

PRACTICE EXAM 9: RED SEAL PLUMBER SIMULATION (125 QUESTIONS)

1. A plumber is cutting galvanized steel pipe with a reciprocating saw. The cut produces a shower of hot metal chips and sparks. A coworker is standing 2 metres away watching the work. What PPE should the coworker be wearing?

A. No PPE is required at 2 metres because the coworker is outside the immediate work zone and at a safe distance

B. Safety glasses at minimum, because hot metal chips and sparks can travel well beyond 2 metres during cutting

C. A full face shield and leather apron because the coworker is within the mandatory 3metre exclusion zone

D. Only hearing protection, because the reciprocating saw noise level exceeds 85 dBA at the 2metre distance

2. A plumber must install a pipe support anchor into a concrete ceiling that was poured 3 days ago. The concrete specification requires a minimum 28day cure before drilling for expansion anchors. Why must the plumber wait?

A. Fresh concrete releases toxic dust when drilled that requires specialized respiratory protection not available on site

B. Expansion anchors installed in concrete less than 7 days old are code violations regardless of concrete strength

C. The drilling operation generates heat that could cause a steam explosion in concrete with high moisture content

D. Concrete has not reached its design compressive strength at 3 days — anchors installed now may pull out under load

3. A plumber is working on a residential renovation and discovers knobandtube electrical wiring running through the same joist bays where new DWV piping must be installed. What is the primary safety concern?

A. The old wiring may lack proper insulation, creating an electrocution hazard if the plumber contacts the energized conductors

B. The knobandtube wiring must be removed before any plumbing work begins in the same joist bay space

C. The wiring interferes with the pipe routing only and presents no electrical hazard to the plumber during installation

D. The plumber must reroute the plumbing to a different joist bay to maintain the required separation from all wiring

4. A plumber is installing a propane water heater in a residential basement. The basement has a window well with an operable window. The propane tank is located outdoors. What ventilation concern is specific to propane in this belowgrade installation?

A. Propane requires no special ventilation consideration because it dissipates naturally in enclosed belowgrade spaces

B. The operable window provides adequate ventilation for propane appliances regardless of the basement's volume

C. Propane is heavier than air and will pool at floor level in the basement, requiring specific ventilation and detection measures

D. Propane appliances are universally prohibited in basements in all Canadian provinces without exception

5. A plumber is mentoring a secondyear apprentice. The apprentice correctly identifies that a 45degree offset requires the 1.414 multiplier to calculate the travel piece length. However, the apprentice forgets to subtract the fitting makeup dimensions before cutting. What teaching approach is most effective?

A. Allow the apprentice to complete the cut and discover the error during assembly, then explain the correction needed

B. Stop the apprentice before the cut, demonstrate the complete calculation including makeup subtraction, then have them recalculate

C. Provide the apprentice with a premade offset calculation chart that eliminates the need to understand the math

D. Assign a different task to the apprentice and complete the offset calculation yourself to save time on the project

6. A plumber receives an emergency call to a building where a water main break has flooded the basement mechanical room. The room contains gasfired boilers, electrical panels, and a sump pump. The water is 450 mm deep. What must be done before the plumber enters the room?

A. Turn off the gas supply to the boilers from the exterior shutoff valve before entering the flooded mechanical room

B. Activate the sump pump by plugging it in from outside the room to lower the water level before entry begins

C. Wait for the water to recede naturally before entering because entering standing water is always prohibited

D. Have the electrical supply to the room confirmed deenergized by a qualified person before entering the standing water

7. A plumber must mark the location of an underground water service on the ground surface before excavation begins. In Canada, what colour is used to mark potable water lines?

A. Blue, which is the standard utility colour code for potable water lines across Canada and North America

B. Green, which identifies sewer and drainage lines on the utility colour coding system for locate markings

C. Red, which identifies electrical power lines and cables on the standard utility colour coding for excavation

D. Yellow, which identifies natural gas and propane lines on the utility colour code system for underground marking

8. A plumber is reviewing a project schedule and discovers that the concrete slab pour is scheduled for tomorrow, but the underground DWV roughin has not been inspected. The general contractor insists that the pour cannot be delayed. What is the correct action?

A. Pour the concrete over the uninspected piping because the final inspection will verify the system after the slab is placed

B. Request the building inspector to waive the underground inspection and approve the system based on photographs only

C. Insist that the underground piping must be inspected before the concrete is poured — delaying the pour if necessary

D. Accept the contractor's timeline and document the uninspected piping in the daily report as a potential future issue

9. A plumber is performing a hydrostatic test on a water supply system at 690 kPa (100 psi). The test gauge is connected at the lowest point of the system. The system extends 8 metres vertically above the gauge. What is the actual test pressure at the highest point in the system?

A. 690 kPa throughout the entire system because hydrostatic pressure is uniform in a closed system at all elevations

B. Approximately 612 kPa at the highest point, calculated by subtracting the static head of $8 \text{ m} \times 9.81 \text{ kPa/m}$ from 690 kPa

C. 768 kPa at the highest point, calculated by adding the static head to the gauge reading at the lowest point

D. The test pressure cannot be calculated without knowing the pipe diameter and material throughout the system

10. A plumber must install a pipe sleeve through a concrete masonry unit (CMU) block wall. The wall is structural and the engineer has specified the maximum hole size. The plumber's pipe requires a 4-inch sleeve, but the maximum permitted hole is 3 inches. What is the correct course of action?

- A. Install the 4inch sleeve anyway because plumbing pipe clearance requirements override structural limitations
- B. Reduce the pipe diameter from 4 inches to 3 inches at the wall penetration to fit the permitted hole size
- C. Cut a 4inch hole through the CMU block and reinforce the wall with steel plates on both sides of the penetration
- D. Consult the structural engineer for an alternative penetration location or a redesigned solution that accommodates both requirements

11. A plumber is working in an occupied hospital and must solder a copper joint in a corridor ceiling above suspended ceiling tiles. The hospital's life safety officer has approved a hot work permit. What additional precaution is specific to a hospital environment?

- A. A fire watch must include notification of the nursing stations on the floors above and below the hot work location
- B. The hot work permit is sufficient — no additional precautions beyond standard construction site procedures apply
- C. The hospital must evacuate all patients from the floor where the hot work is being performed for the duration
- D. The plumber must use brazing instead of soldering because soldering is prohibited in all healthcare facilities

12. A plumber calculates the area of a rectangular room to determine the number of sprinkler heads required. The room measures 6.5 metres by 4.2 metres. What is the area?

- A. 10.7 m², calculated by adding the two dimensions together and rounding to the nearest tenth of a square metre
- B. 21.4 m², calculated by doubling the shorter dimension and multiplying by the ratio of the two wall lengths
- C. 27.3 m², calculated by multiplying 6.5 m × 4.2 m for the rectangular floor area of the room
- D. 54.6 m², calculated by multiplying the area by 2 to account for both the floor and ceiling coverage requirements

13. A plumber discovers that the fire extinguisher assigned to the hot work area has an expired inspection tag — the last inspection was 14 months ago. The extinguisher appears to be in good condition with the gauge in the green zone. Can this extinguisher be used for the fire watch?

- A. Yes, because the gauge reading in the green zone confirms the extinguisher is fully charged and operational
- B. No — the extinguisher must have a current inspection tag; an expired inspection makes it noncompliant for fire watch duty
- C. Yes, but only if the plumber personally verifies the extinguisher's charge by briefly discharging a test burst
- D. No — fire extinguishers more than 12 months past inspection must be removed from service and replaced immediately

14. A plumber must install pipe through a floor penetration in a twostorey woodframe residential building. The floor is not firerated (no fire separation required between the two storeys). Is a firestop device required at this penetration?

- A. Yes — firestop devices are required at all pipe penetrations through all floors in all building types regardless of rating
- B. Yes — but only if the pipe material is plastic; metal pipe through nonrated floors does not require firestopping
- C. No — but the annular space should be sealed with a noncombustible filler material to prevent air and pest passage
- D. No — firestop devices are required only at penetrations through fire-rated assemblies, not through nonrated floors

15. A plumber is calculating the weight of a 20metre horizontal run of 4inch cast iron DWV pipe filled with water. The pipe weighs approximately 25 kg/m and the water adds approximately 8 kg/m. What is the total loaded weight?

- A. 660 kg, calculated as $(25 + 8) \times 20 \text{ m} = 33 \text{ kg/m} \times 20 \text{ m}$, which must be supported by properly rated hangers
- B. 500 kg, calculated by using only the pipe weight multiplied by the run length without the water contribution
- C. 160 kg, calculated by using only the water weight multiplied by the run length without the pipe contribution
- D. 330 kg, calculated by averaging the pipe and water weights and multiplying by the run length for the estimate

16. A plumber is reviewing a change order on a commercial project. The change order modifies the pipe material from copper to CPVC for the hot water supply system. What document must the plumber review to verify that the CPVC installation meets the revised specification?

- A. The original project drawings, which already contain all necessary CPVC installation details for the change order
- B. The general contractor's verbal instructions, which supersede written specifications on all commercial projects
- C. The revised project specification and the CPVC manufacturer's installation instructions for the specific product
- D. The plumber's own experience with CPVC, which is sufficient to install the product without additional reference

17. A plumber is installing a ProPress (copper press) fitting system for the first time. The manufacturer requires a specific pressing tool and jaws for each pipe size. The plumber has the correct jaws but uses an older pressing tool that produces slightly less pressing force than the manufacturer specifies. What is the risk?

- A. The reduced pressing force may produce fittings that appear crimped but have not achieved a full seal on the Oring
- B. The older tool will produce an identical crimp because the jaw geometry determines the seal, not the applied force
- C. The reduced force will cause the fitting body to crack because it cannot withstand the asymmetric pressing load
- D. The fitting will leak immediately during the first pressure test, making the underpressed connection obvious

18. A plumber must join two sections of 3inch HDPE sewer pipe in a trench using butt fusion. The ambient temperature is 5°C. What concern does the cold temperature create for the butt fusion process?

A. The cold temperature causes the HDPE pipe ends to cool too rapidly after the heating plate is removed, potentially producing a weak fusion joint

B. HDPE cannot be fused at temperatures below 10°C and the plumber must wait for warmer weather before joining

C. The cold temperature has no effect on the butt fusion process because the heating plate temperature compensates

D. The cold temperature causes the HDPE to become brittle and the pipe ends may shatter during the clamping process

19. A plumber is soldering a copper joint and applies leadfree solder. The solder melts on contact with the fitting but sits in a ball on the surface instead of flowing into the joint. What is the most likely cause?

A. The fitting has not been cleaned properly — oxidation on the surface prevents the solder from wetting the copper

B. The leadfree solder has a higher melting point than the fitting temperature and needs additional heating time

C. Insufficient flux or expired flux is failing to protect the heated copper surface from oxidation during the soldering

D. The solder wire diameter is too large for the joint size and the excess solder volume cannot enter the capillary gap

20. A plumber is installing a 2inch copper DWV pipe in a commercial building. The specification calls for type DWV copper and soldered joints. The plumber has Type L copper tube in stock. Can Type L be used as a substitute?

A. No — Type L and DWV copper have different outside diameters and Type L fittings will not fit DWV pipe connections

B. Yes — Type L has a thicker wall than DWV and exceeds the DWV specification; it is an acceptable substitute

C. No — Type L is rated only for pressure applications and is codeprohibited for drainage waste and vent piping

D. Yes — but only if the Type L tube is identified with yellow markings to match the DWV colour code standard

21. A plumber installs a mechanical expansion joint on a long straight run of copper pipe in a commercial hydronic heating system. The expansion joint is a bellows type. The plumber installs the joint but does not install pipe guides between the anchors and the joint. What will happen when the pipe expands?

A. The expansion joint will function normally because the pipe's natural rigidity prevents lateral deflection

B. The pipe may buckle laterally between the anchors because there is nothing to constrain its movement direction

C. The expansion joint will absorb the expansion in both the axial and lateral directions simultaneously

D. The pipe will expand axially into the joint without any lateral deflection because gravity holds it in position

22. A plumber is cutting 6inch cast iron pipe in a confined space where a soil pipe cutter (snap cutter) cannot be positioned due to clearance limitations. What alternative cutting tool can the plumber use?

A. A reciprocating saw with a carbidegrit blade designed for cast iron, which can cut in tight spaces without wrapping around the pipe

B. An oxyacetylene torch that cuts through cast iron cleanly when the pipe is preheated to a uniform temperature

C. A standard hacksaw with a 24 TPI blade that provides the fine cut needed for cast iron's brittle composition

D. A diamondblade circular saw that provides the fastest and cleanest cut on cast iron pipe in all conditions

23. A plumber is installing PEX tubing for a radiant floor heating system. The tubing must be routed in a serpentine pattern across the floor. At each 180degree turn, the tubing must maintain a minimum bend radius to prevent kinking. What is the typical minimum bend radius for PEX tubing?

A. 3 times the outside diameter of the tubing, which produces an extremely tight turn for compact loop layouts

B. 12 times the outside diameter of the tubing, which is the standard for rigid copper tube bending operations

C. 6 to 8 times the outside diameter of the tubing, which is the standard minimum for PEX without support bends

D. The bend radius is unlimited — PEX has thermal memory and cannot be kinked regardless of the bend angle

24. A plumber is threading a 1 1/2 inch steel pipe using a handheld ratchet die. After threading, the plumber checks the thread quality by screwing a coupling onto the threads by hand. The coupling threads on smoothly and tightens with approximately 3 turns of hand engagement before resistance is felt. Is this acceptable?

A. No — more than 2 turns of hand engagement indicates the threads are undersized (too loose) and will leak

B. Yes — 3 turns of hand engagement before resistance is typical for properly cut NPT threads on 1 1/2 inch pipe

C. No — NPT threads should engage with zero hand turns; any hand engagement indicates the die was oversized

D. Yes — but only if pipe joint compound is applied heavily enough to fill the gap between the loose thread crests

25. A plumber is installing a transition from copper water supply piping to a PEX manifold system. The transition must occur inside a wall cavity behind an access panel. What fitting type provides the most reliable transition for a concealed location?

A. A pushfit (SharkBitetype) fitting, which provides the fastest installation with no tools required in the wall space

B. A dielectric union between the copper and PEX that prevents galvanic corrosion at the transition junction point

C. A soldertocrimp adapter with a copper solder end and a PEX crimp ring end for a permanent concealed connection

D. A compression fitting with a brass ferrule that provides a removable connection for future service access needs

26. A plumber is sizing a vent stack for a 4inch soil stack in a sixstorey building. The stack serves 250 DFU. The code requires the vent to be at least half the stack diameter (minimum 2 inches). However, the code sizing table for a 250 DFU load at the developed length of 25 metres shows a minimum 2 1/2inch vent. Which requirement governs?

- A. The sizing table governs — 2 1/2 inches is required because the table considers both load and length, which the halfdiameter rule does not
- B. The halfdiameter rule governs — 2 inches is always adequate because the code's minimum ratio overrides the sizing table
- C. Both requirements must be met simultaneously — the plumber must install whichever is larger, which is 2 1/2 inches
- D. Neither governs — a 6storey building always requires a vent equal to the full stack diameter regardless of the table

27. A plumber discovers that an existing building has a 4inch soil stack that serves only a single water closet on the ground floor. No other fixtures connect to this stack. Is a 4inch stack necessary for a single water closet?

- A. No — a 2inch stack is adequate for a single water closet because the DFU value of 3 falls within the 2inch capacity
- B. Yes — but only because the building code requires all soil stacks to be a minimum of 4 inches in all buildings
- C. No — a 3inch stack is the minimum for a water closet, and 4 inches is oversized for this singlefixture application
- D. Yes — a 4inch stack is required whenever a garbage disposal or dishwasher also connects to the same drainage system

28. A plumber is installing a building sewer and must cross over an existing underground electrical conduit. The plumbing code requires a minimum separation between the sewer and the electrical conduit. What is the typical minimum vertical separation?

A. No minimum separation is required between sewers and electrical conduits because they carry different utilities

B. 300 mm (12 inches), with the sewer typically routed above or below the conduit with adequate clearance

C. 1 metre (3 feet), which is the universal minimum for all underground utility crossings in Canadian construction

D. 150 mm (6 inches), which applies only when the sewer and conduit run parallel rather than crossing perpendicularly

29. A plumber installs a floor drain with an integral trap in a basement laundry room. The floor drain receives only occasional mop water and washing machine overflow. Six months later, the homeowner reports sewer gas odour from the laundry room. The plumber inspects and finds the floor drain trap is dry. What is the most effective permanent solution?

A. Install a deeper Ptrap on the floor drain that takes longer to evaporate due to its greater water volume

B. Apply a layer of mineral oil to the trap seal surface, which floats on the water and dramatically slows evaporation

C. Instruct the homeowner to pour water into the floor drain monthly to manually maintain the trap seal level

D. Install a trap seal primer that automatically delivers water to the floor drain at regular intervals to maintain the seal

30. A plumber is troubleshooting a twostorey building where the secondfloor bathroom experiences slow drainage and gurgling only when the washing machine on the ground floor discharges. No other fixtures cause the symptom. What is the most likely cause?

A. The washing machine's highvolume discharge creates pressure fluctuations in the shared stack that affect the secondfloor traps

B. The secondfloor bathroom's vent pipe has been disconnected or blocked, making it sensitive to pressure changes

C. The washing machine's drain pump is defective and creating air pulses that travel up the stack to the second floor

D. The building sewer has a partial blockage that backs up only when the washing machine's largevolume discharge occurs

31. A plumber is installing a new septic system on a property where the soil has been tested and shows a percolation rate of 60 minutes per inch. The code maximum percolation rate for a conventional disposal field is 50 minutes per inch. Can a conventional field be installed?

A. Yes, because the difference between 60 and 50 minutes per inch is negligible and within acceptable tolerance

B. Yes, but the disposal field must be oversized by a factor of 2 to compensate for the slow percolation rate

C. No — the soil percolates too slowly for a conventional field; an engineered alternative system is required

D. No — but a conventional field can be installed at a greater depth where the percolation rate may be different

32. A plumber installs a DWV system in a building with a food processing area. The floor drains in the food processing area collect both washdown water and food processing waste. These drains connect to the building's sanitary drainage system. What device must be installed between the food processing drains and the building drain?

- A. A backwater valve to prevent the building drain from backing up into the food processing floor drains
- B. A sand interceptor to capture sediment from the washdown water before it enters the building drain
- C. An air admittance valve on the food processing branch to prevent sewer gas from entering the food area
- D. A grease interceptor sized for the food processing facility's wastewater volume and grease concentration

33. A plumber discovers that a residential building's vent stack has been extended with a section of ABS pipe that was solventcemented to the existing PVC vent. This connection was made without a transition cement or mechanical coupling. Is this connection acceptable?

- A. Yes — ABS and PVC can be solventcemented together using either ABS cement or PVC cement interchangeably
- B. No — ABS and PVC require a transition cement specifically approved for ABS to PVC joints, or a mechanical coupling
- C. Yes — but only on vent piping, where the connection is not subjected to water pressure or drainage flow loads
- D. No — ABS and PVC are completely incompatible and can never be connected by any method in any plumbing application

34. A plumber installs a 4inch building drain at a slope of 1/4 inch per foot. The drain runs 15 metres (approximately 50 feet) horizontally beneath the basement floor. What is the total vertical fall from the beginning to the end of this run?

A. 12.5 inches (approximately 318 mm), calculated as $50 \text{ feet} \times 1/4 \text{ inch per foot} = 12.5 \text{ inches}$ of total fall

B. 25 inches (approximately 635 mm), calculated by using a 1/2inchperfoot slope for the 4inch drain pipe

C. 6.25 inches (approximately 159 mm), calculated by using a 1/8inchperfoot slope for the 4inch drain pipe

D. 50 inches (approximately 1,270 mm), calculated by using a 1inchperfoot slope for maximum drainage velocity

35. A plumber is installing a cleanout on a 4inch building drain. The cleanout must be accessible after the concrete slab is poured. The plumber installs a cleanout riser extending from the building drain to a flushmounted cover at the floor surface. What material should the cleanout cover be?

A. A standard PVC cap that matches the DWV pipe material used throughout the drainage system installation

B. A wood plug that can be easily drilled out when access is needed for drain cleaning operations later

C. A brass or stainless steel flushmount cover plate designed for floor installation with a removable centre plug

D. A concretefilled cap that matches the floor surface and is broken out with a chisel when access is required

36. A plumber encounters a scenario where a 2inch kitchen sink drain connects to a 3inch horizontal branch that also serves a clothes washer. Both fixtures are on the ground floor. The kitchen sink drains slowly but the clothes washer drains normally. Where is the blockage?

A. In the building sewer, which is restricting flow from the entire ground floor branch serving both fixtures

B. In the kitchen sink's individual trap or trap arm, since the clothes washer drains normally on the same branch

C. In the 3inch horizontal branch between the kitchen sink connection and the clothes washer connection point

D. In the vent serving the kitchen sink, which is creating a vacuum that impedes drainage during sink discharge

37. A plumber is installing a septic system with a pump chamber (dosing chamber) between the septic tank and a raised mound disposal field. The pump must deliver effluent to the mound in timed doses. What controls the pump's operation?

A. A manual switch that the homeowner operates daily based on the household's estimated wastewater generation

B. A float switch in the septic tank that activates the pump whenever the tank water level reaches a preset height

C. A continuous duty pump that runs 24 hours a day, delivering a constant flow of effluent to the disposal field

D. A timer and/or float switch in the pump chamber that activates the pump at programmed intervals to dose the field

38. A plumber installs a vent connection on a horizontal trap arm. The vent must connect within the maximum trap arm length for the pipe size. For a 1 1/2 inch trap arm, what is the maximum distance from the trap weir to the vent connection?

A. 1,070 mm (42 inches), which is the code maximum trap arm length for 1 1/2 inch pipe per most code editions

B. 1,525 mm (60 inches), which is the code maximum for 2 inch pipe but is often confused with the 1 1/2 inch limit

C. 750 mm (30 inches), which is the code maximum for 1 1/4 inch pipe used on bathroom lavatories

D. 1,830 mm (72 inches), which is the code maximum for 3 inch pipe used on water closet connections

39. A plumber is performing a final walkthrough on a new DWV system. The plumber flushes each toilet and runs water in each fixture. While flushing a second floor toilet, the plumber notices that the water level in the ground floor toilet bowl drops briefly and then returns to normal. What venting deficiency does this indicate?

A. The ground floor toilet's individual vent is blocked, allowing its trap to be affected by the second floor discharge

B. The soil stack is undersized for the combined load of both floors and cannot handle simultaneous discharge

C. The second floor toilet discharge is creating negative pressure in the stack that temporarily siphons the ground floor trap

D. The ground floor toilet's flush valve is defective and is losing water to the drain during the second floor discharge

40. A plumber is installing a grease interceptor for a small restaurant. The interceptor is a pointofuse hydromechanical grease interceptor (HGI) installed under the threecompartiment sink. The interceptor is rated at 50 litres per minute flow rate. The threecompartiment sink has a maximum discharge rate of 45 litres per minute. Is this interceptor adequately sized?

A. No, the interceptor must be rated at twice the maximum discharge rate to account for peak flow surges and grease loading

B. Yes — the 50 LPM rating exceeds the 45 LPM maximum discharge rate, providing adequate capacity for the sink

C. No, the interceptor must be sized based on the total DFU of all connected fixtures, not on the flow rate alone

D. Yes — but only if the interceptor is equipped with an automatic grease removal device for continuous operation

41. A plumber installs a 3inch PVC vent stack through the roof of a building in Winnipeg, Manitoba, where winter temperatures regularly reach 30°C. The vent terminal is a standard openend pipe extending 150 mm above the roof surface. What problem is likely to occur?

A. The vent terminal will corrode rapidly due to the freezethaw cycling on the exposed PVC pipe above the roof

B. The standard 150 mm extension above the roof will be buried by snow accumulation during heavy snowfall events

C. The smalldiameter vent with minimal extension is unlikely to experience any problems in this cold climate location

D. Frost closure — warm moist sewer gas condenses and freezes inside the vent, gradually restricting the opening

42. A plumber discovers that an existing building has a 1 1/4 inch vent serving a 3 inch soil stack with 80 DFU. The vent's developed length is 8 metres. The code sizing table shows that a 1 1/4 inch vent at 8 metres handles only 10 DFU. Is this vent adequate?

A. No — the 1 1/4 inch vent is severely undersized for 80 DFU at this developed length and must be increased

B. Yes — the minimum vent size of 1 1/4 inches is always adequate regardless of the DFU load or developed length

C. No — but the vent can be supplemented with an air admittance valve at the highest fixture to add capacity

D. Yes — because the vent serves only the stack (not individual fixtures), the DFU load does not apply to the sizing

43. A plumber is installing a commercial kitchen's drainage system. The code requires that all kitchen fixtures producing greaseladen waste connect to a grease interceptor. The kitchen includes a three-compartment pot sink, a pre-rinse station, two floor drains in the cooking area, and an employee handwash sink. Which fixtures connect to the interceptor?

A. All five fixtures must connect to the interceptor because they are all located in the kitchen food preparation area

B. Only the pot sink and floor drains connect — the pre-rinse and handwash sink produce negligible grease amounts

C. The pot sink, pre-rinse station, and cooking area floor drains connect — the handwash sink does not produce grease

D. Only the floor drains connect because grease from cooking operations drips to the floor before reaching the drain

44. A plumber is troubleshooting a building where the building sewer video inspection reveals a section of pipe that has separated at a joint, leaving a 25 mm gap between the two pipe sections. Tree roots have not yet entered the gap. What is the consequence if this gap is left unrepaired?

A. The gap is too small for roots to enter and will not worsen over time as long as the pipe sections remain stable

B. Roots will eventually penetrate the gap, soil will infiltrate the pipe, and the gap may widen as foundation settlement continues

C. The gap will selfseal over time as mineral deposits from the drainage flow accumulate and bridge the opening

D. The gap improves drainage performance by acting as an expansion joint that accommodates pipe thermal movement

45. A plumber is installing a DWV system and encounters a situation where a horizontal vent pipe must drop below the flood level rim of the fixture it serves to clear a structural beam. Can the vent dip below the flood level rim?

A. Yes — horizontal vent sections may dip below the flood rim temporarily to clear obstructions if they rise above it afterward

B. Yes — but only if the dipped section is one pipe size larger to compensate for the reduced venting effectiveness

C. No — horizontal vent sections must be installed above the flood level rim at all points along their entire run

D. No — the vent pipe must maintain a continuous upward slope from the drain connection to the vent terminal at all times

46. A plumber installs a 4inch building sewer that transitions from PVC inside the building to ductile iron at the point where it passes beneath the building's driveway. Why might ductile iron be specified for the section under the driveway?

A. Ductile iron provides superior structural strength to withstand the concentrated vehicle loads transmitted through the soil above

B. Ductile iron is less expensive than PVC in the 4inch diameter and provides a cost savings on the driveway section

C. PVC pipe is prohibited under driveways by the plumbing code regardless of the depth of burial or soil cover

D. Ductile iron has smoother internal surfaces than PVC, providing better drainage flow characteristics under the driveway

47. A plumber is investigating a sewer gas complaint in a commercial building. All traps have water and the smoke test shows no leaks. The building has a dry fire sprinkler system with auxiliary drains on each floor. The plumber discovers that one auxiliary drain discharges to a floor drain receptor through a direct connection (no trap). Could this be the source?

A. No — fire sprinkler auxiliary drains carry only clean water and cannot introduce sewer gas into the building

B. No — the direct connection creates a closed loop between the sprinkler system and the drain that gas cannot traverse

C. Yes — the untrapped direct connection provides an open pathway for sewer gas from the drainage system into the building

D. Yes — but only if the fire sprinkler system is charged with antifreeze that produces a sewerlike odour when it drains

48. A plumber installs a sewage ejector in a residential basement. The ejector pit has a 100litre capacity. The pit receives drainage from a water closet (3 DFU), a lavatory (1 DFU), and a shower (2 DFU). What is the minimum pump capacity (in litres per minute) typically required for this installation?

A. 10 litres per minute, which provides minimal pumping capacity for infrequent use of the basement fixtures

B. The pump must be sized to handle the peak inflow from all connected fixtures simultaneously, typically 4075 LPM for a residential bathroom group

C. 200 litres per minute, which matches the municipal sewer flow rate required for the building sewer connection

D. 5 litres per minute, which matches the average daily wastewater generation for a single residential basement bathroom

49. A plumber discovers that a residential building's 3inch soil stack has a cleanout at the base that is oriented facing the building drain (downstream direction). The plumber needs to clean the stack (upstream direction) from this cleanout. Is this possible?

A. Yes — any cleanout provides access for cleaning equipment in both the upstream and downstream directions equally

B. No — the cleanout orientation determines the direction of access; a downstreamfacing cleanout serves only the drain

C. Yes — but only if the plumber uses a flexible cable machine that can navigate the 90degree turn at the base of the stack

D. No — a separate cleanout facing upstream (toward the stack) must be installed to provide bidirectional access at this location

50. A plumber is installing underground storm drainage piping for a commercial parking lot. The system includes catch basins (storm drain inlets) connected by underground piping to a stormwater management facility. The catch basins must include a sump (a pocket below the outlet pipe) to trap sediment. What is the purpose of this sediment sump?

- A. The sump captures sand, grit, and debris before it enters the storm piping, preventing accumulation and blockages downstream
- B. The sump stores excess stormwater during peak rainfall events and releases it slowly after the storm passes
- C. The sump provides a gas trap that prevents sewer gas from the storm system from escaping through the inlet grate
- D. The sump acts as an oil interceptor that captures petroleum products from the parking lot before they enter the storm system

51. A plumber encounters a building where the building drain has a section that runs uphill (negative slope) for approximately 2 metres before resuming the correct downhill slope. Standing water permanently fills the uphill section. What is the most likely consequence?

- A. The uphill section creates a permanent air lock that prevents all drainage from flowing past the high point
- B. The standing water in the uphill section improves the system's selfcleaning velocity by acting as a dam
- C. The uphill section has no consequence because the overall slope from the building to the sewer is still downhill
- D. Solids accumulate in the standing water at the low point, creating recurring blockages that require repeated cleaning

52. A plumber is installing a building drain and must decide between ABS and PVC pipe. Both are codeapproved for DWV applications. The installation is beneath a concrete slab in a residential building. What is one practical difference between the two materials that may influence the selection?

- A. ABS is significantly stronger than PVC and is required for all underground installations beneath concrete slabs
- B. ABS does not require primer before cementing — only ABS cement is needed — while PVC requires both primer and cement
- C. PVC is available only in white while ABS is available in multiple colours for easy identification underground
- D. PVC can withstand higher temperatures than ABS and is the required choice for hot water DWV applications

53. A plumber installs a 2inch horizontal branch drain serving three fixtures: a lavatory (1 DFU), a bathtub (2 DFU), and a shower (2 DFU). The total load is 5 DFU. The 2inch branch accommodates a maximum of 6 DFU. If a second lavatory (1 DFU) is added to the same branch, bringing the total to 6 DFU, is the 2inch branch still adequate?

- A. No — the branch must be increased to 3 inches because it now serves four fixtures regardless of the DFU total
- B. No — 6 DFU is the maximum capacity, and operating at maximum capacity provides no safety margin for the branch
- C. Yes — 6 DFU matches the 2inch branch's maximum capacity exactly, which is codecompliant for this installation
- D. Yes — but only if the second lavatory connects upstream of the bathtub on the branch to maintain proper flow order

54. A plumber is installing a DWV system in a building where noise is a critical concern (highend residential condominium). The architect specifies cast iron DWV piping for acoustic performance. The plumber must use nohub couplings on all joints. What additional measure reduces noise transmission from the DWV piping to the building structure?

- A. Install resilient (rubberisolated) pipe hangers that prevent vibration from the pipe from transferring to the framing
- B. Use oversized pipe throughout the system to reduce the velocity of drainage flow and the resulting turbulence noise
- C. Install acoustic insulation wrap around every fitting and coupling in addition to the cast iron pipe segments
- D. Route all drainage piping through the centre of the floor structure rather than along the underside of the joists

55. A plumber is testing a DWV system using the air test method. After pressurizing to 35 kPa, the plumber notices that the pressure gauge needle is moving erratically — jumping between 33 and 37 kPa rapidly. What is the most likely cause?

- A. A major leak is present that is allowing large volumes of air to escape and repressurize in alternating cycles
- B. The gauge is being affected by temperature fluctuations in the piping that cause the air to expand and contract
- C. Wind gusts on the vent terminal are causing pressure pulses that affect the gauge reading inside the system
- D. The gauge itself is defective and should be replaced with a calibrated gauge before the test results are evaluated

56. A plumber discovers that a building's septic tank has a baffle wall dividing it into two compartments. The inlet compartment is approximately twice the size of the outlet compartment. What is the purpose of this twocompartment design?

- A. The two compartments allow the homeowner to alternate between them seasonally to extend the tank's service life
- B. The first compartment provides primary settling and anaerobic digestion while the second provides additional clarification
- C. The two compartments separate greywater from blackwater for different treatment processes within the same tank
- D. The larger inlet compartment provides the primary treatment volume, and the smaller outlet compartment provides additional settling before effluent exits to the disposal field

57. A plumber installs a residential water supply system. The home has a private well with a submersible pump. The pump delivers water to a 120litre pressure tank set at 275/415 kPa (40/60 psi) cutin/cutout. The homeowner complains that the pump cycles rapidly — turning on and off every 30 seconds when a single faucet is running. What is the most likely cause?

- A. The well yield is insufficient and the pump is running dry between cycles, causing it to shortcycle on low water
- B. The submersible pump is oversized for the home's demand and must be replaced with a smaller capacity model
- C. The pressure tank has lost its air precharge (waterlogged), providing almost no drawdown before the pump restarts
- D. The pressure switch differential (20 psi) is too narrow and must be widened to 30 psi for longer pump run times

58. A plumber is installing a water service from the curb stop to the building. The service must pass through 12 metres of soil that contains clay with a high water table. The plumber selects HDPE pipe with butt-fused joints. Why is HDPE with fused joints advantageous in these soil conditions?

- A. HDPE is the only pipe material approved for installation in clay soils with high water tables in Canadian plumbing codes
- B. Fused HDPE joints are monolithic and watertight, preventing groundwater infiltration that could contaminate the service
- C. HDPE resists the chemical composition of clay soil that corrodes copper and steel pipe materials underground
- D. Fused joints cannot be penetrated by tree roots, and HDPE's flexibility accommodates clay soil movement without joint failure

59. A plumber tests a residential water supply system at 690 kPa (100 psi) for 2 hours. The test holds with no pressure drop. After the test, the plumber opens a fixture and notices the water has a brownish tint that clears after running for 2 minutes. What caused the discoloration?

- A. The test pressure dislodged iron oxide (rust) from the interior of the galvanized steel section of the supply piping
- B. The municipal water supply has a temporary discoloration event that coincided with the testing period
- C. The test water was contaminated at the fill point and introduced brown-coloured impurities into the system
- D. The high test pressure forced sediment from the water heater's tank into the supply piping through the cold inlet

60. A plumber discovers that a commercial building's hot water recirculation pump has been running continuously for 3 years without an aquastat or timer control. The building's energy costs are high. What energysaving modification should the plumber recommend?

- A. Replace the recirculation pump with a tankless water heater that eliminates the need for recirculation entirely
- B. Install an aquastat on the return line or a timer on the pump circuit to cycle the pump based on temperature or schedule
- C. Insulate the hot water supply piping only, leaving the return piping uninsulated to promote faster heat loss and cycling
- D. Reduce the water heater thermostat from 60°C to 49°C to decrease the temperature differential that drives heat loss

61. A plumber installs a PRV on a residential water service. The PRV is set to 415 kPa (60 psi). The homeowner later installs a wholehouse water filter on the supply downstream of the PRV. The filter creates a 70 kPa (10 psi) pressure drop when clean and up to 140 kPa (20 psi) when the cartridge is dirty. What is the residual pressure at fixtures when the filter is dirty?

- A. Approximately 275 kPa (40 psi), calculated as $415 - 140 = 275$ kPa, which is still above the 140 kPa fixture minimum
- B. Approximately 345 kPa (50 psi), calculated by subtracting only the clean filter drop from the PRV set pressure
- C. Approximately 415 kPa (60 psi), because the PRV compensates for downstream losses by increasing its output
- D. Approximately 140 kPa (20 psi), because the dirty filter consumes all available pressure above the minimum

62. A plumber is installing a water supply connection to a commercial building's fire sprinkler system. The sprinkler system is a wet system with no antifreeze. The building's domestic supply has an RP backflow preventer. What backflow prevention is required on the sprinkler supply?

- A. An RP device matching the domestic supply because the sprinkler system is also connected to the potable main
- B. No backflow prevention because wet fire sprinkler systems use only clean potable water with no additives
- C. A DCVA (double check valve assembly) because a wet sprinkler system without additives is a minor hazard
- D. An atmospheric vacuum breaker installed at the highest point of the sprinkler riser above the roof penetration

63. A plumber discovers that a residential water heater's cold water inlet has a shutoff valve, but the hot water outlet has no shutoff valve. The plumber must isolate the heater for service. How is the heater isolated?

- A. Close the cold water inlet valve — this stops all water flow into the heater and effectively isolates it from the system
- B. Close the main building shutoff valve, which isolates all water in the building including the water heater supply
- C. The heater cannot be properly isolated without a valve on both the inlet and outlet — a valve must be added
- D. Open the T&P relief valve to depressurize the heater, which isolates it from the supply system through pressure release

64. A plumber installs a tankless water heater in a home served by a private well. The well water has a hardness of 30 grains per gallon. The tankless heater manufacturer recommends a maximum hardness of 7 grains per gallon. What treatment is needed to protect the heater?

A. A sediment filter on the cold water supply to the heater to capture the dissolved mineral particles before they enter

B. A water softener on the supply before the heater to reduce hardness from 30 gpg to below 7 gpg and prevent scale

C. A reverse osmosis system on the cold water supply that removes dissolved minerals before they enter the heater

D. An annual vinegar flush of the heat exchanger to dissolve scale buildup instead of treating the incoming water supply

65. A plumber discovers that a building's copper water supply piping has developed pinhole leaks at multiple locations, all on the underside of horizontal pipe runs. The building is 10 years old. What type of corrosion pattern does this indicate?

A. Pitting corrosion from aggressive water chemistry, concentrated on the bottom where sediment and water contact time is greatest

B. Erosion corrosion from excessive flow velocity that wears the pipe wall thinnest on the bottom of horizontal runs

C. Galvanic corrosion from dissimilar metal contact at the pipe support points where steel hangers contact the copper

D. External corrosion from moisture or chemicals in the building's wall and ceiling cavities attacking the pipe exterior

66. A commercial building has a domestic water heater serving office washrooms and a break room kitchen. The building also has a process water heater serving a commercial dishwasher that uses chemical rinse agents. Both heaters connect to the same municipal supply. What backflow prevention configuration is required?

- A. A single RP device on the main supply protects both heaters because they share the same source connection
- B. The process heater requires an RP device but the domestic heater requires only a standard check valve
- C. The process heater requires an RP device because the chemical rinse agents create a health hazard; the domestic heater needs no additional protection beyond the building's main backflow prevention
- D. Both heaters require RP devices because any water heater connection represents a health hazard crossconnection

67. A plumber is installing a residential water supply and must determine the demand in water supply fixture units (WSFU). The home has two bathrooms, a kitchen, a laundry, and a hose bibb. The total WSFU calculation yields 25 WSFU. Using the demand curve, this converts to approximately 1.9 litres per second (30 GPM). What does this demand value represent?

- A. The average daily water consumption for the household based on the number of fixtures and occupants
- B. The minimum flow rate the water supply must maintain at all times, including overnight lowdemand periods
- C. The maximum flow rate the municipal supply must deliver to the property line meter at all times of the day
- D. The probable peak demand — the estimated maximum simultaneous flow rate during typical peak use periods

68. A plumber troubleshoots a residential system where the hot water at the kitchen faucet takes 45 seconds to arrive, but the hot water at the adjacent dishwasher (connected to the same branch) takes over 3 minutes. Both are approximately the same distance from the water heater. What is the most likely cause?

- A. The dishwasher's solenoid valve is partially blocked, restricting the flow rate and slowing the arrival of hot water
- B. The dishwasher's supply tube is significantly longer than the kitchen faucet's due to the routing beneath the counter
- C. The dishwasher's flow rate is much lower than the faucet's, so the cooled water in the branch takes longer to displace
- D. The dishwasher has a builtin delay that waits 3 minutes before drawing hot water to allow the internal heater to activate

69. A plumber installs a residential water supply using a 1-inch copper trunk and branch system. The homeowner later adds a second bathroom in the basement. The plumber calculates the new total WSFU at 32, which converts to approximately 2.3 litres per second on the demand curve. The 1-inch trunk's maximum capacity at 2.4 m/s velocity is approximately 2.5 litres per second. Is the 1-inch trunk still adequate?

- A. Yes — the 2.3 LPS demand is within the 2.5 LPS capacity of the 1-inch trunk with a small margin remaining
- B. No — the trunk must be upsized to 1 1/4 inches because the demand exceeds 2.0 LPS which is the 1-inch limit
- C. Yes — but the plumber must install a pressure booster pump to compensate for the increased friction in the trunk
- D. No — any addition of fixtures requires upsizing the trunk by at least one pipe size regardless of the demand calculation

70. A plumber discovers that a building's domestic hot water system uses a storage tank with an internal heat exchanger coil connected to the building's hydronic boiler. The boiler water circulates through the coil to heat the domestic water. What type of water heater is this?

- A. A directfired storage water heater that uses a gas burner or electric elements to heat the water directly
- B. A solar water heater that uses solar thermal panels on the roof to preheat the domestic water in the tank
- C. An indirect water heater that uses the hydronic boiler's hot water circulating through an internal coil for heating
- D. A heat pump water heater that extracts heat from the surrounding air and transfers it to the water in the tank

71. A plumber is troubleshooting a commercial building's hot water system. The recirculation pump runs continuously and the return water temperature is consistently 45°C. The aquastat is set to activate the pump below 50°C and deactivate above 55°C. Why is the pump running continuously?

- A. The pump motor has an internal short that bypasses the aquastat control and powers the pump independently
- B. The return water temperature (45°C) is below the aquastat's activation point (50°C), so the pump never reaches the shutoff temperature
- C. The aquastat is defective and is sending a continuous run signal regardless of the actual return water temperature
- D. The circulator pump's impeller is spinning backward due to reversed wiring, preventing hot water from reaching the return

72. A plumber installs a water heater with a powered anode rod instead of a standard sacrificial magnesium anode. The homeowner's well water has elevated sulfate levels that previously caused hydrogen sulfide odour with magnesium anodes. Why does the powered anode eliminate this problem?

- A. The powered anode releases chlorine into the tank water that kills the sulfatereducing bacteria causing the odour
- B. The powered anode heats the water to a temperature that sterilizes the bacteria before they can produce hydrogen sulfide
- C. The powered anode's electrical current disrupts the bacteria's metabolic process without producing the chemical reaction that creates H₂S
- D. The powered anode uses impressed current rather than sacrificial metal, eliminating the magnesiumsulfate reaction that produces hydrogen sulfide

73. A plumber installs a residential water supply using PEX tubing with a manifold system. Each hot water fixture has a dedicated 1/2inch homerun from the hot water manifold. The homeowner installs a pointofuse recirculation pump (undersink type) on the farthest fixture. How does this pump work in a manifold system?

- A. The pump circulates hot water from the dedicated homerun back to the water heater through the cold water homerun of the same fixture
- B. The pump draws hot water from the hot water manifold and returns it through a dedicated return line to the heater
- C. The pump cannot work in a manifold system because there is no common trunk line to create a circulation loop
- D. The pump circulates water within the fixture's own supply tubes only, heating the water without returning it to the heater

74. A plumber is sizing the water supply for a small commercial building. The building has 15 WSFU of cold water demand and 10 WSFU of hot water demand. The main trunk must be sized for the total building demand. How is the total demand calculated?

A. Total = cold + hot = 15 + 10 = 25 WSFU, because both cold and hot fixtures draw from the same main supply

B. Total = the larger of cold or hot = 15 WSFU, because the main trunk only needs to serve the maximum single demand

C. Total = (cold + hot) \times 0.75 = 18.75 WSFU, applying a 25% diversity factor for mixed hot and cold fixture use

D. The total WSFU is calculated from the fixture schedule directly, not by adding cold and hot WSFU values separately

75. A plumber discovers that a building's PRV is chattering — producing a rapid vibrating noise when water flows through it. The PRV is set to 415 kPa (60 psi) and the incoming pressure is 690 kPa (100 psi). What causes this chattering?

A. The PRV is functioning normally — all PRVs produce some chattering noise during pressure reduction operation

B. The PRV is oversized for the building's demand, causing the valve to hunt between open and closed positions rapidly

C. The PRV's internal spring has weakened and cannot maintain a stable position against the inlet pressure fluctuations

D. The incoming pressure is too high for this PRV model — a PRV rated for higher inlet pressure must be installed

76. A plumber installs a wallmounted commercial flushometer water closet. The closet bolts secure the bowl to the concealed carrier inside the wall. After tightening the bolts, the plumber pushes on the bowl and it rocks slightly. What must be corrected?

- A. The closet bolts must be tightened further until the bowl is completely immobile against the finished wall surface
- B. The carrier must be releveled and resecured to the building structure — the bowl rocks because the carrier is not plumb
- C. Shims must be inserted between the bowl and the wall to eliminate the rocking without adjusting the carrier
- D. The bowl is defective and must be replaced with a new unit that fits the carrier mounting bolts without rocking

77. A plumber is installing a water heater in a residential garage. The gasfired heater has an ignition source (standing pilot) located 200 mm above the garage floor. The code requires the ignition source to be elevated at least 450 mm (18 inches) above the garage floor. What must be done?

- A. Install a splash guard around the base of the heater to deflect gasoline vapours away from the pilot light
- B. Leave the heater at the current height because the building inspector will grant a variance for the 250 mm deficit
- C. Install the water heater on a codeapproved platform or raised stand that elevates the ignition source to 450 mm minimum
- D. The heater must be elevated at least 450 mm above the floor — install it on a platform or select a model with a higher ignition source

78. A plumber replaces a residential kitchen faucet. The new faucet has a singlehandle design with a ceramic disc cartridge. During the first week of use, the homeowner reports that the faucet drips slowly from the spout when turned off. What is the most likely cause?

A. Debris from the supply piping has lodged between the ceramic discs, preventing a complete seal when closed

B. The ceramic disc cartridge is defective from the factory and must be replaced under the manufacturer's warranty

C. The faucet handle is not being turned to the fully closed position by the homeowner due to an unfamiliar design

D. The supply tubes are connected to the wrong inlet ports, creating crossflow that prevents the cartridge from sealing

79. A plumber is troubleshooting a residential water softener that is not using any salt during regeneration. The brine tank is full of salt dissolved in water (brine), but the level never drops. What component has most likely failed?

A. The salt has formed a bridge above the water, preventing salt from dissolving — the tank appears full but no brine forms

B. The softener's bypass valve has been left in the bypass position, so untreated water flows without triggering regeneration

C. The brine valve or brine draw mechanism in the control valve has failed, preventing the softener from drawing brine during regeneration

D. The resin bed has become completely exhausted and cannot accept any more hardness ions from the incoming water supply

80. A plumber installs a commercial prerinse spray valve at a restaurant's potwashing station. The spray valve must comply with the federal energy and water efficiency requirements. What is the current maximum flow rate for commercial prerinse spray valves?

- A. 4.0 GPM (15.1 LPM), which provides maximum rinsing power for heavyduty commercial potwashing operations
- B. 1.28 GPM (4.8 LPM) or less, which is the current maximum flow rate mandated by federal water efficiency standards
- C. 2.5 GPM (9.5 LPM), matching the standard maximum flow rate for residential kitchen faucets and showerheads
- D. 0.5 GPM (1.9 LPM), which is the ultralowflow rate required for all new commercial kitchen spray equipment

81. A plumber discovers that a residential electric water heater's lower element is coated with a thick layer of calcium scale. The homeowner reports reduced hot water output. What is the relationship between the scale buildup and the reduced output?

- A. The scale insulates the element from the surrounding water, reducing heat transfer and leaving the lower tank portion underheated
- B. The scale increases the element's electrical resistance, causing it to consume more electricity but produce less heat
- C. The scale has no effect on the element's heating capacity — the reduced output is caused by a different component failure
- D. The scale conducts heat faster than water, causing the element to overheat and trip the highlimit safety cutoff

82. A plumber installs a residential fire sprinkler system under NFPA 13D. The system designer specifies pendant sprinkler heads in the bedrooms and sidewall heads in the hallways. What determines the head type selection for each room?

- A. The homeowner's aesthetic preference because all sprinkler head types provide identical coverage and performance
- B. The room's ceiling type, obstructions, and geometry — pendant heads for flat open ceilings, sidewall for narrow corridors
- C. The building code dictates specific head types for each room type regardless of the room's physical characteristics
- D. The fire marshal assigns head types during the plan review process based on the building's overall risk assessment

83. A plumber services a pointofuse reverse osmosis system. The homeowner reports that the system produces water very slowly and the storage tank never fills completely. The prefilters were replaced recently. What component should the plumber check next?

- A. The postfilter, which may be clogged with carbon fines and restricting the flow of purified water to the storage tank
- B. The inlet water pressure, which may be too low to push water through the RO membrane at an adequate production rate
- C. The RO membrane, which may have fouled or reached the end of its service life and needs replacement for restoration
- D. The storage tank's air bladder, which may have lost pressure and is not pushing water to the faucet when it is opened

84. A plumber installs a wholehouse water filtration system with a sediment filter and a carbon filter on a residential well water supply. The homeowner asks whether the system removes bacteria from the well water. What is the correct answer?

- A. The carbon filter kills bacteria through chemical adsorption as the water passes through the activated carbon media
- B. Neither the sediment filter nor the carbon filter reliably removes or kills bacteria — a UV disinfection unit is needed
- C. The sediment filter captures bacteria larger than the filter's micron rating but allows smaller organisms to pass through
- D. The combination of sediment and carbon filtration provides 99% bacterial removal when properly maintained

85. A plumber is troubleshooting a gasfired tankless water heater that produces hot water for approximately 3 minutes and then shuts off with an error code for "exhaust obstruction." The vent was clean when inspected last month. What should the plumber investigate?

- A. The vent terminal, which may be obstructed by a bird's nest, ice, or debris that accumulated since the last inspection
- B. The gas supply pressure, which may be too low to maintain the flame during extended use beyond 3 minutes
- C. The water flow sensor, which may be sending intermittent signals that cause the heater to cycle off midoperation
- D. The heat exchanger, which may be scaled and overheating, causing the hightemperature limit to trip after 3 minutes

86. A plumber installs a commercial ice machine in a restaurant. The ice machine's drain must connect to the sanitary drainage system. What type of connection is required?

- A. A direct Ptrap connection to the nearest sanitary drain stubout behind the wall for efficient drainage routing
- B. A highloop drain hose similar to a dishwasher installation connected to the nearest available waste pipe connection
- C. A connection to the grease interceptor because ice machine waste is classified as foodservice drainage flow
- D. An indirect waste connection with an air gap between the ice machine drain and the floor sink or drain receptor

87. A plumber is replacing a water heater anode rod. The existing rod is magnesium and the homeowner has reported hydrogen sulfide odour in the hot water. The well water has elevated sulfate levels. What anode rod material should the plumber install as a replacement?

- A. A longer magnesium rod to provide extended protection and delay the recurrence of the hydrogen sulfide odour
- B. An aluminumzinc alloy anode rod, which does not react with sulfatereducing bacteria to produce hydrogen sulfide
- C. A stainless steel rod that provides cathodic protection without any chemical reaction with the water chemistry
- D. No anode rod — removing the rod entirely eliminates the chemical reaction that produces the odour problem

88. A plumber discovers that a residential water heater's T&P relief valve discharge pipe terminates inside a wall cavity — it enters the wall through a hole but does not emerge on the other side. The pipe is invisible and inaccessible. What code violation does this present?

- A. The T&P discharge must terminate at a visible location so the homeowner can observe if the valve is discharging
- B. The T&P discharge may terminate inside a wall if the wall is fire-rated and provides adequate containment
- C. The T&P discharge pipe location is acceptable as long as the pipe is connected to the building's sanitary drain
- D. The T&P discharge pipe routing is acceptable because it prevents hot water from discharging onto occupied areas

89. A plumber installs a water treatment system for a rural home. The well water test shows the following contaminants: hardness (25 gpg), iron (2 ppm), coliform bacteria (positive), and a pH of 6.5. What treatment system sequence addresses all four issues?

- A. Sediment filter → UV disinfection → water softener → pH adjustment, treating particles, bacteria, hardness, and acidity
- B. pH adjustment → water softener → sediment filter → UV disinfection, raising pH first for optimal softener performance
- C. Iron filter → water softener → pH adjustment → UV disinfection, removing iron, hardness, then adjusting pH and killing bacteria last
- D. UV disinfection → iron filter → pH adjustment → water softener, sterilizing first then removing contaminants in sequence

90. A plumber installs a commercial dishwasher in a restaurant kitchen. The dishwasher has a builtin booster heater that raises the water temperature from the building's 60°C supply to 82°C for the sanitizing rinse cycle. The booster heater requires a 240V electrical connection. Who makes this connection?

- A. The plumber, because the booster heater is an integral part of the dishwasher plumbing installation and commissioning
- B. The dishwasher manufacturer's authorized service technician, who must commission all electrical components
- C. The restaurant's maintenance staff, who are authorized to make electrical connections to kitchen equipment
- D. A licensed electrician, because the 240V connection exceeds the plumbing trade's electrical scope of practice

91. A plumber is troubleshooting a residential water system where the kitchen faucet produces water with tiny air bubbles that give it a milky white appearance. The water clears after sitting in a glass for 30 seconds. Is this a water quality problem?

- A. Yes — the bubbles indicate a water treatment system malfunction that is introducing air into the supply piping
- B. No — dissolved air in pressurized water comes out of solution at the faucet, creating harmless temporary cloudiness
- C. Yes — the milky appearance indicates bacterial contamination that requires immediate treatment and disinfection
- D. No — but the condition indicates a failed check valve in the supply piping that is allowing air to enter the system

92. A plumber installs a hydronic boiler with a sealed combustion (directvent) configuration. The boiler draws combustion air from outdoors through a dedicated intake pipe and exhausts combustion gases through a separate exhaust pipe. What advantage does this configuration provide in a tight, energyefficient home?

- A. Sealed combustion eliminates the risk of backdrafting because the combustion process is completely isolated from indoor air
- B. Sealed combustion produces zero emissions that could affect indoor air quality during normal boiler operation
- C. Sealed combustion allows the boiler to be installed in a bedroom or occupied living space without ventilation concerns
- D. Sealed combustion eliminates the need for a carbon monoxide detector in the mechanical room where the boiler is located

93. A plumber is troubleshooting a hydronic system where one baseboard radiator is significantly cooler than all other radiators on the same zone. The plumber has bled the radiator and confirmed no air is present. The balancing valve is fully open. What should be checked next?

- A. The boiler's supply temperature, which may be too low to adequately heat the farthest radiator in the zone
- B. The expansion tank, which may be waterlogged and causing pressure fluctuations that reduce flow to this radiator
- C. The pipe connections to the radiator for a blockage, restriction, or improperly installed fitting that limits flow
- D. The zone valve, which may be partially closed and restricting flow to the entire zone including this radiator

94. A condensing boiler is operating with return water at 45°C. The flue gas dew point for natural gas is approximately 55°C. Is the boiler operating in condensing mode?

A. No — the boiler only condenses when the return temperature drops below 30°C during extreme cold weather events

B. No — the boiler is not condensing because the supply temperature is above the dew point regardless of the return

C. Yes — but condensing mode provides only minimal efficiency gains at a return temperature this close to the dew point

D. Yes — the 45°C return is well below the 55°C dew point, causing significant flue gas condensation and maximum efficiency

95. A plumber discovers that a hydronic system's expansion tank is connected directly to the circulator pump's discharge port. The system experiences pressure relief valve discharge every time the boiler fires. What installation error has occurred?

A. The expansion tank is installed on the wrong end of the system — it should be on the supply pipe near the boiler

B. The expansion tank must be connected to the pump's suction side, not the discharge — the pump's pressure adds to the tank reading

C. The expansion tank is undersized for the system volume and cannot absorb the thermal expansion produced during heating

D. The expansion tank's precharge is set too high, preventing water from entering the tank during thermal expansion events

96. A plumber is commissioning a new radiant floor heating system with a condensing boiler. The system has been filled, purged, and pressure tested. Before the concrete slab is poured over the PEX tubing, what condition must the PEX loops maintain during the pour?

A. The loops must be pressurized with water at the system's operating pressure to prevent the concrete from crushing the tubing

B. The loops must be completely empty to prevent the concrete's heat from expanding the water and bursting the tubing

C. The loops must be filled with compressed air at 350 kPa to provide maximum resistance against the concrete weight

D. The loops must be connected to the boiler and circulated at 35°C to accelerate the concrete curing process from within

97. A hydronic system uses propylene glycol antifreeze to protect exposed piping sections from freezing. The system has been operating for 5 years without a glycol change. The plumber tests the glycol with a refractometer and finds that the freeze protection has degraded from the original 30°C to 15°C. What caused this degradation?

A. The glycol has been diluted by makeup water added through the automatic fill valve over the 5-year period

B. The glycol has been consumed by the corrosion inhibitor package and must be replenished with fresh concentrate

C. The glycol has chemically decomposed due to exposure to the boiler's operating temperature above its rated limit

D. The glycol has settled to the bottom of the system due to its higher density and is no longer circulating with the water

98. A plumber installs a steam boiler in a commercial building. The boiler's pressure gauge reads 0 psig when the boiler is cold and not firing. Is this reading correct?

A. No — the gauge should read the equivalent of the system's static head pressure when the boiler is filled with water

B. Yes — 0 psig is correct because the boiler is at atmospheric pressure when cold; gauge pressure reads zero at atmospheric

C. No — the gauge should read negative pressure (vacuum) when the boiler is cold because steam has condensed

D. Yes — but only if the gauge is a compound gauge that reads both positive pressure and vacuum conditions simultaneously

99. A plumber discovers that a hydronic system's automatic air vent at the highest point in the system is leaking water continuously — a steady stream rather than an occasional drip. The system pressure gauge reads 275 kPa (40 psi), which is above the normal 103–170 kPa operating range. What is causing the excessive pressure and the leak?

A. The circulator pump is oversized and is generating excessive pressure that forces water through the air vent's mechanism

B. The boiler's operating aquastat is set too high, causing the water temperature to approach boiling and overpressurize the system

C. The expansion tank has failed — it cannot absorb thermal expansion, causing pressure to rise until the air vent leaks

D. The automatic fill valve has failed in the open position, continuously adding water and driving the system pressure above normal

100. A twopipe steam system has a condensate return pump with a receiver tank. The pump activates when condensate rises to the highlevel float and deactivates at the lowlevel float. The plumber observes that the pump runs almost continuously. What is the most likely cause?

A. The boiler is producing more steam than the design load requires, generating excessive condensate volume per hour

B. A steam trap or multiple traps have failed in the open position, passing live steam that condenses rapidly in the return

C. The pump's discharge check valve has failed, allowing condensate to flow backward from the boiler to the receiver

D. The condensate return main has a leak that is losing water, causing the boiler to add makeup water that overloads the pump

101. A plumber installs a new hydronic boiler to replace an old cast iron sectional boiler. The existing system piping is copper with soldered joints. The new boiler has a stainless steel heat exchanger. The manufacturer's installation manual warns against using plumbing flux that contains chlorides. Why?

A. Chloridecontaining flux residue can cause stress corrosion cracking of the stainless steel heat exchanger

B. Chloride flux produces acidic fumes during soldering that corrode the boiler's electronic control components

C. Chloride flux leaves a residue that insulates the heat exchanger surface and reduces thermal transfer efficiency

D. Chloride flux reacts with the glycol antifreeze in the system and produces a toxic compound harmful to occupants

102. A plumber is balancing a fourzone hydronic system. After initial adjustment, the plumber measures the supply and return temperatures for each zone. Zone 1: $\Delta T = 8^{\circ}\text{C}$. Zone 2: $\Delta T = 11^{\circ}\text{C}$. Zone 3: $\Delta T = 15^{\circ}\text{C}$. Zone 4: $\Delta T = 11^{\circ}\text{C}$. The design ΔT is 11°C . Which zones need adjustment?

- A. Only Zone 2 and Zone 4 because they exactly match the design ΔT and should not be used as reference points
- B. Zone 3 only, because its high ΔT indicates significantly too little flow — its balancing valve should be opened further
- C. Zone 1 (too much flow, low ΔT) and Zone 3 (too little flow, high ΔT) — partially close Zone 1 and open Zone 3
- D. All four zones need adjustment because the design ΔT represents the system average, not the individual zone target

103. A plumber discovers that a hydronic boiler cycles on and off rapidly (shortcycling) even though the thermostat is calling for continuous heat. The boiler fires for 2 minutes, shuts off on the highlimit for 3 minutes, then fires again. What is the most likely cause?

- A. The thermostat is defective and is sending intermittent heat call signals that cause the boiler to cycle erratically
- B. Insufficient system flow through the boiler — a closed zone valve, failed circulator, or air lock is preventing water from removing heat
- C. The boiler's gas valve is delivering excessive fuel, causing the water to heat too rapidly and trigger the high limit
- D. The expansion tank has lost its precharge, causing pressure fluctuations that trip the boiler's pressure safety controls

104. A plumber is installing a hydronic system with a modulating condensing boiler and a variable-speed circulator pump. Both devices communicate electronically to optimize performance. What advantage does this integrated control strategy provide?

- A. The modulating boiler can fire at reduced capacity during mild weather while the variable pump adjusts flow to match
- B. The integrated controls eliminate the need for zone valves because the boiler and pump modulate instead of zoning
- C. The electronic communication allows the boiler to preheat the system 24 hours before a cold weather event arrives
- D. The modulating boiler and variable pump work together to match heat output precisely to the building's realtime demand

105. A plumber is troubleshooting a one-pipe steam system where several radiators on the first floor heat before any radiators on the second floor. The building has two steam supply mains — one serving each floor. What component should be checked on the first-floor main?

- A. The main air vent at the end of the first-floor supply main, which may be venting too fast and starving the second floor of steam
- B. The thermostat on the first floor, which may be set higher than the second floor and is consuming all available steam
- C. The pressuretrol on the boiler, which may be set to provide steam to only one floor at a time during heating cycles
- D. The steam supply valve at the boiler header, which may be partially closed on the second-floor main's takeoff

106. A plumber installs a hydronic heating system with a boiler that has an aluminum heat exchanger. The manufacturer specifies that the system water pH must be maintained between 7.0 and 8.5. Why is this pH range critical for aluminum?

- A. Aluminum corrodes rapidly in alkaline water above pH 8.5 and in acidic water below pH 7.0, attacking the heat exchanger
- B. Aluminum expands at a different rate outside this pH range, causing the heat exchanger connections to leak at the joints
- C. Water outside this pH range produces scaling that insulates the aluminum surface and reduces heat transfer efficiency
- D. The boiler's electronic control system monitors pH and will lock out the boiler if the water falls outside the specified range

107. A plumber discovers that a steam boiler's gauge glass shows a water level that bounces rapidly up and down (surging). This surging makes it difficult to determine the actual water level. What is the most likely cause?

- A. The boiler's gas burner is cycling too rapidly between high and low fire, causing pressure fluctuations that surge the water
- B. The boiler is operating above its rated steam production capacity, causing violent boiling that bounces the water surface
- C. The gauge glass connections (upper and lower) are partially blocked with scale, restricting water flow and causing erratic readings
- D. The boiler water contains excessive dissolved solids or contaminants that cause foaming, making the water level appear to surge

108. A medical gas system installer discovers during the crossconnection test that pressurizing the oxygen system causes a 10 kPa pressure rise in the medical air system. All other systems show no change. What does this result confirm?

- A. The pressure rise is within the acceptable tolerance range for crossconnection testing and the system passes
- B. The oxygen and medical air systems are not crossconnected — the pressure rise is caused by normal system interaction
- C. The test is inconclusive because the pressure rise could be caused by a faulty gauge on the medical air system
- D. A physical crossconnection exists between the oxygen and medical air piping that must be found and corrected

109. A plumber is installing a compressed air system for a dental office. The compressor is an oilfree type with an integrated refrigerated dryer and particulate filter. The system serves 6 dental chairs. What quality of compressed air must the system deliver for direct patient contact?

- A. Clean, dry, oilfree air that is safe for direct patient contact during dental procedures without contamination risk
- B. Standard industrialgrade compressed air that meets the requirements for pneumatic tools and general workshop use
- C. Medicalgrade compressed air that meets the same purity standards as hospital medical air supply systems
- D. Breathinggrade compressed air that meets the standards for suppliedair respirators and diving applications

110. A plumber is installing a swimming pool circulation system with a sand filter. The filter has a multiport valve with six positions: filter, backwash, rinse, waste, recirculate, and closed. What is the purpose of the "recirculate" position?

- A. It bypasses the pool entirely and recirculates water within the filter tank to clean the sand media internally
- B. It redirects the backwash waste water back through the filter for a second pass before discharging to waste
- C. It bypasses the filter media entirely, circulating water through the pump and back to the pool without filtration
- D. It reverses the flow direction through the filter media to dislodge trapped debris from the sand bed surface

111. A plumber discovers that a commercial irrigation system's backflow preventer (RP device) has been installed in a belowgrade vault that floods with rainwater. The RP's relief valve is submerged during heavy rain. What hazard does this create?

- A. The submerged relief valve cannot discharge during a backflow event because the water pressure outside equals inside
- B. Contaminated water from the flooded vault can be drawn into the potable supply through the submerged relief port
- C. The RP device's internal check valves cannot function when the exterior is submerged in water during flood events
- D. The RP device will corrode rapidly from the standing water in the vault, reducing its service life below the warranty period

112. A medical gas system verifier completes all required tests on a new oxygen piping system. The standing pressure test, crossconnection test, purity test, and flow test all pass. What is the final step before the system can deliver gas to patients?

- A. The system must operate on test gas for 30 days before switching to patientgrade medical oxygen for clinical use
- B. The hospital's pharmacy department must approve the gas quality before the system can be connected to patient outlets
- C. The fire marshal must inspect and approve the medical gas system before any gas can flow to patient care areas
- D. The thirdparty verifier issues the certification report confirming all tests pass, authorizing the system for patient service

113. A plumber is installing a gas supply for a commercial kitchen with multiple gasfired appliances: a range (120,000 BTU), a fryer (80,000 BTU), a griddle (60,000 BTU), and a convection oven (40,000 BTU). What is the total connected BTU load for gas pipe sizing?

- A. 300,000 BTU/hr, calculated by adding all four appliance ratings together for the maximum simultaneous demand
- B. 120,000 BTU/hr, calculated by using only the largest single appliance to determine the main supply pipe size
- C. 225,000 BTU/hr, calculated by applying a 75% diversity factor to the total of all four appliance BTU ratings
- D. 150,000 BTU/hr, calculated by averaging the four appliance ratings for the typical operating demand level

114. A swimming pool system has an ozone generator installed on the circulation return line after the filter. What does the ozone generator accomplish in the pool's water treatment process?

- A. Ozone replaces all chlorine in the pool, eliminating the need for any chemical treatment or monitoring entirely
- B. Ozone heats the pool water more efficiently than a conventional gas or electric heater by using electrical discharge
- C. Ozone is a powerful oxidizer that destroys bacteria, viruses, and organic contaminants, reducing the chlorine demand
- D. Ozone adjusts the pool water's pH to the optimal range of 7.2–7.6 without the need for chemical pH adjusters

115. A plumber is winterizing a commercial irrigation system with a compressed air blowout. The system has 12 zones. The plumber begins with Zone 1 and works through each zone sequentially. After blowing out Zone 6, the plumber notices that the compressor cannot maintain adequate pressure for Zone 7 — the pressure drops below 275 kPa (40 psi) during the blowout. What is the most likely cause?

- A. The compressor's air receiver tank needs to recover pressure — the plumber should wait for the tank to recharge before continuing
- B. Zone 7 has a significantly larger volume of piping than the previous zones and exceeds the compressor's flow capacity
- C. The compressor has been running continuously for too long and is overheating, reducing its output pressure and volume
- D. A leak has developed in the mainline between the compressor connection and Zone 7's valve, losing air before it reaches the zone

116. A plumber discovers that a medical gas system's oxygen outlet in a patient room is labeled "O₂" with a green colour code. However, the DISS connector on the outlet is the correct oxygen connector (DISS 1240). A nurse reports that the colour code should be white for oxygen in Canada (CSA standard), not green (US CGA standard). Is this a compliance issue?

- A. No — green and white are both acceptable colour codes for oxygen outlets in Canadian healthcare facilities
- B. No — the DISS connector provides the mechanical safety and the colour code is a secondary visual aid only
- C. Yes — but the outlet can remain in service because the DISS connector correctly identifies the gas mechanically
- D. Yes — Canadian facilities must use the CSA colour coding standard; the greencoded outlet must be corrected to white

117. A compressed air system in a woodworking shop has experienced a significant increase in moisture problems at the tool stations. The refrigerated air dryer is functioning normally. The plumber discovers that the shop recently added a large dust collection system that creates negative pressure inside the building. How could this affect the compressed air system?

- A. The negative pressure draws warm, humid outside air into the building, which the compressor ingests and compresses into the system
- B. The negative pressure reduces the compressed air system's operating pressure by reducing the ambient pressure at the compressor inlet
- C. The dust collection system is physically connected to the compressed air header and is introducing moisture through the ductwork
- D. The negative pressure has no effect on the compressed air system because compressors operate independently of building pressure

118. A plumber is installing a process piping system in a pharmaceutical clean room. The specification calls for electropolished Type 316L stainless steel pipe with orbitalwelded joints. What does electropolishing accomplish that standard mechanical polishing does not?

- A. Electropolishing removes surface impurities and creates an ultrasmooth finish that minimizes bacterial adhesion and facilitates cleaning
- B. Electropolishing increases the pipe's pressure rating by hardening the surface layer through the electrical treatment process
- C. Electropolishing applies a chrome coating to the stainless steel surface that provides additional corrosion resistance
- D. Electropolishing sterilizes the pipe interior by passing electrical current through the surface that kills all bacteria

119. A plumber is installing a residential irrigation system. The design includes drip irrigation for garden beds and popup spray heads for the lawn areas. Both systems are connected to the same water supply through a common backflow preventer. What advantage does drip irrigation provide over spray heads for the garden beds?

- A. Drip irrigation operates at higher pressure than spray heads, providing more effective water delivery to plant roots
- B. Drip irrigation delivers water directly to the root zone with minimal evaporation, reducing water waste significantly
- C. Drip irrigation requires no filtration or pressure regulation, simplifying the installation compared to spray heads
- D. Drip irrigation provides better coverage for large open areas because the emitters distribute water more evenly than spray heads

120. A swimming pool system has a cartridge filter rated for a maximum flow rate of 150 litres per minute. The pool pump is a variable speed model currently set to run at a speed that produces 180 litres per minute. What problem does this overflow condition create?

- A. The excessive flow rate reduces the filter's effectiveness because water passes through the cartridge too quickly for adequate filtration
- B. The excessive flow rate heats the water faster than the pool's cooling system can dissipate, raising the temperature
- C. The excessive flow creates cavitation in the pump that damages the impeller and generates excessive noise
- D. The excessive flow has no negative effect because variable speed pumps automatically adjust to the filter's capacity

121. A plumber is connecting a natural gas supply to a residential tankless water heater. The manufacturer specifies a 3/4 inch gas supply connection. The existing gas line from the meter is 1/2 inch and runs 8 metres. The plumber calculates the pressure drop across the 1/2 inch line at the heater's BTU demand. The pressure drop exceeds the allowable maximum. What must be done?

- A. Upsize the gas supply line from the meter to the heater to 3/4 inch to reduce the pressure drop to within the allowable range
- B. Install a gas pressure booster between the meter and the heater to compensate for the excessive pressure drop
- C. Reduce the heater's BTU setting to a level that the existing 1/2 inch gas line can support without excessive pressure drop
- D. Install a gas pressure regulator at the heater inlet to maintain the correct supply pressure despite the excessive drop

122. A medical gas system's zone valve box in a hospital surgical suite contains zone shutoff valves for oxygen, medical air, nitrous oxide, and nitrogen. During a fire alarm, what action is taken regarding these zone valves?

- A. All zone valves remain open to ensure uninterrupted gas supply to any patients who may be undergoing surgery
- B. Only the nitrous oxide valve is closed because N_2O supports combustion and could intensify a fire in the suite
- C. All zone valves are closed by authorized staff to eliminate medical gas flow that could fuel or intensify a fire
- D. The zone valves are controlled automatically by the fire alarm system and close without manual intervention

123. A plumber is installing a compressed air outlet in an automotive paint booth. The air quality specification requires pointofuse filtration that removes particles down to 0.01 micron and oil aerosol down to 0.001 mg/m³. What type of filter achieves this level of air quality?

- A. A standard particulate filter rated at 5 microns that provides adequate protection for all paint spray applications
- B. A coalescing filter followed by an activated carbon adsorber that removes both oil aerosol and vapour to the required level
- C. A HEPA filter rated at 0.3 microns that captures all particles and oil droplets in a single filtration stage
- D. A desiccant dryer that removes all moisture along with particles and oil aerosols from the compressed air stream

124. A swimming pool's salt chlorine generator is producing chlorine normally, but the pool's free chlorine level remains low despite adequate salt concentration and generator output. The pool's stabilizer (cyanuric acid) level is 150 ppm — well above the recommended maximum of 80 ppm. What is the relationship between the high stabilizer level and the low chlorine level?

- A. The high stabilizer level has no effect on chlorine effectiveness — the low chlorine is caused by a different factor entirely
- B. Excessive stabilizer binds with free chlorine, reducing its sanitizing effectiveness — a condition known as chlorine lock
- C. The high stabilizer level increases the chlorine demand by reacting chemically with the hypochlorous acid molecules
- D. Excessive stabilizer causes the chlorine to convert to combined chlorine (chloramines) that are not measured as free chlorine

125. A plumber services a swimming pool and discovers that the pool pump's mechanical seal is leaking — water drips from the pump housing at the point where the motor shaft enters the volute. What is the required repair?

- A. Replace the pump's mechanical seal, which creates the watertight barrier between the wet volute and the dry motor
- B. Tighten the pump housing bolts to compress the existing mechanical seal more tightly against the motor shaft
- C. Apply marinegrade silicone sealant around the motor shaft at the point where it enters the pump volute housing
- D. Replace the entire pump motor because the shaft bearing has worn and created the gap where water is escaping

Practice Exam 9: Answer Key and Explanations

1. B — Hot metal chips and sparks from cutting galvanized steel can travel significantly beyond 2 metres, especially in drafty conditions. Safety glasses are the minimum required PPE for any person in the vicinity of grinding, cutting, or spark-producing operations. Eye injuries from flying debris are among the most common and preventable construction injuries.
2. D — Concrete reaches its design compressive strength over a 28-day curing period. At 3 days, the concrete has achieved only approximately 40–50% of its 28-day strength. Expansion anchors installed in under-strength concrete may not develop their rated holding capacity and could pull out under the operational load of the supported piping.
3. A — Knob-and-tube wiring from the early 20th century often has deteriorated or missing insulation on the conductors, exposing bare live wires. A plumber working in the same joist bay could accidentally contact an energized conductor, resulting in electrocution. The electrical hazard must be identified and controlled (de-energized or protected) before plumbing work begins.
4. C — Propane has a specific gravity of 1.52 — it is heavier than air and sinks to the lowest available point. In a below-grade basement, leaked propane pools at floor level, creating invisible explosive pockets. Specific ventilation provisions and gas detection at floor level are required by code for propane installations in below-grade spaces.
5. B — The most effective mentoring approach is to stop the apprentice before the error becomes a wasted cut, demonstrate the complete calculation (including the make-up subtraction that was forgotten), and then have the apprentice recalculate independently. This corrects the knowledge gap immediately, prevents material waste, and builds the apprentice's ability to perform the calculation correctly in the future.
6. D — The primary hazard in a flooded mechanical room with electrical panels and equipment is electrocution from energized circuits in contact with the standing water. The electrical supply must be confirmed de-energized by a qualified electrician before anyone enters the water. Gas shutoff and pump activation are secondary actions that follow electrical isolation.
7. A — Blue is the standard utility colour code for potable water lines across Canada and North America. This standardized colour coding system ensures that all contractors performing excavation can

identify underground utilities correctly: blue = water, green = sewer, red = electrical, yellow = gas, orange = communications.

8. C — Underground DWV piping beneath a concrete slab must be inspected by the AHJ before the concrete is poured. Once concealed, defects cannot be observed or corrected without demolishing the slab. The plumber must insist on the inspection and delay the pour if necessary — pouring over uninspected piping is a code violation.

9. B — In a hydrostatic test, pressure decreases with elevation due to the weight of the water column. At 8 metres above the gauge: $8\text{ m} \times 9.81\text{ kPa/m} = 78.5\text{ kPa}$ of static head loss. The pressure at the highest point is approximately $690 - 78.5 = 611.5\text{ kPa}$ (approximately 612 kPa). The test pressure at the top is lower than the gauge reading at the bottom.

10. D — When the structural engineer's maximum permitted hole size is smaller than the required pipe sleeve, the plumber cannot simply drill a larger hole — doing so could compromise the wall's structural capacity. The correct action is to consult the structural engineer for an alternative penetration location, a reinforced detail, or a redesigned routing that satisfies both the structural and plumbing requirements.

11. A — In a hospital environment, the fire watch must include notification of nursing stations on adjacent floors because smoke and heat can travel through concealed spaces to occupied patient areas. Hospital fire safety protocols are more stringent than standard construction because occupants may be unable to evacuate independently.

12. C — Area = length \times width = $6.5\text{ m} \times 4.2\text{ m} = 27.3\text{ m}^2$. This basic rectangular area calculation is fundamental to determining sprinkler head coverage requirements, fixture counts, and drainage area calculations. Each sprinkler head type has a maximum coverage area per head that divides into the room area to determine the number of heads required.

13. B — Fire extinguishers used for fire watch during hot work must have a current inspection tag — typically inspected annually with monthly visual checks. An expired tag means the extinguisher has not been verified as operational by a qualified inspector within the required period. Even if the gauge reads "charged," internal components may have degraded without inspection.

14. D — Firestop devices are required only at penetrations through fire-rated assemblies. A non-rated floor in a wood-frame residential building does not require firestopping at pipe penetrations. However,

the annular space should still be sealed to prevent air leakage, pest infiltration, and odour transfer between floors — this is a building envelope issue, not a fire protection issue.

15. A — Total weight = (pipe weight + water weight) × length = (25 + 8) × 20 = 33 kg/m × 20 m = 660 kg. This substantial operating weight must be supported by properly rated hangers and structural attachments. Cast iron pipe is one of the heaviest DWV pipe materials, and the water weight adds significantly to the total load.

16. C — When a change order modifies the pipe material, the plumber must review the revised project specification (which defines the new material requirements, joint methods, and quality standards) and the CPVC manufacturer's installation instructions (which specify support spacing, expansion provisions, temperature limits, and cementing procedures specific to that product).

17. D — Using a pressing tool that produces less force than the manufacturer specifies may create fittings that appear properly crimped but have not fully compressed the O-ring seal. These under-pressed fittings may hold initial pressure testing but can develop slow leaks over time as the O-ring relaxes. Only the manufacturer's specified tool and force rating ensures a reliable, warranted connection.

18. A — Cold ambient temperatures cause the HDPE pipe ends to cool rapidly after the heating plate is removed, potentially reducing the time available for proper fusion. The cooled surfaces may not achieve full molecular bonding, producing a weak joint. Manufacturer guidelines specify minimum ambient temperatures and may require a heated enclosure (fusion tent) for cold-weather operations.

19. C — Solder that melts on contact but sits in a ball instead of flowing into the joint indicates that the flux has failed to protect the heated surface from oxidation, or insufficient flux was applied. The solder cannot wet an oxidized copper surface — it beads up rather than spreading and being drawn into the capillary gap. Fresh flux must be applied and the joint re-cleaned.

20. B — Type L copper has a thicker wall than Type DWV and exceeds the DWV specification in every measurable property. Using a higher-rated material as a substitute for a lower-rated specification is always acceptable — the system will meet or exceed the performance requirements. Type L uses the same outside diameter as DWV, so fittings are interchangeable.

21. D — Without pipe guides between the anchors and the expansion joint, the pipe can move laterally (sideways) instead of axially (straight into the joint) when it expands. This lateral deflection can cause

the bellows to buckle, the pipe to bow off its supports, or the expansion joint to fail from misaligned movement. Guides constrain the pipe to axial-only movement.

22. A — A reciprocating saw with a carbide-grit blade designed for cast iron can operate in tight spaces without needing to wrap around the full circumference of the pipe. The blade cuts through one side at a time, making it ideal for confined spaces where snap cutters, soil pipe cutters, and circular saws cannot be positioned around the pipe.

23. C — The typical minimum bend radius for PEX tubing is 6 to 8 times the outside diameter. For 3/4-inch PEX (approximately 25 mm OD), this means a minimum bend radius of 150–200 mm. Bending tighter than this minimum risks kinking the tubing, which permanently restricts flow and cannot be repaired — the kinked section must be cut out and replaced.

24. B — NPT (National Pipe Thread) threads are tapered, so the first few turns engage by hand before the taper creates resistance. For 1-1/2-inch pipe, approximately 3 hand-tight turns before resistance is typical for properly cut threads. Significantly more hand engagement indicates undersized (loose) threads; immediate resistance indicates oversized threads.

25. D — For a concealed PEX-to-copper transition, a solder-to-crimp adapter provides permanent, reliable connections on both ends — the copper end is soldered (a proven permanent joint for copper) and the PEX end uses a crimp ring (a proven permanent joint for PEX). Push-fit fittings, while convenient, may not be approved for concealed use in all jurisdictions.

26. A — The code sizing table governs because it considers both the fixture unit load and the developed length of the vent, which the simple half-diameter rule does not account for. At 250 DFU and 25 metres developed length, the table requires 2-1/2 inches. The half-diameter rule (2 inches) is a minimum starting point, but the sizing table may require a larger diameter.

27. C — A single water closet requires a minimum 3-inch soil pipe. A 4-inch stack is oversized for this single fixture but is not a code violation — it simply exceeds the minimum. The minimum stack size for a water closet is 3 inches because the toilet's integral trap and discharge volume require a 3-inch minimum drain connection.

28. B — The typical minimum vertical separation between a sewer and an underground electrical conduit at a crossing point is 300 mm (12 inches). This separation prevents damage to either utility

during installation or future maintenance, and protects the electrical conduit from sewer leakage that could compromise the wiring.

29. D — A trap seal primer that automatically delivers water at regular intervals is the most effective permanent solution for a floor drain that receives water infrequently. The primer maintains the seal without relying on the homeowner's memory or manual action. Mineral oil, deeper traps, and homeowner instructions are less reliable long-term solutions.

30. A — The washing machine's high-volume discharge creates pressure fluctuations in the shared stack that affect the second-floor traps. The sudden large-volume flow from the washing machine pump can create both positive and negative pressure waves in the stack, causing gurgling and temporary seal disturbance on fixtures connected to the same stack.

31. C — A percolation rate of 60 minutes per inch exceeds the 50 minutes per inch maximum for conventional disposal fields. The soil is too slow to absorb the daily effluent volume from a conventional field — it would become hydraulically overloaded and fail. An engineered alternative system (sand filter, treatment mound, or advanced treatment unit) is required.

32. D — A grease interceptor is required between the food processing floor drains and the building drain because the washdown water and food processing waste contain fats, oils, and grease that would accumulate in the drainage system and municipal sewer. The interceptor must be sized for the facility's wastewater volume and grease concentration.

33. B — ABS and PVC are chemically different plastics and cannot be joined with either material's standard solvent cement. A transition cement specifically formulated and approved for ABS-to-PVC connections, or a mechanical coupling adapter, must be used. Using the wrong cement produces a joint that appears bonded but has not achieved proper chemical fusion.

34. A — Total fall = slope \times length = 1/4 inch per foot \times 50 feet = 12.5 inches (approximately 318 mm). This calculation determines the elevation change from the beginning to the end of the drain run. The 1/4-inch-per-foot slope is the code minimum for pipe 3 inches and smaller, but is also commonly used on 4-inch pipe.

35. C — A brass or stainless steel flush-mount cover plate is the standard for cleanouts installed in concrete floor surfaces. It provides a durable, accessible, and aesthetically acceptable cover that can be

removed for drain cleaning access and replaced after service. PVC caps, wood plugs, and concrete-filled caps are not appropriate for finished floor installations.

36. B — When the kitchen sink drains slowly but the clothes washer drains normally on the same branch, the blockage is isolated to the kitchen sink's individual trap or trap arm. The shared branch and building drain are clear (proven by the clothes washer draining normally). The blockage is between the kitchen sink and its connection to the 3-inch branch.

37. D — A timer and/or float switch in the pump chamber controls the dosing pump's operation. The timer activates the pump at programmed intervals (typically 2–4 doses per day), delivering a measured volume of effluent to the disposal field with each dose. This controlled dosing allows the field's soil to absorb each dose and rest between doses for optimal treatment.

38. A — The maximum trap arm length for 1-1/2-inch pipe is 1,070 mm (42 inches) per most code editions. This is shorter than the 1,525 mm maximum for 2-inch pipe and the 1,830 mm maximum for 3-inch pipe. The smaller the pipe, the shorter the maximum trap arm because smaller pipe fills to full bore more easily, creating stronger siphonage risk.

39. C — The second-floor toilet discharge creates negative pressure (vacuum) in the shared soil stack that temporarily draws water out of the ground-floor toilet's trap seal. This is induced siphonage — the flowing water in the stack creates a pressure wave that affects traps connected to the same stack. Proper venting provides air to equalize pressure and prevent this effect.

40. B — The 50 LPM interceptor rating exceeds the 45 LPM maximum sink discharge, providing adequate capacity. Point-of-use hydromechanical grease interceptors (HGIs) are sized primarily on flow rate — the interceptor must accommodate the connected fixture's peak discharge without being bypassed. The 50 LPM rating provides a small margin above the 45 LPM demand.

41. D — Frost closure is the primary concern. In Winnipeg's extreme cold (-30°C and colder), warm moist sewer gas rises through the vent and condenses on the cold pipe interior above the roof. The condensate freezes, gradually building an ice layer that restricts or completely blocks the vent opening. Increasing the diameter through the roof and using a standard minimum extension addresses this.

42. A — The code sizing table shows that a 1-1/4-inch vent at 8 metres handles only 10 DFU — far below the 80 DFU load on the stack. The vent is severely undersized. The sizing table must be consulted

for the specific DFU load and developed length to determine the correct vent diameter. A 1-1/4-inch vent serving 80 DFU is a significant code violation.

43. C — The pot sink, pre-rinse station, and cooking area floor drains produce grease-laden waste and must connect to the interceptor. The employee handwash sink does not produce grease-laden waste — it handles only hand soap and clean rinse water. Connecting the handwash sink to the interceptor would dilute the grease concentration and reduce the interceptor's efficiency.

44. B — A 25 mm gap at a pipe joint, even without current root intrusion, will eventually allow roots to penetrate (roots seek the moisture and nutrients in the sewage), soil to infiltrate the pipe (reducing the effective bore), and the gap to widen as differential settlement continues. Early repair prevents these progressive problems from developing.

45. C — Horizontal vent sections must be installed above the flood level rim of the fixture they serve at all points along their entire run. If the vent dips below the flood rim, a backed-up fixture could fill the vent with water at the dip point, converting it from a vent to a drain and eliminating its air supply function.

46. A — Ductile iron provides superior structural strength compared to PVC — it withstands the concentrated wheel loads from vehicles transmitted through the soil above the pipe without deflecting, deforming, or cracking. Under driveways and roads, the higher external loads justify the stronger, heavier material even though PVC is acceptable for general buried sewer applications.

47. C — The untrapped direct connection between the sprinkler auxiliary drain and the floor drain receptor provides an open pathway for sewer gas from the sanitary drainage system to travel backward through the drain, through the untrapped connection, and into the building space where the auxiliary drain discharges. A trap or air gap is required.

48. B — The sewage ejector pump must handle the peak simultaneous inflow from all connected fixtures. For a residential basement bathroom group (WC + lavatory + shower = 6 DFU), the pump must be sized to handle the combined peak flow, typically 40–75 LPM for this application. The pump must also be rated for solids handling because a water closet is connected.

49. A — A cleanout provides access for drain cleaning equipment in both directions from the cleanout opening. A cable or camera can be directed upstream (into the stack) or downstream (into the building

drain) from the same cleanout, regardless of the cleanout's orientation. The fitting's direction influences which direction the cable enters more easily, but both directions are accessible.

50. A — The sediment sump in a catch basin captures sand, grit, gravel, and debris before it enters the underground storm drainage piping. Without the sump, this material would accumulate in the piping, gradually reducing the effective diameter and flow capacity, leading to backups during heavy rain events. The sump must be cleaned periodically.

51. D — The negative-slope section creates a permanent pool of standing water where solids, grease, and debris accumulate because they cannot be carried uphill by gravity flow. Over time, this accumulation creates a recurring blockage that requires repeated cleaning. The permanent solution is to excavate and re-establish correct downhill slope throughout.

52. B — ABS does not require primer before cementing — only ABS solvent cement is applied directly to the cleaned pipe and fitting surfaces. PVC requires both a primer (which softens the plastic surface) and cement (which fuses the softened surfaces together). This distinction is a practical difference that affects installation speed and cost.

53. C — At 6 DFU, the branch is at its maximum rated capacity for 2-inch pipe. The code permits operating at the table's maximum value — 6 DFU is code-compliant for a 2-inch branch. While there is no additional capacity margin, the sizing table values already incorporate design factors. Adding a third lavatory (7 DFU) would exceed the capacity and require upsizing.

54. A — Resilient (rubber-isolated) pipe hangers prevent vibration from drainage flow through the cast iron pipe from transferring directly to the building's wood or steel framing. The rubber isolation pads absorb the pipe's vibration energy before it reaches the structure, significantly reducing the noise transmitted to occupied spaces above and below.

55. B — Erratic gauge needle movement between 33 and 37 kPa is most commonly caused by pressure fluctuations from wind gusts on the open vent terminal. Outside air pressure changes from gusts push against or draw from the vent terminal, creating small pressure pulses that affect the gauge reading. Capping the vent terminal temporarily during the test eliminates this interference.

56. D — The two-compartment septic tank design provides sequential treatment. The larger inlet compartment receives raw wastewater and provides the primary settling and anaerobic digestion volume

(where the majority of solids settle and decompose). The smaller outlet compartment provides additional settling and clarification before the treated effluent exits to the disposal field.

57. C — Rapid pump cycling (short-cycling) with normal demand is the classic symptom of a waterlogged pressure tank. The tank has lost its air pre-charge and is full of water — it provides almost no drawdown volume between the cut-in and cut-out pressures. The pump must start almost immediately each time any faucet is opened. Recharging or replacing the tank restores normal operation.

58. A — HDPE with butt-fused joints creates a monolithic pipeline with no gaskets, mechanical components, or potential leak points at the joints. In clay soil with a high water table, joint integrity is critical — gasketed joints on other pipe materials can allow groundwater infiltration that contaminates the potable supply. Fused HDPE joints are permanently watertight.

59. D — The high test pressure (690 kPa) is more than typical operating pressure and can dislodge sediment and scale that is loosely adhered to the pipe interior. If the system includes any galvanized steel sections, iron oxide (rust) particles are released from the interior surfaces. The brownish tint clears after running because the dislodged material is flushed out.

60. B — Installing an aquastat on the return line cycles the pump based on temperature (activating when the return cools below the setpoint and deactivating when it warms above). A timer cycles the pump based on schedule (running only during occupied/demand hours). Either control reduces the pump's operating hours from 24/7 to as-needed, significantly cutting energy costs.

61. A — Residual pressure = PRV setting – dirty filter drop = $415 - 140 = 275$ kPa (40 psi). This is above the 140 kPa (20 psi) minimum required at fixtures but represents a significant pressure reduction. The homeowner should be advised to replace the filter cartridge regularly to maintain pressure closer to the 345 kPa level (clean filter drop of 70 kPa).

62. C — A wet fire sprinkler system without antifreeze or chemical additives is classified as a minor (non-health) hazard cross-connection. A double check valve assembly (DCVA) provides adequate protection for this hazard level. If antifreeze were added, the hazard classification would increase to severe (health), requiring an RP device.

63. D — Closing the cold water inlet valve stops water from entering the heater but does not isolate the hot water outlet — hot water from the tank can still flow backward into the distribution system, and the system remains connected through the open outlet. For complete isolation, valves on both the inlet and

outlet are recommended. However, as a practical matter, closing the inlet and opening a hot fixture to relieve pressure can effectively drain the heater for service.

64. B — A water softener installed on the cold water supply before the tankless heater reduces the hardness from 30 gpg to below the manufacturer's 7 gpg maximum. This prevents calcium scale from accumulating on the heat exchanger's narrow passages, which would reduce efficiency, cause overheating, and eventually lead to premature heat exchanger failure.

65. A — Pinhole leaks concentrated on the underside of horizontal copper pipe runs indicate pitting corrosion caused by aggressive water chemistry. Sediment and particulates settle on the bottom of horizontal pipes, creating localized corrosion cells where the sediment contacts the copper surface. The extended contact time between the settled material and the pipe wall accelerates pit formation.

66. C — The process water heater serving the commercial dishwasher with chemical rinse agents requires an RP device because the chemicals create a health hazard cross-connection. The domestic heater serving only washrooms and a break room kitchen does not require additional backflow prevention beyond the building's main service protection.

67. D — The WSFU value converted through the demand curve represents the probable peak demand — the estimated maximum simultaneous flow rate during typical peak use periods. It accounts for the statistical probability that not all fixtures will operate simultaneously, producing a realistic design flow rate that is less than the theoretical maximum.

68. A — The dishwasher's fill solenoid valve has a relatively low flow rate compared to the kitchen faucet's full-open flow. Both are on the same branch with the same volume of cooled water between uses. The faucet's higher flow rate displaces the cooled water quickly (45 seconds), while the dishwasher's lower flow rate takes much longer (3+ minutes) to push the same volume of cooled water through the branch.

69. A — The 2.3 LPS demand is within the 2.5 LPS capacity of the 1-inch trunk with approximately 8% margin remaining. The existing trunk is adequate for the added bathroom. While the margin is small, the demand curve already accounts for the probability that all fixtures will not operate simultaneously, and the 2.4 m/s velocity limit provides an additional safety factor.

70. C — An indirect water heater uses the hydronic boiler's hot water (not the domestic supply) circulating through an internal heat exchanger coil to heat the domestic water stored in the tank. The two

water circuits — boiler water and domestic water — are physically separated by the coil. The domestic water never enters the boiler.

71. B — The return water temperature of 45°C is below the aquastat's 50°C activation point. The pump activates when the return drops below 50°C, but the piping heat losses are so great that the return never reaches the 55°C deactivation point. The pump runs continuously because the return temperature never satisfies the aquastat's shutoff condition. Insulating the return piping or adjusting the aquastat setpoints addresses the issue.

72. D — A powered (impressed current) anode protects the tank using electrical current rather than sacrificial metal dissolution. Because no magnesium dissolves into the water, the chemical reaction between magnesium and sulfate-reducing bacteria that produces hydrogen sulfide gas cannot occur. The powered anode eliminates both the odour and the need for periodic anode replacement.

73. A — In a manifold system, a point-of-use recirculation pump at the farthest fixture circulates water from the hot water homerun back to the heater through the cold water homerun of the same fixture. When the pump activates, it pushes cooled water from the hot line through a bypass valve into the cold line, returning it to the heater for reheating.

74. C — The total WSFU for the main trunk is typically derived from the complete fixture schedule — counting each fixture once based on its total (hot and cold combined) WSFU value. Simply adding hot and cold values separately can overcount fixtures that draw both hot and cold. The fixture schedule approach counts each fixture's total demand contribution once.

75. B — PRV chattering is most commonly caused by an oversized valve that is too large for the building's actual flow demand. The valve opens slightly to satisfy the demand, but the low flow causes the internal mechanism to oscillate (hunt) between slightly open and slightly closed positions, producing the rapid vibrating noise. A properly sized PRV eliminates the chatter.

76. B — A wall-mounted commercial water closet that rocks on its carrier indicates the concealed carrier is not properly plumb, level, or securely anchored to the building structure. The carrier must be re-leveled and re-secured — the bowl itself cannot compensate for a misaligned carrier. Shims between the bowl and wall are a temporary measure that does not address the root cause.

77. D — The ignition source (standing pilot) at 200 mm is below the code-required 450 mm minimum above the garage floor. The heater must be elevated to bring the ignition source above 450 mm. This is

accomplished by installing the heater on a code-approved platform or raised stand, or by selecting a model with an elevated or sealed combustion configuration.

78. A — Debris from the supply piping (solder beads, flux residue, copper chips, sediment) can lodge between the ceramic discs during the first uses after installation. Even a tiny particle prevents the precision-ground discs from seating completely, causing a persistent drip. Removing the cartridge, flushing the supply lines, cleaning the discs, and reassembling typically resolves the issue.

79. C — If the salt is dissolving normally (the tank has salt dissolved in water = brine ready for use) but the brine level never drops during regeneration, the brine valve or brine draw mechanism inside the control valve has failed. The softener attempts to regenerate but cannot draw brine from the tank, so the resin is never recharged and hard water passes through.

80. B — Current Canadian and US federal water efficiency standards limit commercial pre-rinse spray valves to a maximum flow rate of 1.28 GPM (4.8 LPM). This standard significantly reduces water consumption in commercial kitchens where pre-rinse sprays operate for extended periods during meal preparation and cleanup.

81. A — Calcium scale on the heating element acts as an insulating layer between the element and the surrounding water. The element must heat through the scale layer before the heat reaches the water, dramatically reducing heat transfer efficiency. The result is slower heating, higher energy consumption, and reduced effective hot water output.

82. D — Sprinkler head type selection is based on the room's physical characteristics — ceiling type (flat, sloped, cathedral), obstructions (beams, soffits, ceiling fans), and geometry (open rooms, narrow corridors, closets). Pendant heads are standard for flat open ceilings; sidewall heads are used in narrow spaces, corridors, or rooms where ceiling-mounted pendants are impractical.

83. C — After recent pre-filter replacement, the most likely cause of reduced RO production is the RO membrane itself. Over time (typically 2–5 years), the membrane fouls with scale, biofilm, and contaminants that reduce its permeability. If the pre-filters were badly neglected before replacement, chlorine may have damaged the membrane, further reducing production.

84. B — Neither standard sediment filters nor activated carbon filters reliably remove or kill bacteria from water. Sediment filters may trap some larger organisms but cannot be relied upon for pathogen

removal. Carbon filters adsorb chemicals but do not sterilize water. A UV disinfection unit is required to kill bacteria, viruses, and protozoa in well water.

85. A — An error code for "exhaust obstruction" that develops after a vent was clean last month points to a new obstruction at the vent terminal. Bird nests, ice formation, debris accumulation, and wasp nests are common causes of sudden vent terminal blockage. The plumber should inspect the exterior vent terminal first before investigating internal causes.

86. D — Commercial ice machines require an indirect waste connection with an air gap between the machine's drain outlet and the floor sink or receptor. This prevents any possibility of contaminated drain water back-siphoning into the ice machine, which contacts food-grade ice consumed directly by restaurant patrons.

87. B — An aluminum-zinc alloy anode rod does not produce the chemical reaction with sulfate-reducing bacteria that generates hydrogen sulfide gas. Magnesium anodes are the most reactive and are the primary cause of H₂S odour in water heaters with elevated sulfate levels. Switching to aluminum-zinc is the standard remedy.

88. A — The T&P relief valve discharge pipe must terminate at a visible location where the homeowner or occupant can observe whether the valve is discharging. A discharge pipe terminating inside a wall cavity is invisible — the homeowner would never know the valve was relieving, and the hot water would cause concealed moisture damage. The discharge must be visible.

89. C — The treatment sequence must address all four contaminants in the correct order: iron filter first (removes iron that would foul the softener resin), water softener second (removes hardness), pH adjustment third (raises the 6.5 pH to protect piping and optimize downstream UV performance), UV disinfection last (kills bacteria in clear, neutral-pH water).

90. D — A 240V electrical connection for the dishwasher's booster heater exceeds the plumbing trade's electrical scope. A licensed electrician must run the dedicated circuit, install the disconnect or junction box, and make the electrical connection. The plumber handles the water supply, drain connections, and air gap installation.

91. B — Dissolved air in pressurized water comes out of solution when the pressure drops at the faucet outlet (similar to opening a carbonated beverage). The tiny bubbles give the water a milky white

appearance that clears from the bottom up as the bubbles rise and dissipate. This is completely harmless — it is not a contamination or system malfunction issue.

92. A — Sealed combustion eliminates backdrafting risk because the combustion air supply and exhaust are both ducted to/from the outdoors through dedicated pipes. The combustion process is completely isolated from the building's indoor air — no indoor air is consumed for combustion and no exhaust gases can spill into the occupied space.

93. C — After confirming no air (bleeding produced no change) and a fully open balancing valve, the next diagnostic step is to check the pipe connections to and from the radiator for a blockage, restriction, or improperly installed fitting. A partially blocked valve body, a kinked supply tube, or debris inside the fitting can restrict flow to a single emitter without affecting the rest of the zone.

94. D — At 45°C return water temperature, the boiler is operating well below the natural gas flue gas dew point of approximately 55°C. The moisture in the combustion exhaust condenses on the cool heat exchanger surfaces, releasing latent heat that the boiler captures. This is full condensing mode, providing maximum efficiency (90–98% AFUE).

95. B — The expansion tank must be connected on the suction side of the circulator pump, not the discharge side. When connected to the discharge side, the pump's generated pressure (head) adds to the tank's pre-charge reading, making the system's effective pressure higher than intended. This elevated pressure reaches the relief valve during heating, causing discharge.

96. A — The PEX loops must remain pressurized with water during the concrete pour. The hydrostatic pressure inside the tubing provides internal support that prevents the weight of the wet concrete from crushing or deforming the flexible PEX tubes. Maintaining pressure throughout the pour and curing process is standard practice.

97. A — Over 5 years of operation, the automatic fill valve periodically adds fresh water to the system to replace minor losses from air vents, weeping relief valves, and micro-leaks. Each addition of fresh water dilutes the glycol concentration. The cumulative dilution has reduced the freeze protection from -30°C to -15°C. The glycol must be tested annually and adjusted.

98. B — Gauge pressure (psig) reads zero at atmospheric pressure by design — it measures pressure above atmospheric. When the boiler is cold and not firing, the system is at atmospheric pressure. A

reading of 0 psig is correct and expected. The gauge will show positive pressure only when the boiler fires and produces steam above atmospheric pressure.

99. D — The automatic fill valve has failed in the open position, continuously adding municipal water to the system even though the system is already full. The continuous addition raises the system pressure above the normal operating range (to 275 kPa), and the excess pressure forces water through the automatic air vent, which was never designed to seal against this elevated pressure.

100. C — A pump that runs almost continuously is receiving condensate faster than normal — likely because one or more steam traps have failed in the open position. Failed-open traps pass live steam into the return system, where it condenses rapidly, generating excessive condensate volume that overwhelms the pump's normal cycling capacity.

101. A — Chloride-containing flux residue left inside the piping after soldering can cause stress corrosion cracking of stainless steel heat exchangers. Stainless steel is susceptible to chloride-induced cracking, especially at elevated temperatures. The manufacturer specifies chloride-free flux (or thoroughly flushed joints) to protect the heat exchanger's integrity.

102. C — Zone 1 has a ΔT of 8°C (below the 11°C design), indicating too much flow — water passes through too quickly and does not give up enough heat per pass. Zone 3 has a ΔT of 15°C (above design), indicating too little flow — water stays too long and gives up too much heat. Zone 1's balancing valve should be partially closed, and Zone 3's should be opened further.

103. B — Short-cycling on the high-limit control indicates that the boiler's heat is not being removed fast enough — the water in the boiler heats to the high-limit temperature ($90\text{--}95^{\circ}\text{C}$) in just 2 minutes because insufficient flow is carrying the heat away. A closed zone valve, failed circulator, or air lock traps the heat in the boiler rather than distributing it.

104. D — The modulating condensing boiler adjusts its firing rate (from minimum to maximum) to match the building's real-time heat demand, while the variable-speed pump adjusts its flow rate to match. Together, they deliver exactly the amount of heat the building needs at any moment — no more, no less — maximizing efficiency and comfort.

105. A — In a one-pipe steam system, the main air vent at the end of each supply main is responsible for rapidly venting the air ahead of the advancing steam. If the first-floor main's air vent is venting too fast

relative to the second-floor main's vent, steam fills the first-floor main and radiators before the second-floor main has finished venting its air.

106. A — Aluminum is amphoteric — it corrodes in both acidic (below pH 7.0) and alkaline (above pH 8.5) conditions. Maintaining the system water pH within the 7.0–8.5 range prevents chemical attack on the aluminum heat exchanger. Regular water testing and treatment adjustment are essential for any hydronic system with an aluminum heat exchanger.

107. B — A surging (bouncing) water level in a steam boiler gauge glass most commonly indicates the boiler is operating above its rated capacity. The violent boiling action at high firing rates creates turbulent waves on the water surface that cause the gauge glass level to bounce erratically, making it impossible to determine the actual steady-state water level.

108. D — A 10 kPa pressure rise in the medical air system when only the oxygen system is pressurized is definitive proof of a physical cross-connection between the two piping systems. The oxygen pressure is communicating with the medical air piping through a shared connection somewhere in the system. This cross-connection must be found and corrected before the system can be certified.

109. A — Dental compressed air must be clean, dry, and oil-free because it contacts patients directly (air/water syringe, handpiece cooling, air abrasion). An oil-free compressor with integrated drying and filtration produces air quality suitable for dental patient care. The air must meet dental air quality standards, which are more stringent than general workshop air.

110. C — The "recirculate" position on a multiport valve bypasses the filter media entirely, circulating water from the pump through the valve and back to the pool without passing through the sand bed. This position is used when adding chemicals (to distribute them without filtering them out), heating the pool (maximum circulation without filter restriction), or troubleshooting flow issues.

111. B — When the RP device's relief valve is submerged in a flooded vault, contaminated water from the vault can enter the relief port and migrate into the RP assembly. During a backflow event, the submerged relief valve cannot discharge to atmosphere (its intended function), and contaminated vault water could be drawn into the device and potentially into the potable supply.

112. D — After all physical tests pass (standing pressure, cross-connection, purity, flow), the independent third-party verifier issues a formal certification report documenting that every test was

completed and passed. This certification authorizes the system for patient service. Without this report, the system cannot legally deliver gas to patient-use outlets.

113. A — Total connected BTU load = 120,000 + 80,000 + 60,000 + 40,000 = 300,000 BTU/hr. Gas pipe sizing uses the total connected load — the sum of all individual appliance ratings — because all appliances may operate simultaneously during peak kitchen operations. No diversity factor is typically applied to commercial kitchen gas pipe sizing.

114. C — Ozone is a powerful oxidizer (much stronger than chlorine) that destroys bacteria, viruses, and organic contaminants in the pool water. By handling much of the sanitizing workload, ozone significantly reduces the amount of chlorine needed to maintain the required free chlorine residual. Ozone does not replace chlorine entirely — a small chlorine residual is still maintained.

115. B — If the compressor maintained adequate pressure for Zones 1–6 but cannot maintain pressure for Zone 7, that zone likely has a larger volume of piping (more heads, longer lateral runs) that exceeds the compressor's CFM output capacity at the required pressure. The plumber should wait for the receiver to recharge (option A is also valid) or determine if Zone 7 requires a higher-capacity compressor.

116. D — In Canadian healthcare facilities, the CSA standard specifies colour coding for medical gas piping and outlets. If the local jurisdiction follows the CSA standard (white for oxygen) rather than the CGA standard (green for oxygen), the green-coded outlet must be corrected to white. The DISS connector provides mechanical safety, but the visual identification must also comply with the applicable standard.

117. A — The dust collection system creates negative pressure inside the building, which draws warm, humid outside air through any available opening (doors, windows, gaps). The compressor ingests this warm, humid makeup air and compresses it. Compressed warm air holds more moisture than compressed cool air, overwhelming the dryer's capacity and delivering moisture to the distribution system.

118. A — Electropolishing is an electrochemical process that removes a thin surface layer from the stainless steel, eliminating microscopic impurities, embedded particles, and surface roughness. The resulting ultra-smooth finish (measured in microinches Ra) minimizes bacterial adhesion points and creates a surface that can be thoroughly cleaned and sterilized during CIP procedures.

119. B — Drip irrigation delivers water directly to the plant root zone through low-flow emitters at or below the soil surface. This targeted delivery minimizes evaporation losses (no airborne spray), wind drift, and runoff that occur with spray heads. Drip systems typically use 30–50% less water than spray systems for the same planted area.

120. A — When the pump delivers flow above the filter's maximum rated capacity, water passes through the cartridge too quickly for the filter media to effectively capture particles. Filtration efficiency drops because the contact time between the water and the filter media is insufficient. The pump speed should be reduced to match the filter's rated maximum flow.

121. A — The gas supply line must be upsized from 1/2 inch to 3/4 inch to reduce the pressure drop to within the allowable range. An undersized gas line cannot deliver the volume of gas the tankless heater requires at its rated BTU input. The heater will either fail to fire, fire at reduced capacity, or produce error codes indicating insufficient gas flow.

122. C — During a fire alarm in a surgical suite, all medical gas zone valves are typically closed by authorized staff to prevent gas from flowing into an area where fire may be present. Medical gases (especially oxygen and nitrous oxide) support combustion and could intensify a fire. The decision to close zone valves follows established hospital fire safety protocols.

123. B — Paint-grade compressed air quality requires a coalescing filter (to remove oil aerosol down to 0.01 micron) followed by an activated carbon adsorber (to remove oil vapour down to 0.001 mg/m³). The coalescing filter captures liquid and aerosol oil; the carbon adsorber captures oil in vapour form that the coalescing filter cannot. Both stages are needed for paint-grade quality.

124. D — Excessive cyanuric acid (stabilizer) levels above 80 ppm bind with free chlorine molecules, rendering them less available for sanitizing. This condition, known as "chlorine lock" or "over-stabilization," means that even though the generator produces chlorine and the test measures free chlorine, the sanitizing effectiveness is severely reduced. Partially draining and refilling the pool reduces the stabilizer level.

125. A — The pool pump's mechanical seal is the component that creates the watertight barrier between the wet pump volute (where pool water circulates) and the dry motor compartment. When the seal wears, water leaks at the shaft penetration point. Replacing the mechanical seal restores the watertight barrier. The motor shaft and bearings are separate components.