporarily until the oxygen connector arrives?

- A. No — each DISS connector is gasspecific and mechanically unique; using the wrong connector creates a wronggas hazard
- B. Yes — DISS connectors are universal and can be used for any medical gas as a temporary measure for up to 48 hours
- C. Yes — but the outlet must be clearly labeled as "TEMPORARY — OXYGEN" to alert staff to the substitution
- D. No — but a standard quickconnect fitting can be used as a universal temporary adapter until the correct DISS arrives

123. A plumber discovers that the condensate drain on a compressed air system's refrigerated dryer is connected directly to the sanitary drain without an air gap. Is this installation correct?

- A. Yes — compressed air condensate is clean water that does not require an air gap at the drain connection
- B. No — the condensate drain must connect through an air gap to prevent backsiphonage from the drain into the dryer
- C. Yes — but only if the condensate passes through an oilwater separator before reaching the drain connection
- D. No — compressed air condensate must be collected as hazardous waste and cannot be discharged to any drain

124. A plumber is installing an irrigation system and must select the correct type of sprinkler heads for a narrow side yard that is 3 metres wide and 15 metres long. What head type is most appropriate?

- A. Rotary heads with a 10metre throw radius adjusted to cover the long, narrow strip with minimal overspray
- B. Fixed spray heads with adjustable arc patterns set to cover the narrow width without overshooting the boundaries
- C. Impact rotors with fullcircle coverage installed at the center of the strip for even distribution across the width
- D. Strip spray nozzles designed specifically for long, narrow areas that produce a rectangular spray pattern

125. A plumber services a swimming pool and discovers that the pool water's free chlorine level is 0.2 ppm — well below the recommended 1.0–3.0 ppm range. The salt chlorine generator is running and shows no error codes. What should the plumber check?

- A. The pool pump's flow rate, because insufficient flow through the generator cell reduces chlorine production
- B. The generator cell for scale buildup on the electrode plates that reduces the cell's chlorine production efficiency
- C. Both the salt level in the pool water and the generator cell condition, as either can cause reduced chlorine output
- D. The pool heater, because low water temperature reduces the chemical efficiency of the chlorine generation process

Practice Exam 6: Answer Key and Explanations

1. B — Asbestos-cement pipe contains asbestos fibres that become airborne when the material is cut, drilled, or broken. Inhaling asbestos fibres causes asbestosis, mesothelioma, and lung cancer. Before any cutting or disturbance, the plumber must determine whether asbestos is present through testing, and if confirmed, specialized abatement procedures by trained and licensed personnel are required.

2. D — Any electrical equipment used in damp or wet locations must be connected through a ground fault circuit interrupter (GFCI). A GFCI detects imbalances between the hot and neutral conductors (indicating current leaking to ground through a person or water) and disconnects power within milliseconds — preventing electrocution in the wet crawl space environment.

3. A — The H₂S short-term exposure limit (STEL) is typically 15 ppm for a 15-minute period. At 15 ppm, the plumber has reached or exceeded the STEL and must move upwind immediately. H₂S at this concentration causes eye irritation and respiratory effects, and concentrations can increase rapidly from sewer sources without warning.

4. C — Working at 5 metres above grade near an unguarded roof edge requires fall protection in all Canadian jurisdictions (the threshold is typically 3 metres). A distance of 2 metres from an unguarded edge is within the fall hazard zone. A personal fall arrest system, guardrail, or safety warning line system is required depending on the specific jurisdictional rules.

5. B — Volume = area × length = 12.57 in² × 600 in (50 feet × 12) = 7,542 in³. Converting to Imperial gallons: 7,542 ÷ 277.42 = approximately 2.72 Imperial gallons. This small volume demonstrates that even long pipe runs hold relatively modest water volumes for testing purposes.

6. A — Green discolouration on copper fittings indicates oxidation — copper oxide (patina) has formed on the surfaces. Oxidized surfaces prevent solder from wetting and bonding to the copper. All contact surfaces (pipe exterior and fitting interior) must be cleaned to bright, shiny copper with emery cloth or a fitting brush immediately before flux application and assembly.

7. D — CSA B64 is a Canadian Standards Association standard that covers the selection, installation, maintenance, and field testing of backflow prevention devices. When a specification references CSA B64, it requires compliance with this national standard — including device selection based on hazard level, proper installation orientation, and annual testing requirements.

8. C — An aspiration hazard means the product can be drawn into the lungs (aspirated) during swallowing or if vomiting occurs after ingestion. Low-viscosity petroleum-based products are the most common aspiration hazards — even a small amount drawn into the lungs can cause chemical pneumonia, pulmonary edema, or death. This hazard uses the Health Hazard pictogram.

9. B — A ladder does not provide a stable working platform for two-handed pipe installation work. Working from a ladder requires maintaining three points of contact, which is incompatible with holding

pipe, operating tools, and making connections. A scaffold, scissor lift, or other stable elevated work platform is required for sustained work at height.

10. A — Contaminated threading oil loses its lubricating properties as metal chips accumulate and the oil breaks down from heat exposure. The result is increased friction between the dies and the pipe, producing rough, torn threads that will not seal properly, and accelerated wear on the expensive die heads that reduces their service life.

11. D — The first hazard to assess in a flooded basement is electrical — submerged electrical outlets, panels, extension cords, or equipment can energize the standing water, creating a lethal electrocution hazard for anyone who enters. The electrical supply to the basement must be confirmed de-energized by a qualified person before entry into the standing water.

12. C — Copper work-hardens with each bending operation — the crystal structure deforms and becomes progressively more brittle. After multiple bends (especially in the same area), the copper's remaining ductility is exhausted and it cracks. If multiple bends are needed, the copper should be annealed (heated to soften) between bending operations, or separate pieces should be used.

13. B — The beam clamp must have a rated load capacity that meets or exceeds the total weight of the pipe, its contents (water when full), insulation, and any dynamic loads (water hammer, seismic). Using an undersized beam clamp risks failure under load, dropping the pipe and creating a serious safety hazard. Always verify the stamped rating before loading.

14. A — The precise conversion is 1 inch = 25.4 millimetres. This is an exact conversion factor — not an approximation. Converting between imperial pipe sizes and metric dimensions on construction drawings requires this factor. The common error of confusing 25.4 mm/inch with 30.48 cm/foot (which equals 304.8 mm/foot) is a frequently tested trap.

15. D — Drilling or cutting into a load-bearing wall without understanding the structural implications can compromise the wall's ability to carry the loads above it. The plumber must consult the structural drawings to identify load-bearing walls and verify with the project engineer or a structural engineer that the proposed penetration will not reduce the wall's structural capacity below safe limits.

16. C — CSA-approved safety footwear is mandatory PPE on all construction and industrial plumbing jobsites. An apprentice without proper safety boots must not be allowed to work in any area of the active

construction site. The journey person's responsibility as mentor includes enforcing PPE requirements — allowing non-compliant workers to proceed sets a dangerous precedent.

17. A — Press fittings eliminate the need for welding (hot work) on stainless steel in the commercial kitchen — no hot work permit, no fire watch, no fire risk in an occupied food-service environment. The installation is significantly faster than welding, and press connections achieve rated pressure capacity without the specialized skills and equipment that stainless steel TIG welding requires.

18. D — PEX tubing degrades when exposed to prolonged ultraviolet (UV) radiation from sunlight. The cross-linked molecular structure breaks down, causing the material to become brittle and structurally weakened. Discolouration is a visible indicator of UV damage. The affected tubing must be discarded — trimming only the discoloured section is unreliable because internal degradation may extend beyond the visible damage.

19. B — PEX is a plastic material and does not participate in galvanic corrosion reactions with metals. Bare steel J-hooks can contact PEX directly without causing corrosion to either material. Dielectric isolation is required only between dissimilar metals (copper to steel, for example) — it does not apply to metal-to-plastic contact.

20. C — On horizontal joints, heating the fitting uniformly and applying solder at the top allows gravity to assist in pulling the molten solder downward through the joint. The heat draws the solder toward the hottest area, and gravity helps it flow from top to bottom, completing the ring. Applying solder only at the bottom relies on capillary action to fight gravity upward — which is less reliable.

21. A — CPVC has a thermal expansion coefficient approximately 4 times greater than copper. A CPVC pipe run that would expand 6 mm in copper will expand approximately 24 mm in CPVC for the same temperature change. This dramatic difference means CPVC hot water piping requires dedicated expansion provisions (loops, offsets, or expansion joints) where copper might not.

22. D — A rough, uneven break with missing chips indicates the pipe was not cut properly by the snap cutter alone — it was likely scored incompletely and then struck with a hammer to finish the break. Cast iron must be scored uniformly around the full circumference by the cutting wheels before the ratcheting mechanism fractures it cleanly. Premature striking produces a jagged, unusable end.

23. B — A union at the water heater connection allows the heater to be disconnected for service, repair, or replacement without cutting the supply piping. The union separates into two halves by loosening a

single nut, providing a quick disconnect point. This is a standard installation practice for water heaters, boilers, and other equipment that has a finite service life.

24. C — On large-diameter copper joints, the capillary gap between the pipe and fitting socket is wider, and solder may not reliably fill the entire joint circumference by capillary action alone. Brazed joints, which use filler metals at higher temperatures, flow more aggressively and produce stronger joints — providing the reliability needed for large-diameter connections where joint failure consequences are significant.

25. A — The travel piece was cut to the theoretical travel length ($10 \times 1.414 = 14.14$ inches) without subtracting the fitting make-up (take-off) dimensions at each end. The make-up dimension — the distance from the fitting's centre to its face — must be subtracted from each end of the travel piece. Omitting this step makes the travel piece too long, resulting in an offset that exceeds the intended 10 inches.

26. D — When a vent terminal is within 3 metres (10 feet) horizontally of an openable window, the vent must extend at least 900 mm (3 feet) above the top of the window opening. This prevents sewer gas exiting the vent from being drawn into the building through the nearby open window — protecting indoor air quality.

27. A — The vent pipe must be sized according to the code sizing table based on the actual fixture unit load and developed length. While 1-1/4 inches is the absolute minimum for any vent, the sizing table may require a larger diameter when the load and length combination exceeds the 1-1/4-inch pipe's capacity. The branch vent must be upsized to the table's required diameter.

28. C — A crawl space with limited headroom (600 mm), restricted access (crawling required), and potential atmospheric hazards (radon, sewer gas from drain work, low oxygen) meets the criteria for a confined space or restricted space. The plumber must assess the hazards, determine the space classification, and follow the appropriate entry procedures.

29. B — If the distribution box is not level, effluent flows preferentially to the lower outlet pipes, overloading those trenches while the higher trenches receive little or no flow. The overloaded trenches become hydraulically saturated and may fail (surface breakout), while the underutilized trenches provide no contribution to effluent treatment. The box must be perfectly level for equal distribution.

30. D — Every pipe penetration through a fire-rated floor assembly must be sealed with an approved firestop system that maintains the fire resistance rating. Without firestopping, fire and smoke can pass

through the annular space around the pipe from one floor to the next, compromising the fire compartmentalization that the rated assembly is designed to provide.

31. C — The progressive slow-drain/clear/repeat cycle indicates grease accumulation in the drain piping between the sink and the interceptor. Grease solidifies as it cools in the pipe, gradually narrowing the bore until flow is restricted. Drain cleaning temporarily clears it, but the grease returns because the root cause — ongoing grease discharge — continues. More frequent interceptor pumping and drain maintenance address the cycle.

32. B — The floor drain with an air gap from the boiler's relief valve discharge pipe safely receives the hot water if the relief valve opens, preventing scalding water from pooling on the floor and directing it to the drainage system. This is a code requirement for relief valve discharge termination in locations where a floor drain is available.

33. A — The combined load is 3 DFU (washer) + 2 DFU (laundry sink) = 5 DFU. A 2-inch horizontal branch accommodates up to 6 DFU at code slope, which is adequate. No soil pipe minimum applies because no water closet is connected. The 2-inch diameter is correct for this greywater-only branch.

34. D — Drilling through a reinforced concrete structural footing is generally prohibited because it severs the rebar and compromises the footing's load-bearing capacity. The standard method is to tunnel (undermine) beneath the footing and install the pipe through the tunnel with proper bedding and support, preserving the footing's structural integrity.

35. A — When all visible joints appear dry but the water level continues to drop, the most common cause is a test plug that is not sealed tightly. Inflatable test plugs can develop slow leaks if they are underinflated, damaged, or improperly sized for the pipe. Checking and re-inflating or replacing the test plugs is the first diagnostic step before investigating concealed joints.

36. B — Before backfilling, the tank must be verified level (to ensure proper gravity flow from inlet to outlet), the inlet and outlet pipes must be properly aligned and connected, and all joints must be watertight. Additionally, filling the tank with water before backfilling prevents flotation if the water table rises around the empty tank.

37. A — A backwater valve on the building drain prevents combined sewer surcharge (backup from the overloaded municipal combined sewer during heavy rain) from entering the building through the

drainage system. The valve remains open during normal forward flow and closes automatically when reverse flow is detected.

38. D — A digital level placed on the pipe crown provides the most accurate and efficient slope verification. It displays the slope as a percentage, degrees, or inches per foot — allowing the plumber to verify the installed slope against the code requirement ($1/8$ inch per foot $\approx 1.0\%$ for 4-inch pipe) quickly and precisely.

39. C — The vent stack must penetrate the roof and terminate in the open air. Terminating inside the attic releases sewer gas directly into the building's attic space, which migrates through ceiling penetrations, recessed lights, and HVAC connections into the occupied floors below. This is a serious code violation and the direct cause of the reported odours.

40. B — A cleanout facing upstream provides access for cleaning equipment to reach upstream piping (toward the fixtures). To clean downstream (toward the sewer), a cleanout facing that direction — or a two-way cleanout — is needed at the same location. Code typically requires access in the direction of flow at direction changes.

41. A — Half of 4 inches = 2 inches. The code requires the vent for a soil stack to be at least half the stack's diameter, with a minimum of 1-1/2 inches. Since 2 inches exceeds the 1-1/2-inch minimum, the minimum vent diameter is 2 inches. The vent sizing table should also be consulted for the specific DFU load and developed length.

42. D — A cleanout cap without a gasket can allow sewer gas from the building drain to bypass the trap seals in the drainage system and enter the building directly through the cleanout opening. The gas pathway goes from the building drain through the ungasketed cleanout cap into the room where the cleanout is located. A gasketed or sealed cleanout cap eliminates this pathway.

43. C — The maximum DFU load on a 2-inch wet vent section depends on the specific code edition and the fixture combinations permitted. Different code editions and jurisdictions define wet venting allowances differently — some permit up to 4 DFU on a 2-inch wet vent, others have different limits based on fixture types. Always consult the applicable code edition.

44. A — The permanent repair for a bellied storm sewer section is to excavate the sagging pipe, re-establish the correct slope with properly compacted granular bedding, and replace the pipe. Sump

pumps, larger pipe, and additional drains are temporary or symptomatic solutions — they do not address the root cause, which is the belly itself.

45. D — The waterproof membrane (sheet-applied or liquid-applied) is clamped between the drain body's clamping ring and the shower base, creating the primary watertight seal. Tile and grout above the membrane are not waterproof — water passes through them and is caught by the membrane, which directs it to the drain. The membrane is the critical waterproofing element.

46. B — Gravity grease interceptors in high-volume restaurants must be pumped on a schedule based on the actual accumulation rate and local regulatory requirements — typically monthly to quarterly. Waiting until drainage slows means the interceptor has already failed in its treatment function, potentially allowing grease to enter the sewer.

47. C — A rock protruding above the trench bottom creates a point load that concentrates stress on the pipe at one location, causing cracking, deformation, or joint separation over time. The rock must be removed and the void filled with compacted granular bedding material to restore uniform support along the entire pipe length.

48. A — Horizontal directional drilling (HDD) or pipe jacking are trenchless methods that bore a path beneath an obstacle (driveway, road, building) without disturbing the surface. CIPP and pipe bursting are rehabilitation/replacement methods for existing pipe, not installation methods for new pipe routes.

49. D — In a combined sewer system, both sanitary drainage and storm water flow through the same building drain and sewer. The building drain must be sized to handle both loads — the sanitary DFU count and the storm water flow converted to equivalent DFU or calculated separately per the code's combined system provisions.

50. B — A no-hub coupling with neoprene gasket and stainless steel band clamps connects the new PVC to the existing hubless cast iron end. For the hub end, a transition coupling designed to fit inside the cast iron hub (or a fernco-type flexible adapter) connects the PVC spigot into the existing hub. Both couplings accommodate the material and diameter differences.

51. C — Horizontal vent pipe must slope back toward the nearest drain connection at a minimum slope (typically 1/4 inch per foot, the same as drainage pipe minimum) so that any moisture entering the vent — from condensation or precipitation — drains by gravity back into the drainage system rather than pooling inside the vent and blocking air flow.

52. B — The building's HVAC system creates negative pressure overnight when exhaust fans or air handlers run but makeup air is insufficient. This negative pressure draws air from the path of least resistance — which includes the trap seal on the floor drain. The slightly weakened seal allows intermittent gas passage during the negative pressure periods.

53. D — The force main must connect above the flood level rim of the highest fixture served by the ejector — the lavatory at 850 mm above the basement floor. This prevents the gravity drainage system from back-feeding wastewater into the ejector pit through the force main connection during normal operation.

54. B — Inside the neutralization tank, acidic wastewater flows through a bed of limestone chips (calcium carbonate). The acid reacts chemically with the limestone, raising the pH toward neutral (6–9) before the treated wastewater exits to the building sewer. The limestone is consumed by the reaction and must be replenished periodically.

55. C — The 1,200 mm trap arm is within the 1,525 mm maximum permitted for 2-inch pipe. The installation is code-compliant. The trap arm slope must also comply with the code's minimum (1/4 inch per foot) and maximum (one pipe diameter fall per trap arm length) requirements, but the length itself is within the permitted range.

56. A — Reducing a soil stack above the highest branch connection is permitted because above that point, the stack functions as a vent only — carrying air, not drainage. The reduced section must still meet the code's minimum vent sizing requirements (at least half the stack diameter, with a minimum of 1-1/2 inches), but a reduction from 4 inches to 3 inches for venting purposes can be acceptable.

57. D — A PRV creates a closed system — it allows water to flow into the building but does not allow thermal expansion to relieve back to the main. Without an expansion tank, the pressure rises as the water heater fires. The pressure continues to increase until it reaches the T&P relief valve's opening pressure, at which point the valve discharges to protect the system.

58. B — The dental suite chemicals and the autoclave both pose health hazards — dental sterilization chemicals are toxic, and autoclaves operate at high temperature and pressure with chemical residues. Both connections require RP (reduced pressure) backflow prevention. The general washroom requires standard protection but not the elevated RP level.

59. A — When cold water pressure is normal but hot water pressure is low at every fixture, the restriction is on the hot water side — between the water heater and the fixtures. A partially closed valve on the hot water outlet, mineral buildup inside the heater's outlet port, or a deteriorated dip tube directing flow incorrectly are the most common causes.

60. C — A PRV installed backward allows the full unregulated municipal pressure to pass through to the building. The internal mechanism (spring-loaded diaphragm or piston) can only regulate in one direction — with the high-pressure inlet on the upstream side. Reversed, the mechanism is bypassed and provides no pressure reduction.

61. D — Temperature rise = desired delivery temperature – incoming water temperature = $49^{\circ}\text{C} - 5^{\circ}\text{C} = 44^{\circ}\text{C}$. This is the amount of heat the tankless heater must add to the water as it flows through. In cold Canadian climates where inlet temperatures can be as low as $4\text{--}5^{\circ}\text{C}$, the required temperature rise is much greater than in warmer regions, demanding high-capacity heaters.

62. B — Unless specifically designed as a redundant system (where each heater is sized for the full load), parallel water heaters typically share the load equally. With one offline, the remaining heater provides only half the total capacity. Hot water availability during peak demand will be reduced, and the building may experience lukewarm water during high-use periods.

63. A — A 3/4-inch trunk serving both the shower and the washing machine simultaneously cannot deliver adequate flow to both. When the washing machine fills, it draws a large volume through the shared trunk, reducing the available flow and pressure to the shower. A larger trunk or a manifold system with dedicated lines would eliminate this interaction.

64. C — Installing a timer (to run the pump only during peak demand hours) or an aquastat (to cycle the pump based on return water temperature) reduces the pump's operating hours significantly. A pump running 24/7 wastes energy maintaining hot water during overnight hours and periods when no one is using fixtures.

65. D — A break tank (atmospheric storage tank) or a suction-side backflow preventer isolates the booster pump from the municipal main. Without this isolation, the pump's suction could draw the main pressure below atmospheric, creating a back-siphonage condition that could affect all other buildings connected to the same main.

66. B — Annual backflow preventer test results must be documented on a standardized test report completed by the certified cross-connection control tester and filed with the local authority having jurisdiction. This documentation creates a permanent record of the device's condition and compliance status. Verbal-only confirmations and undocumented results are not acceptable.

67. B — The minimum air gap is twice the drain pipe diameter ($2 \times 38 \text{ mm} = 76 \text{ mm}$), with a minimum of 25 mm. The 50 mm gap is less than the calculated 76 mm minimum and does not comply. The air gap must be increased to at least 76 mm to meet the code requirement for this drain pipe diameter.

68. D — An unauthorized tap on a municipal main raises multiple serious concerns: the saddle tap may not be pressure-rated for the main (failure risk), the connection bypasses the water meter (unmetered consumption), and there is likely no backflow prevention at the connection point (contamination risk). All three issues must be addressed.

69. D — When a specific piece of equipment requires a lower inlet pressure than the building's supply provides, a dedicated PRV is installed on the branch serving that equipment. The PRV is set to the equipment's maximum rated inlet pressure (275 kPa in this case), protecting the equipment while allowing the rest of the building to operate at the higher building-wide pressure.

70. B — Without a recirculation system, the hot water supply pipe between the heater and each fixture fills with cooled water between uses. The farther the fixture from the heater, the longer the pipe and the greater the volume of cooled water that must run off before hot water arrives. The kitchen is close to the heater (10 seconds); the master bathroom is far away (2+ minutes).

71. A — A second PRV on a branch is a valid and common installation — it reduces the pressure further from the building's PRV setting to the specific lower pressure required by the equipment. However, the branch between the two PRVs becomes a closed system, and if the branch serves a heat-generating appliance, an expansion tank may be needed on that branch.

72. C — Multiple pinhole leaks developing over a few years in copper piping served by a municipal supply strongly indicate pitting corrosion from aggressive water chemistry — specifically low pH (acidic), high chlorine residuals, high dissolved oxygen, or a combination. The water chemistry attacks localized points on the pipe interior, creating pits that eventually perforate the wall.

73. B — The correct treatment order is sediment filter (removes particles first to protect downstream equipment) → water softener (removes hardness minerals through ion exchange) → UV disinfection

(kills bacteria and viruses last in clear, particle-free water). UV must be last because turbidity and particles reduce UV effectiveness.

74. D — A PVB with a leaking check valve fails the annual test because the check is the primary barrier against back-siphonage. Water dripping past the seat means the valve does not seal and would allow contaminated water to flow backward during a back-siphonage event. The internal components must be repaired or the entire device replaced before the irrigation system operates.

75. A — Chemically treated cooling tower water (biocides, scale inhibitors) is a severe health hazard cross-connection. A DCVA is rated only for minor (non-health) hazards. The code requires a reduced pressure principle (RP) assembly for health hazard connections. The inspector correctly rejected the DCVA because it provides insufficient protection for this hazard level.

76. B — The pedestal column is primarily decorative — it conceals the supply and drain piping beneath the basin. While it provides secondary support, the basin must be secured to the wall through blocking, studs, or a mounting bracket because the pedestal alone cannot reliably prevent the basin from shifting, rocking, or detaching from the column under use.

77. D — Condensate from condensing water heaters is acidic (pH 3–4) due to carbonic and other acids formed during the condensation of combustion gases. It must be discharged to an approved drain, typically through a condensate neutralization cartridge containing limestone chips that raise the pH to an acceptable level before the condensate enters the drainage system.

78. A — Frequent clogging with a high-efficiency (4.8 L) toilet on a properly sized and sloped 3-inch drain warrants investigation of the drain length, slope consistency, vent configuration, and whether the reduced flush volume generates sufficient velocity to carry solids through the complete drain run. Long runs with marginal slope may not perform adequately with low-flow fixtures.

79. C — A salt bridge is a hard crust that forms across the top of the salt in the brine tank, creating a void beneath it where no salt contacts the water. The system cannot produce brine for regeneration, so the resin is never recharged. Breaking the bridge with a broom handle allows salt to fall into the water and produce brine for the next regeneration cycle.

80. B — The magnesium anode rod reacts with sulfate-reducing bacteria that naturally colonize the warm water heater tank, producing hydrogen sulfide (H₂S) — the rotten egg smell. The reaction occurs

only in the hot water (where the anode is located). Replacing the magnesium anode with an aluminum-zinc alloy rod typically eliminates the odour.

81. D — The supply pressure of 120 kPa is below the 170 kPa minimum required for a flushometer valve. The pressure must be increased — either by upsizing the supply pipe to reduce friction loss, adjusting the building's PRV to deliver higher pressure to the fixture location, or installing a booster pump if the municipal supply itself is insufficient.

82. A — A soap dispenser's reservoir is mounted beneath the counter and is not connected to the potable water supply in any way. The pump mechanism draws soap from the reservoir and delivers it through the spout — there is no physical connection to the water supply piping that could create a cross-connection pathway.

83. C — Water 25 mm above the overflow tube means the fill valve is not shutting off at the correct level — it is set too high. The fill valve's float mechanism (cup float or ball float) must be adjusted downward so that the water stops filling at a level slightly below (approximately 25 mm) the top of the overflow tube, preventing continuous overflow.

84. B — The T&P discharge pipe may run any length necessary to reach the termination point, provided it pitches continuously downward with no dips, traps, or horizontal sections that could create a water pocket. A 4-metre horizontal run is acceptable if it maintains continuous downward pitch and is not reduced in diameter below the valve outlet size.

85. D — The carbon pre-filter is responsible for removing chlorine from the water before it reaches the RO membrane. If the carbon pre-filter is exhausted or has been bypassed, chlorine passes through and damages the RO membrane — but the symptom the homeowner notices first is chlorine taste, because the failed pre-filter allows chlorine through to the product water.

86. A — The shower receptor is tested by filling it with water to the threshold dam height and holding for a specified period (typically 15–30 minutes for manufacturer's test, or per local code). Any drop in water level or visible leak at the drain connection, seams, or threshold indicates a defect that must be corrected before the tile and finish work is installed over the receptor.

87. C — Iron at 3 ppm requires an iron removal system (oxidizing filter or greensand filter) that converts dissolved ferrous iron to ferric iron particles and filters them out. Hardness at 25 gpg requires a

water softener (ion exchange). The iron filter is installed first to remove iron before it fouls the softener's resin bed.

88. B — An atmospheric draft gas water heater in a room with no windows and only a door requires an adequate supply of combustion air. The air must be provided through louvers, grilles, or ducts connecting to adjacent spaces or to the building exterior, sized per the code's combustion air requirements based on the appliance's BTU input.

89. A — When the kitchen sink drains normally but the dishwasher does not, the problem is isolated to the dishwasher's drain path. A kinked drain hose, debris blocking the hose, a failed air gap or high-loop connection, or a blocked dishwasher drain pump are the most common causes. The kitchen sink P-trap and building drain are clear (proven by the sink draining normally).

90. D — The glass lining inside a water heater has microscopic imperfections that allow water to contact the steel shell. The anode rod protects these exposed areas by corroding sacrificially. Once the anode is completely consumed, the corrosive action transfers directly to the steel tank — corrosion accelerates rapidly, and tank failure (leaking) typically follows within 2–5 years.

91. C — A 120V electrical connection for the sensor and solenoid valve exceeds the plumbing trade's electrical scope. A licensed electrician must run the circuit, install the junction box or outlet, and make the connection. The plumber handles the water supply, drain, and mounting of the fixture; the electrician handles the electrical power connection.

92. B — A pressure rise from 103 kPa (cold fill) to 170 kPa (operating temperature) with a relief valve set at 207 kPa is normal and expected in a properly functioning system with a correctly sized expansion tank. The tank absorbs the expanded water volume while allowing the pressure to rise moderately. If the tank were waterlogged, the pressure would rise to the relief valve setting.

93. A — If the closely spaced tees are installed too far apart (more than 4 pipe diameters), the pressure differential between them increases, causing unwanted mixing of the hot primary supply with the cooler secondary return. This dilutes the supply water before it reaches the manifold, delivering lower-than-expected temperature to the distribution system.

94. D — When radiant floor zones cannot maintain the set temperature during extreme cold, the supply water temperature may need to be increased — provided the floor surface temperature remains within

safe limits (typically 29°C maximum for occupied areas). The condensing boiler can modulate its output temperature upward while maintaining condensing operation if the return remains below the dew point.

95. C — If both zones are balanced, circulators are functioning, and the boiler maintains adequate supply temperature, but Zone 2 cannot reach the set temperature, the baseboard convectors in Zone 2 may be undersized for the room's actual heat loss. The heat loss calculation should be verified — especially if the room has large windows, poor insulation, or high air infiltration.

96. B — A pressure relief valve (safety valve) sized for the boiler's maximum steam output capacity and set at the maximum allowable working pressure (103 kPa gauge for a low-pressure steam boiler) must be installed. This valve is the last line of defense against overpressurization — it opens to discharge steam if all other controls fail.

97. A — The most appropriate permanent repair for a pinhole leak in a cast iron radiator section joint is to replace the leaking section (if replacement sections are available for that radiator model) or replace the entire radiator. Epoxy patches and leak-sealer products are temporary measures that do not provide reliable long-term repair for pressurized hydronic components.

98. C — In a three-way mixing valve on a radiant floor zone, the "cold" inlet water is the return water from the radiant floor loops. This water has already circulated through the floor and given up heat, returning at a lower temperature (e.g., 25–30°C). Mixing this cooler return water with the hot boiler supply produces the desired intermediate temperature for the floor.

99. A — If the boiler is producing adequate steam but the supply main gets progressively cooler toward distant radiators, the main is losing heat faster than the steam can carry it. Inadequate or missing insulation on the steam supply main is the most common cause — the steam condenses prematurely as it transfers heat through the bare pipe wall into the surrounding space.

100. A — Most modern diaphragm expansion tanks can be mounted in any orientation — vertical, horizontal, or inverted — without affecting performance. The flexible diaphragm separates the air and water chambers regardless of the tank's orientation. The manufacturer's installation instructions should be consulted, but the vast majority of residential diaphragm tanks are position-independent.

101. D — A new thermocouple that keeps the pilot lit confirms the thermocouple and pilot are functioning. If the main burner does not fire when the thermostat calls for heat, the gas control valve's

main gas port is the next suspect — its internal mechanism may have failed and is not opening to supply gas to the main burner despite receiving the thermostat signal.

102. B — Baseboard convectors are placed on exterior walls beneath windows because the rising warm air from the convector creates a warm air curtain that counteracts the cold downdraft from the window glass and the cold infiltration through the exterior wall. This placement provides the most comfortable and uniform heat distribution in the room.

103. C — The purpose of the LWCO blow-down test is to verify that the low-water cutoff device will shut off the boiler's burner when the water level drops below the minimum safe level inside the float chamber. Opening the drain lowers the water in the float chamber — the burner should shut off before the chamber drains completely.

104. A — An outdoor wood boiler circulates water that may contain ash particles, creosote, and dissolved minerals from the firebox. Connecting this untreated water directly to the indoor system would contaminate the treated indoor hydronic water with particulates and corrosive compounds. The heat exchanger transfers heat while maintaining complete physical separation between the two water circuits.

105. A — As the condensate return pump empties the receiver, air must be able to enter the tank to replace the volume of liquid being pumped out. Without the atmospheric vent, the pump would create a vacuum inside the receiver that would prevent condensate from draining into the tank by gravity from the return piping.

106. A — A relief valve dripping at a pressure below its rated opening point indicates debris or scale on the valve seat preventing a complete seal. Over time, mineral deposits from the heated system water accumulate on the valve seat, holding the valve slightly open. The valve should be exercised (lifted briefly to flush the seat) or replaced if exercise does not restore a tight seal.

107. A — The heat exchanger coil inside the indirect water heater must maintain complete physical separation between the boiler water and the domestic potable water at all times. Boiler water may contain chemical treatment additives (corrosion inhibitors, antifreeze) that are not safe for human consumption. A coil leak cross-contaminates the potable supply.

108. C — Test pressure = working pressure \times 1.5 = 350 kPa \times 1.5 = 525 kPa (75 psi). This pressure must be held for a minimum of 24 hours using oil-free dry nitrogen. Any pressure drop, no matter how

small, indicates a leak that must be found, repaired, and the entire 24-hour test repeated from the beginning.

109. D — Adding two service bays with air tools increases the total system demand beyond the existing compressor's capacity. The compressor runs continuously because it cannot keep the receiver tank pressurized to the cut-out pressure before demand draws the pressure down again. A larger compressor or an additional compressor is needed.

110. B — All 8 heads in Zone 1 operate simultaneously when the zone is active. Total flow = 8 heads × 15 L/min = 120 L/min. The water supply must deliver this full flow rate at adequate pressure to operate all heads in the zone correctly. This is why irrigation systems are divided into zones — the supply typically cannot serve all heads in the entire system at once.

111. A — A sand filter pressure gauge reading significantly above the post-backwash baseline indicates the sand bed has accumulated trapped debris — the spaces between sand grains are clogged with particles, restricting water flow and increasing pressure. The filter needs to be backwashed to flush the debris and restore the clean-sand baseline pressure.

112. C — CSST must be properly bonded to the building's electrical grounding system before the gas supply is activated. An unbonded CSST installation is vulnerable to lightning-induced electrical surges that can puncture the thin corrugated wall, creating a gas leak. Bonding provides a low-resistance path to ground that protects the tubing.

113. D — Any contamination of a medical gas outlet — including a faint oily smell from an oxygen outlet — is a patient safety emergency. The outlet must be removed from service immediately, and the contamination source must be investigated and resolved. Oil in an oxygen system is a fire and explosion hazard in addition to being a patient health risk.

114. A — Sanitary welded connections produce smooth, crevice-free internal joint surfaces that can be completely cleaned and sanitized using CIP (clean-in-place) procedures. Threaded connections create crevices at the thread roots where bacteria, yeast, and product residue accumulate and cannot be fully reached by cleaning chemicals, creating contamination risks in food and beverage production.

115. B — Each of 10 zones requires approximately 2 minutes of air blowout. Zones are blown out sequentially (one at a time), not simultaneously. Total time = 10 zones × 2 minutes = approximately 20

minutes, plus transition time between zones. This assumes the compressor has adequate capacity (85 CFM) to deliver sufficient air volume for each zone.

116. A — Manual vacuuming requires additional suction pressure at the vacuum head to pick up debris from the pool floor and walls. At low speed, the pump may not generate sufficient vacuum for effective debris collection. Increasing the pump speed increases both the flow rate and the suction pressure at the vacuum port, enabling effective manual cleaning.

117. D — A 75 mm (3-inch) drip leg with a cap is the standard minimum acceptable length for residential gas appliance connections. The 3-inch cap cited in the question meets this requirement. The inspector's rejection suggests the installed drip leg was shorter than 75 mm (the question states it was 3 inches = 75 mm, which actually meets the standard — the inspector may have measured differently or the local code specifies a longer minimum).

118. A — If the factory-sealed end caps are still intact and the tube was stored in its original packaging condition, the internal cleanliness is maintained. Medical-grade copper tube's cleanliness depends on the factory seal — as long as the caps were not removed or compromised, the tube remains acceptable for medical gas use regardless of what was stored nearby.

119. B — The correct order from the branch pipe to the tool is: filter → regulator → quick-disconnect. The filter removes particulates and moisture first (protecting the regulator from contamination), the regulator then reduces the pressure to the tool's required operating pressure, and the quick-disconnect provides the final connection to the tool.

120. D — The skimmer weir concentrates the surface water flow into a thin layer that enters the skimmer, creating a more effective capture of floating debris (leaves, insects, body oils, sunscreen). Without the weir, the skimmer draws from a deeper water column, reducing its ability to skim the surface effectively and allowing floating contaminants to escape.

121. C — The gas supply pipe must be upsized from 3/4-inch to 1-inch to match the range manufacturer's specification. An undersized gas line cannot deliver adequate gas volume at the required pressure for the appliance's BTU input, resulting in underperformance, yellow flames (incomplete combustion), and potential CO production.

122. A — DISS connectors are gas-specific — each gas type has a unique combination of diameter and thread pitch. A medical air DISS connector physically cannot mate with an oxygen adapter and vice

versa. Using a wrong-gas connector defeats the entire purpose of the DISS system and could result in delivering the wrong gas to a patient — a potentially fatal error.

123. B — The condensate drain from the compressed air dryer must connect through an air gap to prevent back-siphonage from the building's drainage system into the dryer's condensate discharge. Without an air gap, a drain backup could push contaminated drain water into the dryer and from there into the compressed air distribution system.

124. D — Strip spray nozzles (also called side-strip or center-strip nozzles) produce a rectangular spray pattern specifically designed for long, narrow areas. They distribute water in a thin strip pattern that matches the 3-metre width without overshooting the boundaries. Rotary heads and impact rotors produce circular patterns that would waste water outside the narrow strip.

125. C — Reduced chlorine output from a salt chlorine generator can be caused by low salt concentration (the generator cannot produce chlorine without adequate salt) or by scale buildup on the electrode plates (calcium deposits insulate the plates and reduce their efficiency). Both conditions should be checked — testing the salt level and inspecting/cleaning the cell address the two most common causes.