PRACTICE EXAM 11: RED SEAL PLUMBER SIMULATION (125 QUESTIONS)

1. A plumber is brazing a copper joint in a ceiling space. The ceiling contains sprayapplied fireproofing on the steel deck above. Sparks and heat from the torch are directed upward toward the fireproofing material. What specific precaution addresses this situation?

A. No precaution is needed because sprayapplied fireproofing is noncombustible and cannot be ignited by torch sparks

B. Increase the torch temperature to reduce brazing time and minimize the total heat exposure to the material above

C. Wet the fireproofing material with water spray before brazing to prevent any thermal damage from the torch heat

D. Position a noncombustible heat shield between the torch work and the fireproofing to protect the material above

2. A plumber discovers a cracked mercury thermometer in the mechanical room near the boiler. Mercury beads are visible on the floor. What is the correct response to this mercury spill?

A. Sweep up the mercury beads with a standard broom and dustpan and dispose of them in the regular waste container

B. Do not touch the mercury — evacuate the area and notify the supervisor for a hazardous material cleanup response

C. Vacuum the mercury beads with a standard shop vacuum and wipe the area with a damp cloth to collect residue

D. Collect the mercury beads with bare hands and place them in a sealed glass container for safe storage and disposal

3. A plumber is working in a room where the oxygen level has been measured at 23.5% using a calibrated 4gas monitor. The normal atmospheric oxygen level is 20.9%. What does the elevated oxygen reading indicate?

A. The room has excellent ventilation and the elevated oxygen level is beneficial for worker health and performance

B. The reading is within the normal range for indoor spaces with mechanical ventilation and HVAC system circulation

C. The atmosphere is oxygenenriched, which significantly increases the fire and explosion risk in the room

D. The 4gas monitor is malfunctioning and must be recalibrated before any atmospheric reading can be trusted

4. A plumber must install pipe hangers on an exposed structural concrete beam. The beam has no preinstalled inserts. What anchoring method is used to attach the hangers to the concrete?

A. Expansion anchors, adhesive anchors, or powderactuated pins rated for the concrete strength and the pipe load

B. Wood screws driven into the concrete surface using a hightorque impact driver at maximum speed setting

C. Pipe straps nailed to the concrete surface using hardened masonry nails driven with a standard framing hammer

D. Selftapping screws designed for steel framing inserted into predrilled holes in the concrete beam surface

5. A plumber is using a power threading machine and notices that the threading oil is not flowing onto the pipe during the cutting operation. The oil reservoir is full. What is the most likely cause and what is the risk?

A. The oil is too thick for the current temperature and must be thinned with solvent before the machine is used

B. The oil filter is clogged and requires cleaning but the machine can continue operating briefly without oil flow

C. The threading operation can continue without oil because modern die heads are selflubricating at all temperatures

D. The oil pump or delivery tube is blocked — threading without oil produces rough threads, excessive heat, and rapid die wear

6. A plumber must lift a 75 kg bathtub from a delivery truck to the second floor of a building under construction. No elevator or crane is available. The stairway is narrow and has two landings. What is the safest lifting method?

A. Two plumbers carry the tub up the stairs using manual lifting techniques with regular rest stops at each landing

B. A minimum of three workers carry the tub to distribute the weight, or use a stairclimbing hand truck or material hoist

C. The bathtub manufacturer provides lifting straps that allow two workers to carry the load safely up any stairway

D. One plumber can carry the 75 kg tub by using a back brace and proper squatlifting technique on each flight

7. A plumber is reviewing a plumbing isometric drawing and encounters a symbol showing a pipe rising vertically and then continuing horizontally with a small circle at the direction change. What does this symbol typically represent?

A. A vent connection at the point where the vertical pipe turns horizontal in the DWV piping system layout

B. A cleanout fitting at the base of a vertical pipe where it transitions to a horizontal run below the floor

C. A test tee installed at the direction change for future system testing access after the system is completed

D. A coupling that joins two pipe sections at the direction change between vertical and horizontal orientations

8. A plumber is preparing a job hazard analysis (JHA) for installing underground pipe in a trench. The JHA must identify hazards and controls for each step of the work. Which of the following is a hazard associated specifically with the backfilling step?

A. Oxygen depletion inside the trench from decomposing organic material in the native soil being replaced

B. Heat exhaustion from the physical exertion of manually shoveling heavy soil into the trench in warm weather

C. Pipe damage from dropping large rocks or frozen soil chunks onto the installed piping during the backfill operation

D. Noise exposure from the excavator or compaction equipment operating during the mechanical backfill process

9. A plumber encounters a valve that is marked "OS&Y." This type of valve is commonly found on fire sprinkler system supply lines. What does "OS&Y" stand for and what is its defining feature?

A. "Overflow Safety Yield" — the valve automatically closes when the system flow exceeds a preset maximum limit

B. "Oil Sealed Yoke" — the valve stem is sealed with oil to prevent corrosion in outdoor fire protection applications

C. "Open Standard Yield" — the valve is designed to provide zero friction loss when in the fully open position

D. "Outside Screw and Yoke" — the valve's stem rises visibly outside the body when open, showing its position

10. A plumber needs to calculate the number of litres of water in a 50metre horizontal run of 4inch (100 mm inside diameter) copper pipe. The formula for volume is $V = \pi \times r^2 \times L$. What is the approximate volume?

A. 785 litres, calculated by using the diameter instead of the radius in the formula for the pipe's internal volume

B. Approximately 393 litres, calculated as $\pi \times (0.05\ \text{m})^2 \times 50\ \text{m} = 0.393\ \text{m}^3 = 393$ litres of water in the pipe run

C. Approximately 157 litres, calculated by using the radius of 25 mm and converting cubic millimetres to litres

D. Approximately 50 litres, estimated using the rule of thumb of 1 litre per metre for all 4inch copper pipe runs

11. A plumber discovers that a fire extinguisher in the work area has been discharged — the gauge reads zero pressure. A brazing operation is scheduled for this afternoon. What must be done?

A. The discharged extinguisher must be replaced with a fully charged unit before any hot work can begin in the area

B. The brazing can proceed if the plumber has a bucket of water available as an alternative fire suppression method

C. The discharged extinguisher can be pressurized in the field using a standard compressed air source for temporary use

D. The brazing operation can proceed because the hot work permit covers fire risk regardless of extinguisher status

12. A plumber calculates the circumference of a 6inch pipe to determine the length of heat shrink wrap needed. Using $C = \pi \times d$, what is the circumference?

A. 37.70 inches, calculated by multiplying π (3.14159) by 12 inches (using the full 12inch dimension instead of 6)

B. 9.42 inches, calculated by multiplying π by the radius (3 inches) instead of the diameter of the pipe section

C. 18.85 inches, calculated by multiplying π (3.14159) by the 6inch diameter of the pipe for the circumference

D. 28.27 inches, calculated using $\pi \times r^2$ (the area formula) instead of the circumference formula for the pipe wrap

13. A plumber is installing pipe in a building where structural concrete columns are spaced at 6metre intervals. The pipe must be supported at maximum 1.8metre intervals (the code maximum for the pipe size). How many intermediate supports are needed between two adjacent columns?

A. One intermediate support at the 3metre midpoint between the two columns located 6 metres apart

B. Two intermediate supports, dividing the 6metre span into three sections of approximately 2 metres each

C. Three intermediate supports, dividing the 6metre span into four sections of exactly 1.5 metres each

D. Four intermediate supports, dividing the 6metre span into five sections of exactly 1.2 metres each

14. A plumber is assigned to install a commercial water heater in a mechanical room that has a concrete floor, CMU block walls, and an openweb steel joist ceiling. The plumber must install a pipe penetration through the CMU wall for the vent connector. What tool is used to create a round hole through the CMU block?

A. A rotary hammer drill with a standard masonry twist bit at the desired hole diameter for the vent sleeve

B. An angle grinder with a masonry cutting wheel to score the block and then chisel the opening to shape

C. A hydraulic punch press that stamps the hole through the block using a hardened steel die of the correct size

D. A core drill with a diamondtipped core bit that bores a clean, round hole through the CMU block wall

15. A plumber is reviewing the safety data sheet for a threadcutting oil used in the power threading machine. Section 11 lists the longterm health effects. The product contains mineral oil mist. What chronic health effect is associated with prolonged exposure to mineral oil mist?

A. Respiratory irritation and potential development of lipoid pneumonia from chronic inhalation of mineral oil mist

B. Hearing loss from the ultrasonic vibration generated by the oil mist interacting with the rotating pipe surface

C. Skin cancer from ultraviolet radiation emitted by the oil mist when it contacts the heated pipe during threading

D. Bone density loss from the mineral content of the oil absorbing calcium through skin contact over extended periods

16. A plumber is working on a construction site where multiple trades are operating simultaneously. The plumber needs to use a scissor lift to install overhead pipe. Before operating the lift, what must the plumber have?

A. A valid driver's licence, because scissor lifts are classified as motor vehicles on construction jobsites

B. Written permission from the building owner authorizing the plumber to operate mobile equipment in the building

C. Training and certification for the specific type of scissor lift being used on the construction project site

D. A full medical examination confirming the plumber is physically capable of operating elevated work platforms

17. A plumber is installing a copper press fitting system and encounters a fitting that has a green Oring visible in the fitting socket. The manufacturer's standard fittings use black EPDM Orings. What does the green Oring indicate?

A. The fitting is a specialty hightemperature model rated for steam service above 150°C operating temperature

B. The green Oring identifies the fitting as a "Smart Connect" or leakdetection type that leaks intentionally during pressure testing if not pressed

C. The fitting is from a competitor manufacturer and is not compatible with the plumber's pressing tool jaws

D. The green Oring indicates an expired or recalled fitting that must not be installed under any circumstances

18. A plumber must install a water supply pipe through an exterior wall where the pipe will be exposed to freezing temperatures for the 150 mm section passing through the wall. What protection prevents the pipe from freezing at this penetration?

A. Insulate the pipe sleeve with closedcell foam insulation and seal both ends of the sleeve with fire caulk

B. Install a selfregulating heat trace cable on the pipe section within the wall sleeve with adequate insulation

C. Increase the pipe diameter by one size through the wall to reduce the freezing risk from the larger water volume

D. No protection is needed because the 150 mm section is too short for the water inside to freeze at normal flow rates

19. A plumber is joining PPR (polypropylene random copolymer) pipe using socket fusion. The fusion tool heats both the pipe exterior and the fitting interior simultaneously. After the specified heating time, the plumber removes both pieces from the tool and pushes them together. What must NOT be done during assembly?

A. The pipe and fitting must not be held together for the manufacturer's specified holding time after insertion

B. The pipe must not be pushed into the fitting beyond the insertion depth mark to prevent bore restriction

C. The assembled joint must not be exposed to any air movement or drafts during the initial cooling phase

D. The pipe must not be rotated or adjusted after insertion — any movement disrupts the molecular fusion bond

20. A plumber is installing a largediameter (8inch) PVC DWV pipe in a commercial building. The pipe sections are 6 metres long and weigh approximately 12 kg each. When solvent cementing these large joints, what technique ensures a proper bond?

A. Apply cement to the pipe only — the fitting socket does not require cement on largediameter PVC DWV joints

B. Use a mechanical jack or comealong to pull the pipe fully into the fitting after applying cement to both surfaces

C. Apply cement to both surfaces, assemble, and give the pipe a quarterturn twist to distribute the cement evenly

D. Allow the cement to dry for 30 seconds on both surfaces before assembly to achieve a thicker bond layer

21. A plumber encounters a section of existing copper pipe that has been repaired with a rubber sleeve and hose clamps (a "hose clamp repair"). This repair was made 5 years ago. Is this repair acceptable as a permanent installation?

A. Yes — rubber sleeve repairs are codeapproved for permanent installations on copper pipe in all applications

B. No — this is a temporary emergency repair only; it must be replaced with a proper soldered or mechanical coupling

C. Yes — but only if the rubber sleeve is rated for the system's operating pressure and temperature conditions

D. No — but the repair can remain if the plumber installs a secondary backup clamp over the existing rubber sleeve

22. A plumber must install an isolation valve on a 2inch copper hot water supply line in a commercial building. The valve will be operated frequently (weekly) for system maintenance. Which valve type provides the best combination of fullbore flow and ease of operation for frequent use?

A. A fullport ball valve with a quarterturn lever handle that opens and closes quickly with minimal effort required

B. A gate valve with a multiturn handwheel that provides precise flow control and a tight shutoff when fully closed

C. A globe valve with a multiturn handwheel that provides excellent throttling capability for flow regulation tasks

D. A butterfly valve with a quarterturn lever that provides moderate flow control in the fully open position

23. A plumber is installing PEXA tubing using the coldexpansion method. After expanding the tube end with the expansion tool, the plumber inserts the fitting. The expanded tube begins to shrink back toward its original diameter. The plumber notices that the tube has not fully recovered to grip the fitting tightly after 30 seconds. What could cause slow recovery?

A. The PEXA tubing is defective and the crosslinking has failed, preventing the thermal memory from functioning

B. The fitting diameter is oversized for the PEX tube and the tube cannot shrink enough to grip the fitting tightly

C. The expansion tool created too large an expansion, exceeding the tube's ability to recover within the normal timeframe

D. The ambient temperature is cold (below 5°C), which slows the PEXA's thermal memory recovery rate significantly

24. A plumber is threading a 2inch steel pipe and the die head chatters during the cutting operation, producing rough, inconsistent threads. What is the most likely cause?

A. The pipe is not properly secured in the machine's chuck and is vibrating during the threading operation

B. The threading oil is the wrong viscosity for the pipe diameter and is not providing adequate lubrication

C. The die head is the wrong size — a 11/2inch die is being used on 2inch pipe due to mislabeling

D. The pipe wall is too thin (Schedule 10 instead of Schedule 40) for standard NPT threading operations

25. A plumber is installing a ProPress fitting on a copper tube and must verify that the fitting has been pressed. After pressing, the plumber examines the fitting. What visual indicator confirms a successful press?

A. The fitting changes colour from copper to silver after being pressed, indicating the Oring has been compressed

B. The pressed fitting displays a visible depression (press mark) around its circumference from the pressing jaws

C. A small tab on the fitting body breaks off during pressing, providing a tactile and visual confirmation of completion

D. The fitting becomes warm to the touch after pressing due to the friction energy generated by the jaw compression

26. A plumber is installing a DWV system in a multistorey residential building. The 4inch soil stack serves bathrooms on four floors. The total connected load is 48 DFU. The code permits up to 90 DFU on a 4inch stack. During the final walkthrough, the plumber flushes all four toilets within 10 seconds of each other. What phenomenon might occur in the stack during this simultaneous discharge?

A. The stack will overflow at the base because four simultaneous flushes exceed the building drain's instantaneous capacity

B. The simultaneous flushes will cause the stack to pressurize, pushing water out of traps on the lower floors

C. The stack venting system will handle the simultaneous discharge without any noticeable effect on any fixture

D. Nothing unusual — a properly sized and vented 4inch stack handles four simultaneous water closet flushes within its capacity

27. A plumber discovers that an existing building has a 2inch vent pipe that serves as the sole vent for a 4inch soil stack with 80 DFU. The vent's developed length from the drain to the roof terminal is 20 metres. The code sizing table shows that a 2inch vent at 20 metres accommodates 20 DFU. Is this vent adequate?

A. No — the 2inch vent at 20 metres accommodates only 20 DFU, which is far below the 80 DFU load on the stack

B. Yes — the 2inch vent exceeds the halfdiameter minimum (half of 4 inches = 2 inches) and is always adequate

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

D. Yes — because vent sizing tables are advisory guidelines, not mandatory code requirements for existing buildings

28. A plumber is installing a floor drain in a restaurant's walkin cooler (operating at 2°C). The floor drain must prevent sewer gas from entering the cooler. Unlike a freezer, the temperature is above freezing. However, the drain receives very little water — only condensate from the cooling unit drips into it. What is the concern?

A. The 2°C temperature will cause the trap seal to freeze within hours, requiring a heated trap for this application

B. The lowvolume condensate may not maintain the trap seal over time, and a trap seal primer should be installed

C. The walkin cooler's positive air pressure prevents sewer gas from entering regardless of the trap seal condition

D. The cold temperature causes the trap water to evaporate faster than normal, requiring a deeper trap for protection

29. A plumber is sizing a horizontal branch drain for a commercial washroom with 2 water closets (3 DFU each), 2 urinals (2 DFU each), and 2 lavatories (1 DFU each). The total is 12 DFU. What minimum pipe size is required?

A. 21/2 inches, which accommodates the 12 DFU load per the code sizing table for horizontal branch drains

B. 3 inches minimum, because the branch carries water closet discharge (soil waste) and must be at least 3 inches

C. 4 inches, because any branch serving more than one water closet requires a minimum 4inch pipe diameter

D. 2 inches, because the 12 DFU load is within the maximum capacity of a 2inch branch at code minimum slope

30. A plumber encounters an older residential building where the cast iron building drain has a belly (sag) that holds approximately 300 mm of standing water. The homeowner reports recurring drain odour and slow drainage. Video inspection confirms the belly but shows no root intrusion or joint failure. What is the recommended repair?

A. Pour enzymatic drain cleaner into the system monthly to dissolve the organic matter accumulating in the belly

B. Install a largercapacity exhaust fan in the basement to remove the sewer gas odour without repairing the drain

C. Excavate the bellied section, reestablish correct slope with proper bedding, and replace the sagging pipe section

D. Install a sump pump at the belly's low point to continuously pump out the standing water and prevent accumulation

31. A plumber is installing a 3inch vent stack that must pass through a 2hour firerated floor assembly. The pipe material is ABS. What firestop device is required at this penetration?

A. An intumescent firestop collar that expands in fire to crush and seal the ABS pipe as it melts and burns away

B. Standard fire caulk applied in the annular space between the ABS pipe and the sleeve through the floor assembly

C. A metal thimble (steel sleeve) with mineral wool packing that prevents flame passage through the annular space

D. No firestop is required for vent piping because vents carry only air and do not contribute fuel to a fire event

32. A plumber discovers that an existing building's grease interceptor has a flow control device (restrictor) installed on the inlet piping. This device limits the flow rate of wastewater entering the interceptor. What is the purpose of this flow restrictor?

A. It reduces the water velocity entering the interceptor to below 0.3 m/s for proper grease separation by gravity

B. It prevents kitchen fixtures from draining too quickly, which would overwhelm the interceptor's separation capacity

C. It creates backpressure that forces grease to solidify in the drain piping before reaching the interceptor inlet

D. It slows the incoming flow to match the interceptor's rated capacity, providing adequate retention time for grease separation

33. A plumber installs a horizontal building drain beneath a basement floor slab. The drain transitions from 3inch to 4inch at a point where additional fixtures are connected. This increase is made using a 3×4 increaser fitting. In which direction does the larger end of the increaser face?

A. Upstream (toward the fixtures), because the larger pipe must receive the smaller pipe entering from the upstream direction

B. Downstream (toward the building sewer), because drainage pipe may increase but never decrease in the direction of flow

C. The direction depends on whether the fitting is a concentric or eccentric increaser — each orientation is different

D. Either direction is acceptable because increaser fittings are symmetrical and function identically in both orientations

34. A plumber is troubleshooting a residential DWV system where the homeowner reports a gurgling sound from the kitchen sink drain whenever the upstairs bathtub is drained. No water level change is visible in the kitchen sink. What does the gurgling indicate without visible trap seal loss?

A. Induced siphonage is pulling air through the kitchen sink trap seal, creating the gurgling sound as air passes through the water

B. The bathtub's discharge is too large for the shared stack and is creating turbulence that resonates at the kitchen sink

C. The kitchen sink's Ptrap is oversized, creating a reservoir that absorbs the pressure change without losing water level

D. The building sewer has a partial blockage that creates backpressure during the bathtub's largevolume discharge event

35. A plumber installs a septic system with an effluent filter in the outlet tee of the septic tank. The filter screens effluent before it reaches the disposal field. The homeowner asks how often the filter must be cleaned. What is the typical maintenance interval?

A. The effluent filter is maintenancefree for the life of the septic system and never requires cleaning or replacement

B. The filter should be cleaned every 5 to 10 years, coinciding with the septic tank pumpout schedule at maximum intervals

C. The filter should be cleaned annually or whenever drainage performance decreases, to prevent clogging and backup

D. The filter must be replaced every 6 months because it cannot be cleaned and reused after it accumulates solids

36. A plumber is installing underground DWV piping in a trench that has been excavated through sand and gravel soil. The trench walls appear stable without shoring. Despite the apparent stability, the plumber is concerned about the soil classification. What property of sand and gravel makes it particularly dangerous?

A. Sand and gravel soil contains toxic minerals that leach into the trench water and pose a chemical exposure hazard

B. Sand and gravel soil conducts electricity more readily than clay, increasing the electrocution risk from buried utilities

C. Sand and gravel soil emits methane gas that accumulates at the trench bottom and displaces breathable oxygen

D. Sand and gravel can collapse suddenly without warning signs — unlike clay, which often cracks and bulges before failure

37. A plumber discovers during a renovation that a building's 3inch soil stack has a fitting installed at a secondfloor bathroom connection that appears to be a standard pressuretype tee rather than a sanitary tee. The fitting has no directional sweep on the branch. What code issue does this create?

A. Pressuretype tees are acceptable for DWV connections because the branch angle is 90 degrees in both types

B. The pressure tee's sharp internal transition creates a pocket where waste accumulates, causing recurring blockages

C. Pressuretype tees are prohibited only on horizontal connections — vertical connections can use either type freely

D. The pressure tee reduces the stack's DFU capacity by 50% because it restricts airflow through the branch connection

38. A plumber is installing a building sewer for a new restaurant. The sewer must accommodate both the sanitary drainage (from fixtures) and the grease interceptor discharge. The grease interceptor's outlet connects to the building sewer downstream of the building drain exit. What pipe size must the building sewer be to handle both flows?

A. The building sewer must be sized based on the total combined DFU from all building fixtures including the interceptor's connected fixtures

B. The building sewer must be double the building drain diameter to accommodate the additional interceptor discharge volume

C. The grease interceptor's discharge requires a separate dedicated sewer line to the municipal connection at the street

D. The building sewer size equals the building drain size because the interceptor does not add DFU to the downstream system

39. A plumber installs a DWV system using ABS pipe. After cementing the joints, the plumber notices that several joints have excess cement visible on the exterior of the fitting and pipe. Is this excess cement a concern?

A. Yes — excess cement on the exterior indicates that too much cement was applied, which weakens the joint from oversoftening

B. No — excess cement on the exterior is normal and indicates adequate cement coverage on the joint's interior surfaces

C. Yes — the excess cement must be cleaned immediately before it hardens because it will prevent future leak detection

D. No — but only if the excess cement is wiped away within 30 seconds before it creates a permanent cosmetic defect

40. A plumber is investigating a commercial building where the groundfloor restroom has recurring sewer gas odour despite all traps having water seals. The restroom has a mop sink with an indirect waste connection (air gap to a floor drain). The plumber notices that the mop sink's drain hose is submerged in the floor drain receptor — below the flood rim of the receptor. What is the problem?

A. The submerged drain hose is acceptable because the floor drain's trap seal prevents gas from escaping upward

B. The submerged hose blocks the floor drain's inlet and prevents other water from entering the drain receptor

C. The mop sink's drain hose being submerged in the receptor creates a potential crossconnection hazard only

D. The submerged hose eliminates the air gap, creating a direct connection that allows sewer gas to travel up through the hose

41. A plumber discovers that an existing building has a running trap (house trap) on the building drain. The trap has two cleanout access plugs — one on the upstream side and one on the downstream side. The building has had recurring drainage problems. Should the running trap be removed?

A. No — the running trap provides essential double trap seal protection that the individual fixture traps cannot match alone

B. Yes — running traps restrict flow, accumulate debris, and the doubletrap condition causes venting difficulties throughout the system

C. No — running traps are required by the current National Plumbing Code and removing one would be a code violation

D. Yes — but only if the building's DWV system is completely revented after the running trap is removed from the drain

42. A plumber is sizing a storm drainage leader (vertical pipe from a roof drain). The roof area served by this leader is 150 m^2. The local design rainfall intensity is 100 mm/hr. Using the code sizing table, the plumber determines that a 3inch leader accommodates 160 m^2 at 100 mm/hr. Is a 3inch leader adequate?

A. Yes — the 3inch leader's 160 m^2 capacity at 100 mm/hr exceeds the 150 m^2 catchment area served by this leader

B. No — the leader must be sized at twice the calculated area for safety margin, requiring a 4inch leader minimum

C. Yes — but only if the leader pipe is vertical with no horizontal offsets that would reduce its effective capacity

D. No — storm leaders must always be a minimum of 4 inches regardless of the roof area and rainfall intensity

43. A plumber installs a septic system disposal field and must verify the required separation distances. The code specifies minimum distances from the disposal field to the well, the building, the property line, and any surface water. Which of these separation distances is typically the greatest?

A. The distance from the disposal field to the building foundation, which must prevent moisture damage to the structure

B. The distance from the disposal field to the property line, which must prevent effluent from reaching adjacent land

C. The distance from the disposal field to the drinking water well, which must prevent groundwater contamination

D. The distance from the disposal field to surface water (creek, pond), which must prevent direct contamination of waterways

44. A plumber is troubleshooting a commercial building where one specific toilet frequently blocks and requires plunging, while identical toilets on the same branch drain normally. The drain has been snaked with no blockage found. The vent is clear. What should the plumber investigate?

A. The toilet seat height, which may be causing users to position themselves differently and use more toilet paper

B. The toilet itself — internal flush passages, rim holes, or the jet hole may be partially blocked by mineral deposits

C. The water supply pressure to this specific toilet, which may be too high and causing a turbulent flush pattern

D. The building's municipal sewer connection, which may create backpressure that affects only this one toilet fixture

45. A plumber installs a 4inch PVC building sewer at a slope of 1/8 inch per foot. The sewer run is 25 metres (approximately 82 feet). What is the total fall from the building drain exit to the connection at the municipal main?

A. 20.5 inches (520 mm), calculated at 1/4 inch per foot over 82 feet for the steeper minimum slope requirement

B. 5.1 inches (130 mm), calculated at 1/16 inch per foot which is the minimum for all building sewer installations

C. 41 inches (1,041 mm), calculated at 1/2 inch per foot which is the maximum recommended sewer slope

D. Approximately 10.25 inches (260 mm), calculated at 1/8 inch per foot × 82 feet for the 4inch sewer pipe

46. A plumber installs a DWV system in a building where the architect specifies that all exposed drainage piping in the tenant space must be chromeplated brass rather than ABS or PVC. The chromeplated brass pipe is significantly more expensive. Why might the architect specify this material?

A. Aesthetic appearance — chromeplated brass provides a decorative exposed pipe finish that matches the interior design

B. Chromeplated brass provides superior fire resistance compared to plastic DWV pipe in commercial tenant spaces

C. Chromeplated brass is quieter than plastic pipe, providing acoustic benefits in exposed ceiling installations

D. The building code requires chromeplated brass for all exposed DWV piping in commercial occupied spaces

47. A plumber encounters a building where the 4inch building drain changes direction by 135 degrees at a corner. What fitting or combination of fittings is appropriate for this severe direction change?

A. A standard longsweep 90degree elbow combined with a 45degree elbow for the total 135degree change

B. A single shortpattern 135degree fitting (threequarter bend) installed at the corner for the full direction change

C. Two 45degree elbows and one longsweep 90degree elbow installed in sequence for the combined 135degree turn

D. A 135degree direction change is prohibited by code — the pipe must be rerouted to avoid angles greater than 90 degrees

48. A plumber tests a newly installed DWV system with the water test method. The system is filled to the top of the highest vent stack. After the required holding period, the plumber drains the test water. Where does the test water go?

A. The test water is directed to a storm drain or sewer connection because it has not contacted any waste during testing

B. The test water drains into the building's sanitary drainage system through the test plugs as they are removed sequentially

C. The test water must be collected in a holding tank and disposed of as construction waste water per environmental regulations

D. The test water is pumped back into the water supply system for reuse in subsequent testing of other building sections

49. A plumber is installing a DWV system in a building where the horizontal building drain must travel 20 metres beneath a slab before exiting the building. The plumber installs cleanouts at 15metre maximum intervals as required by code. Given the 20metre run, what is the minimum number of cleanouts needed on this section?

A. Two cleanouts — one at or near the beginning of the run and one at or near the end, with the 20metre distance within the combined access range

B. Three cleanouts — at the beginning, middle, and end of the 20metre run for complete maintenance access

C. One cleanout — at the building sewer exit point, which provides adequate access for the entire 20metre run

D. Four cleanouts — at 5metre intervals to provide maximum maintenance access for the underslab building drain

50. A plumber discovers that a building's existing DWV system has a 2inch waste pipe serving a kitchen sink (2 DFU) and a dishwasher (2 DFU). The total load is 4 DFU. The 2inch pipe at code minimum slope accommodates 6 DFU. The homeowner wants to add a second kitchen sink (2 DFU) to the same branch, bringing the total to 6 DFU. Is this addition permitted?

A. No — kitchen sinks require a minimum 3inch branch when more than one sink connects to the same horizontal drain

B. No — the addition would require a grease interceptor that changes the pipe sizing requirements for the branch

C. Yes — but only if the second sink connects upstream of the existing sink on the branch to maintain proper flow order

D. Yes — 6 DFU matches the 2inch pipe's maximum capacity, and no soil pipe minimum applies (no water closet connected)

51. A plumber is installing a sewage ejector system in a commercial building basement. The ejector serves a complete washroom with 2 water closets, 2 lavatories, and 1 floor drain. The force main runs 5 metres vertically and 10 metres horizontally to connect to the gravity building drain above. What determines the pump size for this system?

A. The total DFU of the connected fixtures, converted to a flow rate using the demand curve for peak simultaneous use

B. The total head (vertical lift plus friction losses in the force main) and the peak flow rate from all connected fixtures

C. The volume of the ejector pit divided by the desired pump cycle time for the minimum pump capacity calculation

D. The diameter of the force main pipe only — the pipe size directly determines the required pump output capacity

52. A plumber encounters a scenario where a 3inch horizontal branch drain must pass through a structural steel beam's web. The structural engineer has specified a maximum 100 mm (4inch) round hole in the beam web. The 3inch pipe has an outside diameter of approximately 89 mm (31/2 inches). The pipe fits through the 100 mm hole with approximately 5.5 mm clearance on each side. What must be installed in the annular space?

A. Fire caulk rated for the fire rating of the adjacent floor assembly to maintain fire compartmentalization at the beam

B. Expanding foam insulation to prevent air leakage and provide thermal insulation around the pipe at the beam penetration

C. A rubber grommet or neoprene sleeve to prevent the pipe from contacting the steel beam directly during thermal movement

D. Nothing — the 5.5 mm clearance provides adequate space for thermal expansion without any contact between pipe and beam

53. A plumber discovers that an existing residential building has a 11/2inch trap on a water closet drain — someone installed a Ptrap on the pipe beneath the toilet in addition to the toilet's integral trap. This creates what code violation?

A. A doubletrapped condition — the fixture has two traps in series, which is prohibited because it restricts flow and traps air

B. The 11/2inch trap is undersized for a water closet — the minimum trap size for a WC is 3 inches regardless of configuration

C. The external trap must be a drum trap, not a Ptrap, when installed as a secondary trap on a water closet drain pipe

D. No violation exists because water closets benefit from double trapping that provides enhanced protection against sewer gas

54. A plumber installs a building drain and must connect it to an existing building sewer at the foundation wall. The building drain is 4inch PVC and the existing building sewer is 4inch vitrified clay. What coupling connects these two dissimilar materials?

A. A solventcemented PVC coupling that bonds to both PVC and clay through the chemical softening process

B. A nohub coupling designed for cast iron pipe that cannot accommodate the different diameters of PVC and clay

C. A flexible transition coupling (ferncotype) with stainless steel band clamps that accommodates both pipe materials

D. A threaded adapter that screws onto the clay pipe end and provides a PVC socket for the building drain connection

55. A plumber installs a 4inch soil stack in a building. The stack must include a test tee above the highest branch connection and below the vent terminal. What is the purpose of this test tee?

A. It provides a connection point for a pressure gauge during the DWV air or water test to monitor test pressure

B. It provides an access point for filling the system with water during the DWV water test from the top of the stack

C. It allows a video camera to be inserted into the stack for postconstruction inspection of the interior joints

D. It serves as a permanent access point for future drain cleaning operations through the top of the soil stack

56. A plumber is troubleshooting a residential building where the homeowner reports that the toilet on the second floor "gurgles" and the water level in the bowl drops slightly whenever the bathtub on the same floor is drained. Both fixtures connect to the same 3inch horizontal branch before the soil stack. What is the most likely venting deficiency?

A. The bathtub's vent is blocked or disconnected, causing the bathtub's discharge to create negative pressure on the shared branch

B. The toilet does not have its own individual vent and is relying on the bathtub's vent, which is too far from the WC trap

C. The soil stack is undersized — a 3inch stack cannot handle both a bathtub and water closet on the same branch

D. The bathtub's discharge exceeds the branch drain's capacity, causing a hydraulic bore that affects the toilet's trap seal

57. A plumber installs a water supply for a new building. The water service enters the building and connects to the water meter, PRV, and backflow preventer in sequence. The plumber notices that the backflow preventer has a test cock that is dripping. What does a dripping test cock indicate?

A. The test cock's cap or packing is loose — tightening the cap or replacing the packing seal stops the drip

B. The backflow preventer's internal check valve has failed and the drip is system water leaking through the device

C. The test cock is functioning correctly — a slight drip is normal and indicates the backflow preventer is operational

D. The municipal supply pressure exceeds the backflow preventer's maximum rating, forcing water through the test cock

58. A plumber is troubleshooting a residential water system where the cold water pressure is excellent but the hot water pressure is significantly lower at all fixtures throughout the building. The water heater is a gasfired tanktype model. What component is most likely restricting hot water flow?

A. The gas control valve on the water heater, which is partially closed and reducing the combustion heat output

B. The T&P relief valve, which is stuck partially open and diverting hot water pressure to the discharge pipe

C. A partially closed valve, mineralrestricted nipple, or kinked flex connector on the hot water outlet of the heater

D. The water heater's thermostat, which is set too low and producing lukewarm water that feels like low pressure

59. A plumber installs a water supply for a commercial building that will have a cooling tower. The cooling tower's chemical treatment includes biocides. The plumber installs an RP backflow preventer on the cooling tower supply. The RP's relief valve discharges to a floor drain through an air gap. Why is the air gap on the relief discharge critical?

A. The air gap allows the RP relief valve to discharge faster during a backflow event for improved response time

B. The air gap prevents contaminated drain water from backsiphoning through the relief port into the RP device

C. The air gap prevents the chemical odour from the cooling tower water from entering the building through the drain

D. The air gap provides a visual indicator to maintenance staff that the RP device is discharging during operation

60. A plumber discovers that a building's copper water supply piping has developed widespread pinhole leaks — over 15 locations throughout the building in the 8 years since installation. The water supply is from a municipal source. Water testing shows a pH of 6.2 and high dissolved oxygen. What is causing the widespread corrosion?

A. The copper pipe was manufactured from a substandard alloy that does not meet ASTM B88 specifications

B. Galvanic corrosion from dissimilar metal contacts at each of the 15 leak locations in the piping system

C. Erosion corrosion from excessive water velocity that has worn through the pipe wall at bends and tees

D. Aggressive water chemistry — the low pH (acidic) and high dissolved oxygen are causing pitting corrosion throughout the system

61. A plumber installs a residential water heater and connects the T&P relief valve discharge pipe. The discharge pipe runs to the exterior wall and terminates 150 mm above grade, pointing downward. The local climate regularly reaches 25°C in winter. What risk does this exterior termination create?

A. The T&P discharge water will freeze at the termination point, creating an ice dam that blocks future relief valve discharge

B. Wildlife may nest in the open discharge pipe termination during summer months, creating a blockage hazard

C. The exterior termination exposes the discharge pipe to UV radiation that degrades the CPVC pipe material over time

D. The cold exterior temperature will cause the relief valve to malfunction by cooling the valve's thermal element below its rated range

62. A plumber is installing a commercial water supply system with a PRV on the main service and a separate PRV on the branch serving a sensitive piece of laboratory equipment that requires 200 kPa (29 psi) maximum inlet pressure. The main PRV is set to 415 kPa (60 psi). After installing the branch PRV at 200 kPa, the plumber realizes this creates a closed system on the branch. What additional component is needed?

A. A pressure relief valve on the branch set at 250 kPa to protect the laboratory equipment from overpressure

B. A check valve on the branch to prevent backflow from the laboratory equipment into the building supply system

C. An expansion tank on the branch if the equipment heats water or creates thermal expansion within the closed branch

D. A flow restrictor on the branch to limit the maximum flow rate and prevent the pressure from exceeding 200 kPa

63. A plumber discovers that a building's hot water recirculation system has no balancing valve on the return line. The recirculation pump runs continuously. The homeowner reports that hot water arrives quickly at fixtures near the water heater but takes much longer at distant fixtures. What is the cause?

A. The recirculation pump is undersized and cannot move water through the entire loop at an adequate flow rate

B. The hot water distribution piping is undersized at the distant fixtures, restricting flow in the recirculation loop

C. The return line connects to the system at a point too close to the heater, shortcircuiting the recirculation path

D. Without a balancing valve, the recirculated water follows the path of least resistance, favoring the shortest loop

64. A plumber installs a tankless water heater for wholehouse use. The homeowner has a private well with a variablefrequency drive (VFD) pump. The incoming water pressure fluctuates between 275 and 415 kPa depending on the VFD's operating speed. The tankless heater's flow sensor requires a minimum pressure of 140 kPa to activate. Is the fluctuating pressure a problem?

A. Yes — the pressure fluctuation causes the tankless heater to cycle on and off erratically during use, varying the temperature

B. Yes — the fluctuating pressure will damage the tankless heater's internal components over time from the constant cycling

C. No — the minimum pressure (275 kPa) exceeds the heater's 140 kPa activation threshold throughout the VFD's operating range

D. No — all tankless heaters include an internal pressure regulator that compensates for inlet pressure fluctuations automatically

65. A plumber is sizing a water supply branch to serve a residential bathroom group (water closet, lavatory, bathtub/shower). The total WSFU is 8. Using the demand curve and the friction loss chart for copper tube, the plumber determines that 3/4inch copper tube at the design flow rate produces a velocity of 2.2 m/s. Is this velocity acceptable?

A. Yes — 2.2 m/s is below the recommended maximum velocity of 2.4 m/s for copper supply piping in residential buildings

B. No — the maximum velocity for residential copper supply piping is 1.5 m/s to prevent noise and erosion corrosion

C. Yes — but only for cold water piping; hot water piping must be limited to 1.5 m/s to prevent thermal stress on joints

D. No — any velocity above 2.0 m/s requires Schedule 80 copper pipe instead of standard Schedule 40 tube throughout

66. A plumber is troubleshooting a commercial building's water supply system. The building has a booster pump serving the upper floors. The pump runs continuously even when no water is being used on the upper floors. What is the most likely cause?

A. The booster pump's pressure switch is defective and is not sensing the system pressure correctly to cycle the pump

B. The booster pump's control is set to continuous operation rather than demandactivated operation for this application

C. The pressure tank on the booster system has lost its air charge and the pump shortcycles, appearing to run continuously

D. A leak in the upperfloor piping causes continuous demand on the booster pump, preventing it from reaching cutout pressure

67. A plumber installs a residential water supply using PEX tubing with a trunkandbranch layout. The main trunk is 1inch PEX. The branch to the kitchen serves a kitchen faucet (1.5 WSFU) and a dishwasher (1.5 WSFU). What minimum branch size serves these two fixtures?

A. 3/8 inch, which is the minimum connection size for individual lowflow residential fixtures in PEX supply systems

B. 1/2 inch, which provides adequate flow for a combined 3 WSFU demand from the kitchen faucet and dishwasher

C. 3/4 inch, which is the minimum branch size for any kitchen fixture group regardless of the WSFU calculation result

D. 1 inch, matching the trunk size because kitchen branches must never be smaller than the main supply trunk pipe

68. A plumber discovers that a water heater's expansion tank bladder has failed — the Schrader valve releases water when depressed (indicating the bladder has ruptured and the air side is flooded). The homeowner reports no symptoms — the T&P valve has never discharged. Why might the system show no symptoms despite the failed tank?

A. The system may have a small leak elsewhere that relieves the thermal expansion pressure before it reaches the T&P threshold

B. The water heater's thermostat is set too low to generate significant thermal expansion in the cooler stored water

C. The PRV on the service is not creating a truly closed system — it may be allowing some backrelief to the main

D. The expansion tank failure has no effect on system pressure because the tank is a supplementary device with no function

69. A plumber installs a residential water service from the curb stop to the building entry. The total distance is 20 metres. The pipe is Type K soft copper installed in a continuous run from the coil with no underground joints. The pipe enters the building through a sleeve in the foundation wall. What must be applied inside the sleeve?

A. Concrete mortar packed around the pipe to create a permanent, rigid, watertight seal at the foundation penetration

B. Expanding spray foam to insulate the pipe and fill the annular space for a weathertight seal at the wall entry

C. A flexible sealant that allows the pipe to move within the sleeve during thermal expansion and ground settlement

D. A rubber link seal (boot seal) compressed between the pipe and sleeve with bolts for a watertight, flexible connection

70. A plumber tests a reduced pressure (RP) backflow preventer. The test reveals that both check valves hold and the relief valve opens correctly. However, the relief valve does not close completely after the test — it continues to drip at approximately 1 drop per second. What is the required action?

A. The RP passes the test — a 1droppersecond drip from the relief valve after testing is within acceptable limits

B. The RP device's relief valve seat has debris — it must be flushed or repaired to achieve a complete shutoff after testing

C. The dripping relief valve indicates both check valves will fail soon and the entire RP device must be replaced immediately

D. The dripping is caused by the test procedure itself and will stop within 24 hours as the valve reseats under system pressure

71. A plumber installs a hot water recirculation system with a dedicated return line. The return line connects to the cold water inlet of the water heater. A check valve is installed on the return line. The plumber does not install a balancing valve. What problem may result?

A. The recirculation flow will be too fast, causing excessive heat loss from the piping and wasting energy continuously

B. The system will function normally because the check valve provides all necessary flow control for the recirculation loop

C. The recirculated water will follow the path of least resistance, potentially shortcircuiting and leaving distant fixtures unserved

D. The water heater will overheat because the recirculation pump adds heat to the system faster than the thermostat can control

72. A plumber discovers that a building's water supply system has copper piping throughout except for one section of galvanized steel pipe that was left from a previous renovation. The galvanized section connects directly to the copper piping at both ends without dielectric unions. What will happen over time?

A. The galvanized steel will corrode at an accelerated rate at the coppertosteel connection points due to galvanic corrosion

B. The copper piping will corrode at an accelerated rate because copper is less noble than galvanized steel in water

C. Both materials will corrode equally because the water chemistry attacks copper and steel at the same rate over time

D. No corrosion will occur because the galvanized coating on the steel pipe provides dielectric isolation from the copper

73. A plumber installs a water heater in a residential basement. The basement floor drain is 3 metres from the water heater. The T&P discharge pipe must terminate in a visible location. Can the discharge pipe extend 3 metres horizontally to terminate above the floor drain?

A. No — the T&P discharge pipe must terminate within 150 mm of the floor directly beneath the water heater location

B. No — the maximum length for a T&P discharge pipe is 1 metre from the valve to the termination point total distance

C. Yes — but only if the pipe is increased by one size to compensate for the additional friction from the extended length

D. Yes — provided the pipe pitches continuously downward with no dips or traps and is not reduced below the valve outlet size

74. A plumber is installing a water supply for a commercial building with a fire sprinkler system. The fire sprinkler supply taps off the main water service before the PRV. The domestic supply passes through the PRV. Why does the sprinkler supply bypass the PRV?

A. Fire sprinkler systems require unreduced municipal pressure for adequate flow during a fire suppression event

B. The PRV cannot handle the combined flow of both domestic and fire sprinkler demand during a fire event

C. The sprinkler system requires the full unrestricted pressure and flow from the municipal main during fire events

D. Building codes prohibit any pressurereducing device on fire protection supply lines because it could restrict fire flow

75. A plumber tests a residential water supply system at 690 kPa (100 psi) for 2 hours. The test holds with no pressure drop. The plumber then installs fixtures and turns on the water. Within the first hour of use, a fitting behind the shower wall begins leaking. What likely caused this fitting to pass the static pressure test but fail during use?

A. The fitting was fingertight during the test and held static pressure but failed when water flow created dynamic forces

B. The static test pressure was below the dynamic pressure created by the water flow at the shower's flow rate

C. The soldered joint had a pinhole that sealed under static pressure but opened when flow vibration disturbed the seal

D. The fitting held static pressure but the thermal expansion from hot water use weakened the solder joint under dynamic conditions

76. A plumber installs a barrierfree (accessible) water closet in a public washroom. The water closet must meet accessibility requirements for seat height. What is the typical coderequired seat height range for an accessible water closet?

A. 430–480 mm (17–19 inches) from the finished floor to the top of the toilet seat, including the seat itself

B. 380–400 mm (15–16 inches), which is the standard height for all residential and commercial water closets

C. 500–550 mm (20–22 inches), which provides the maximum height for wheelchair transfer to the toilet seat

D. 300–350 mm (12–14 inches), which provides the lowest possible height for users with limited mobility conditions

77. A plumber is troubleshooting a residential water softener. The homeowner reports that the softener's brine tank is overflowing with water. The salt level appears normal. What component has most likely failed?

A. The resin bed has become saturated and can no longer exchange ions, causing the softener to produce excess brine

B. The softener's control valve or brine refill mechanism has failed, allowing excessive water to fill the brine tank

C. The drain line is kinked or blocked, preventing the softener from discharging brine during the regeneration cycle

D. The incoming water pressure is too high and is forcing water through the softener's resin bed into the brine tank

78. A plumber installs a gasfired tankless water heater. The manufacturer's installation manual specifies a minimum gas line size of 3/4 inch for the unit's 199,000 BTU input. The existing gas line from the meter is 3/4 inch but runs 15 metres. The plumber calculates the pressure drop across this 15metre run at the heater's BTU demand. The pressure drop exceeds the allowable 0.5 kPa maximum. What must be done?

A. Increase the gas line pressure at the meter regulator to compensate for the excessive pressure drop over the run

B. Upsize the gas supply line from 3/4 inch to 1 inch to reduce the pressure drop to within the allowable maximum

C. Install a gas pressure booster between the meter and the heater to maintain adequate pressure at the heater inlet

D. Reduce the heater's BTU input setting to match the capacity of the existing 3/4inch gas line over the 15metre run

79. A plumber is installing a commercial prerinse spray valve in a restaurant. The spray valve connects to the hot and cold water supply through a mixing valve. The prerinse spray must comply with the maximum 1.28 GPM flow rate standard. What is the primary benefit of the lowflow restriction?

A. It prevents scalding by limiting the volume of hot water delivered through the highpressure spray nozzle tip

B. It reduces the noise level of the spray operation in the commercial kitchen environment during busy periods

C. It reduces the prerinse station's drain flow rate to prevent overloading the grease interceptor during heavy use

D. It conserves water — commercial kitchens use prerinse sprays for extended periods, making water savings significant

80. A plumber discovers that a residential water heater's dip tube has broken — a section of the plastic tube has separated and fallen to the bottom of the tank. The homeowner complains of lukewarm water and small white plastic particles appearing at fixture aerators. What is the connection between these two symptoms?

A. The broken dip tube allows cold inlet water to mix at the top of the tank near the hot outlet, reducing delivery temperature — and the broken plastic pieces flow to fixtures

B. The broken dip tube causes the water heater to overheat, which melts the remaining dip tube material into particles

C. The white plastic particles are from the water heater's glass lining that has cracked due to the missing dip tube

D. The broken dip tube has no effect on water temperature — the lukewarm water is caused by a separate thermostat failure

81. A plumber is installing a commercial dishwasher that requires a 180°F (82°C) final rinse for sanitization. The building's hot water supply is set to 140°F (60°C). The dishwasher has a builtin electric booster heater. What does the booster heater do?

A. It replaces the building's water heater entirely and provides all hot water for the dishwasher from its own element

B. It preheats the incoming cold water to the building's hot water temperature before the dishwasher's wash cycle begins

C. It raises the incoming 60°C hot water to the required 82°C for the final sanitizing rinse cycle inside the dishwasher

D. It maintains the building's hot water supply temperature at the dishwasher connection during extended wash cycles

82. A plumber installs a wholehouse UV disinfection system on a residential well water supply. The UV system has an alarm that activates when the UV lamp output drops below the minimum effective intensity. The alarm sounds 11 months after installation. What should the plumber do?

A. Ignore the alarm for 30 days because UV lamps are rated for 12 months and the alarm is premature by definition

B. Replace the UV lamp immediately because the alarm indicates the lamp can no longer deliver adequate disinfection intensity

C. Clean the quartz sleeve first — a dirty sleeve reduces the UV intensity reading and may clear the alarm without lamp replacement

D. Reset the alarm and monitor the system for 48 hours to determine whether the alarm is intermittent or continuous

83. A plumber is troubleshooting a residential reverse osmosis system. The RO faucet delivers water at normal pressure initially but the flow decreases to a trickle within 30 seconds. The prefilters and membrane were replaced recently. What is the most likely cause?

A. The RO storage tank's air bladder has lost its precharge — the tank fills but cannot push water to the faucet under sustained demand

B. The postcarbon filter is clogged and restricting the flow of purified water from the storage tank to the RO faucet

C. The RO membrane is installed backward, producing water at a reduced rate that cannot sustain normal faucet flow

D. The incoming water pressure is too low to push water through the membrane at a rate that keeps the tank adequately filled

84. A plumber replaces a water closet and discovers that the closet flange is broken — a quarter of the flange ring is missing. The remaining threequarters of the flange are securely anchored to the floor. Can the toilet be installed on this damaged flange?

A. A flange repair ring or reinforcement plate can be installed over the broken flange to restore the full bolt pattern

B. The entire flange must be replaced because a quartermissing ring cannot support the toilet under any conditions

C. The toilet can be installed using only the two closet bolts on the intact portion of the flange for adequate support

D. The broken flange is acceptable if extra wax ring material is applied to compensate for the gap at the broken section

85. A plumber installs a water heater with a standard magnesium anode rod. The homeowner's municipal water supply has a pH of 8.5 and moderate hardness (12 grains per gallon). After 6 months, the homeowner reports a sulfur (rotten egg) smell in the hot water only. What is causing the odour?

A. The magnesium anode is reacting with the water chemistry to produce a harmless but smelly mineral compound

B. The water heater's T&P relief valve is leaking, allowing air and bacteria to enter the tank from the discharge pipe

C. The magnesium anode rod is reacting with sulfatereducing bacteria in the tank, producing hydrogen sulfide gas

D. The water heater thermostat is set too high, causing dissolved sulfur compounds in the water to vaporize at the faucet

86. A plumber is installing a residential fire sprinkler system under NFPA 13D. The system uses CPVC piping. The manufacturer prohibits certain contact materials near the CPVC pipe. Which common construction material must NOT contact CPVC sprinkler pipe?

A. Fiberglass batt insulation, which is chemically inert and is approved for direct contact with all plastic pipe types

B. Copper pipe, which creates a galvanic reaction with the CPVC material at the point of direct metaltoplastic contact

C. Drywall compound (joint compound), which is alkaline and does not affect CPVC pipe chemistry during contact

D. Certain adhesives, sealants, fire caulks, and aerosol products that contain chemicals that cause environmental stress cracking of CPVC

87. A plumber services a commercial water treatment system that includes an iron removal filter (greensand filter). The filter uses potassium permanganate for regeneration. During service, the plumber notices that the treated water has a pinkishpurple tint. What does this indicate?

A. The potassium permanganate regeneration was performed correctly and the pink tint is a normal postregeneration colour

B. Potassium permanganate is passing through the filter bed and entering the treated water supply — the filter is malfunctioning

C. The iron in the water supply has increased beyond the filter's capacity and the excess iron is causing the discolouration

D. The greensand filter media has expired and is releasing its own colour compounds into the treated water stream

88. A plumber installs a commercial sensor faucet in a public washroom. After installation, the faucet delivers water for only 2 seconds before shutting off, requiring the user to trigger the sensor repeatedly. What adjustment is needed?

A. The faucet's runtime setting must be increased to deliver water for a longer duration per sensor activation cycle

B. The sensor's detection range must be increased so it detects the user's hands from a greater distance for longer

C. The solenoid valve's spring tension must be reduced to allow it to remain open longer during each activation

D. The faucet's water supply pressure must be increased to provide adequate flow during the sensor's detection cycle

89. A plumber discovers that a residential water heater's expansion tank is mounted horizontally on a shelf above the water heater. The manufacturer's installation instructions show the tank mounted vertically with the water connection at the top. Is the horizontal mounting acceptable?

A. No — the horizontal position causes the diaphragm to sag and reduces the tank's effective expansion absorption capacity

B. Yes — most modern diaphragm expansion tanks can be mounted in any orientation without affecting their performance

C. No — but only because the shelf mounting does not provide adequate support for the tank's weight when full of water

D. Yes — horizontal mounting is preferred because it reduces the stress on the water connection fitting compared to vertical

90. A plumber installs a pointofentry water softener on a residential well water supply. The softener is installed after the pressure tank and before the water heater. The homeowner asks if the outdoor hose bibbs should receive softened water. What is the standard practice?

A. Yes — all fixtures in the building should receive softened water for consistent water quality throughout the home

B. No — hose bibbs are typically connected before the softener (on the hard water side) to avoid wasting softened water outdoors

C. Yes — but only during winter months when the softened water prevents hose bibb freeze damage from hard water scale

D. No — but only because softened water damages lawn grass and garden plants from the elevated sodium content

91. A plumber is troubleshooting a residential electric water heater. The homeowner reports that the hot water runs out much faster than it did when the heater was new. The heater is 7 years old, 190 litres (50 gallons). The plumber drains the tank and only 130 litres flows out before the tank is empty. What has happened?

A. The water heater's thermostat has drifted and is shutting off the elements before the full tank volume is heated

B. The expansion tank connected to the water heater is absorbing 60 litres of the storage volume from the tank

C. The water heater's heating elements have degraded and can no longer heat the full 190litre tank volume to temperature

D. Approximately 60 litres of sediment has accumulated at the bottom of the tank, displacing usable water storage volume

92. A plumber installs a hydronic boiler and must select the correct expansion tank size. The system water volume is 500 litres. The coldfill temperature is 15°C and the operating temperature is 80°C. What factor determines the expansion tank's required size?

A. The total system water volume, the temperature range (cold to hot), the system's fill pressure, and the relief valve setting

B. The boiler's BTU input rating and the distribution piping diameter only, without considering the water volume

C. The number of zones in the system and the circulator pump's flow rate at maximum speed during fullload operation

D. The outdoor design temperature and the building's heat loss calculation that determines the boiler's firing rate

93. A plumber discovers that a hydronic system's circulator pump has been installed on the return pipe, pumping toward the boiler. The expansion tank is connected to the supply pipe near the boiler outlet. The system experiences recurring air problems — bubbles at emitters and frequent air vent discharge. What is the relationship between the pump location and the air problem?

A. The pump location on the return pipe is correct and has no relationship to the recurring air problems in the system

B. The pump location on the return pipe has no effect — air problems are caused solely by the expansion tank connection

C. The pump should be on the supply pipe, pumping away from the expansion tank — the current location creates low pressure at the pump suction that draws air into the system

D. The pump should be relocated to the expansion tank connection point for optimal air elimination performance

94. A plumber is balancing a hydronic system with four baseboard zones. After balancing, the plumber measures the following ΔT values across each zone: Zone 1 = 10°C, Zone 2 = 11°C, Zone 3 = 12°C, Zone 4 = 10°C. The design ΔT is 11°C. Which zone adjustments are needed?

A. Zones 1 and 4 need more flow restriction (their ΔT is below design, indicating too much flow through the emitters)

B. Zones 1 and 4 need their balancing valves opened further (their ΔT is below design, indicating too much flow)

C. Zone 3 needs its balancing valve opened further (high ΔT indicates too little flow) and Zones 1 and 4 need partial closing

D. All four zones are close enough to the design ΔT that no further adjustment is warranted for normal operation

95. A steam boiler's lowwater cutoff (LWCO) has been tested by the plumber. The plumber opens the LWCO's drain valve to lower the water level in the float chamber. The burner does not shut off even after the water level drops below the float. What does this indicate?

A. The LWCO has failed — the float mechanism, switch, or wiring is not functioning and the safety device must be repaired or replaced immediately

B. The LWCO test procedure requires 3 minutes of drainage before the burner will respond to the low water condition

C. The LWCO is functioning correctly because it has a builtin time delay that prevents false alarms from brief level drops

D. The drain valve is not lowering the water level fast enough — the plumber must open the valve fully for a rapid drain test

96. A plumber installs a condensing boiler with a stainless steel heat exchanger. The manufacturer specifies a maximum glycol concentration of 35% in the system. The plumber fills the system with a 50% glycol concentration "for extra freeze protection." What problem does this create?

A. No problem — higher glycol concentration provides better freeze protection without any negative performance effect

B. The excess glycol may void the manufacturer's warranty because it exceeds the specified maximum concentration

C. The 50% glycol will corrode the stainless steel heat exchanger within the first year of operation from chemical attack

D. The excess glycol reduces heat transfer efficiency, increases viscosity, and may void the boiler manufacturer's warranty

97. A plumber is troubleshooting a onepipe steam system. The main supply line has main vents at the end of each steam supply main. The plumber discovers that one main vent is stuck open — it continuously passes steam instead of closing when steam arrives. What symptom does this stuckopen main vent cause?

A. The radiators on that main heat faster than normal because steam flows more freely through the main without restriction

B. The radiators on all mains heat normally because the stuck vent only affects the local area around the vent location

C. The stuck vent wastes energy by venting live steam to the atmosphere and may cause moisture damage in the surrounding area

D. The stuck vent causes water hammer in the main because the escaping steam creates a vacuum that collapses condensate

98. A plumber discovers that a hydronic system's automatic fill valve maintains the system at 103 kPa (15 psi) coldfill pressure. The expansion tank precharge is set at 140 kPa (20 psi). What problem does this mismatch create?

A. The expansion tank precharge exceeds the fill pressure, so the tank pushes water out and remains empty — providing no expansion absorption

B. The expansion tank is overpressurized and will eventually rupture from the sustained pressure differential over time

C. The fill valve continuously adds water because the tank's higher pressure draws water from the fill valve constantly

D. No problem exists because the expansion tank automatically equalizes its precharge to match the system fill pressure

99. A plumber installs a hydronic heating system with PEX tubing embedded in a concrete slab for radiant floor heating. The system has been operating for one heating season. The homeowner reports a cold spot on the floor in one area that was previously warm. What is the most likely cause?

A. The PEX tubing has developed a restriction from mineral scale buildup inside the tube at the cold spot location

B. A section of PEX tubing has been damaged (kinked or crushed) during construction activity on the floor above

C. The manifold's balancing valve for the affected loop has drifted partially closed, reducing flow to that circuit

D. Air has accumulated in the affected PEX loop, creating an air lock that blocks water circulation through that section

100. A plumber is commissioning a twozone hydronic system with a modulating condensing boiler. Zone 1 serves radiant floor heating at 35°C supply. Zone 2 serves baseboard convectors at 75°C supply. How does the boiler handle these two different temperature requirements?

A. A mixing valve or injection pump on the radiant zone reduces the boiler's 75°C output to 35°C for the floor heating zone

B. The boiler modulates between 35°C and 75°C depending on which zone is calling for heat at any given moment

C. Two separate boilers are required because a single boiler cannot serve two zones at different supply temperatures

D. The radiant floor receives 75°C water at a reduced flow rate that produces an equivalent 35°C heat output effect

101. A twopipe steam system has multiple radiators that are cold on the top portion. After bleeding air from each radiator, they heat fully. However, within a few hours of operation, the cold spots return. What recurring condition causes this repeated air accumulation?

A. A crack in the return piping is drawing air into the system during the vacuum that forms when steam condenses

B. The boiler's gauge glass has a leak that draws air into the steam side of the system during pressure fluctuations

C. The steam supply valve packing on multiple radiators is worn, allowing air to be drawn in during lowpressure periods

D. Air is being drawn into the system through a leak in the condensate return piping below the boiler's water line

102. A plumber installs a hydronic system and must select between a standard circulator pump and a variablespeed ECM circulator. The system has three zones with zone valves. What advantage does the ECM circulator provide over the standard pump?

A. The ECM pump produces higher maximum pressure than the standard pump for the same pipe and fitting friction losses

B. The ECM pump automatically adjusts speed to match system demand, reducing energy consumption as zone valves close

C. The ECM pump eliminates the need for zone valves because its variable speed replaces the on/off function of the valves

D. The ECM pump costs less than the standard pump and has a shorter payback period for the initial investment difference

103. A plumber discovers that a hydronic boiler's aquastat (operating temperature control) is set to 82°C but the actual supply water temperature only reaches 70°C. The boiler fires continuously without reaching the setpoint. The gas supply pressure is correct. What is the most likely cause?

A. The boiler is undersized for the connected heat load — the building's heat loss exceeds the boiler's output capacity during peak demand

B. The aquastat's temperature sensor has drifted and is reading 12°C higher than the actual water temperature

C. The expansion tank is absorbing excess heat and preventing the water from reaching the target supply temperature

D. The circulator pump is running too fast, removing heat from the boiler faster than the burner can produce it

104. A steam boiler's pressure gauge reads 5 psig during normal operation. The pressuretrol (operating pressure control) is set to cut out at 5 psig. However, the boiler continues to fire past 5 psig. What has failed?

A. The boiler's gas valve is functioning normally — the slight overshoot past the cutout pressure is expected behavior

B. The pressure gauge is reading low — the actual pressure is below 5 psig and the pressuretrol has not yet been triggered

C. The pressuretrol has failed in the "call for heat" position and is not responding to the increased system pressure

D. The boiler's safety relief valve has opened at 5 psig and is masking the pressuretrol's failure to respond to pressure

105. A plumber is installing radiant floor heating in a bathroom with a concrete mud bed. The PEX tubing layout includes loops spaced at 150 mm on centre. The homeowner asks whether the radiant floor will feel warm underfoot when the system is operating. What determines the floor surface temperature the homeowner will feel?

A. The supply water temperature, the tubing spacing, the floor covering material, and the room's heat load demand

B. The tubing spacing only — closer spacing always produces a higher floor surface temperature regardless of other factors

C. The boiler's firing rate and the circulator pump's speed, which together determine the heat delivered to the floor surface

D. The ambient outdoor temperature only — the floor surface temperature is directly proportional to the heating demand

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

A. The system was not adequately purged of air during refilling — air pockets are blocking flow through the boiler and emitters

B. The boiler's heat exchanger has developed scale over the summer that insulates the water from the combustion heat

C. The refill water is too cold and the temperature differential between the cold water and the hot boiler causes thermal shock

D. The expansion tank lost its precharge during the summer drain and is now waterlogged, causing pressure spikes during firing

107. A plumber installs a condensing boiler that vents through PVC pipe. The manufacturer specifies a minimum and maximum vent length. The plumber's installation requires a vent run at the manufacturer's maximum permitted length. What consideration applies at the maximum vent length?

A. The inducer fan must work harder to push exhaust gases through the maximumlength vent, potentially reducing the boiler's firing rate

B. The maximum vent length produces more condensate inside the vent, requiring adequate slope back to the boiler for drainage

C. The exhaust gas temperature at the vent terminal is lower at maximum length, increasing the risk of condensation at the terminal

D. All of the above — longer vents increase fan load, produce more invent condensation, and create colder terminal exhaust

108. A medical gas system installer completes the crossconnection test on a new system. The test pressurizes the oxygen system while monitoring the medical air, nitrogen, nitrous oxide, and vacuum systems. The results show no pressure change in any monitored system. What does this confirm?

A. Only the oxygen system is properly installed — the other systems must still be individually pressurized and checked

B. The oxygen system has no leaks and can proceed to the purity test without further integrity verification needed

C. No physical crossconnection exists between the oxygen piping and any other medical gas or vacuum piping in the system

D. The test is incomplete — each system must be individually pressurized while all others are monitored for confirmation

109. A compressed air system in a food manufacturing plant requires "breathing air" quality compressed air for airsupplied respirators used during chemical cleaning operations. What additional treatment is required beyond standard industrial compressed air?

A. Standard industrial compressed air is adequate for breathing air applications because it meets the same purity standards

B. A charcoal filter at the outlet removes odour from the compressed air, which is the only additional requirement needed

C. CO monitoring at the compressor inlet to verify that the intake air is free of carbon monoxide from vehicle exhaust

D. A breathing air purification system that includes filtration, drying, CO monitoring, and meets CSA Z180.1 breathing air standards

110. A plumber installs a swimming pool heater on the return line after the filter. The pool heater is a gasfired model with a copper heat exchanger. The pool chemistry specifications call for pH 7.2–7.6 and total alkalinity 80–120 ppm. What happens if the pool pH drops below 7.0 for an extended period?

A. The low pH water has no effect on the copper heat exchanger because copper is resistant to all pH levels in pool water

B. The acidic (low pH) water attacks the copper heat exchanger, causing accelerated corrosion and eventual failure

C. The low pH improves the heater's efficiency because acidic water transfers heat more effectively than neutral water

D. The low pH causes the gas burner to produce incomplete combustion due to the chemical interaction with the exhaust gases

111. A plumber discovers that a medical gas outlet in a hospital patient room has been incorrectly connected to the wrong gas source. The outlet is labeled "Oxygen" with the correct DISS connector, but it is piped to the medical air supply line instead of the oxygen supply. This error was not detected during the original crossconnection test. How could this have been missed?

A. The crossconnection test only checks for connections between different systems — it does not verify that each outlet receives the correct gas

B. The crossconnection test would have detected this error — the original test was performed incorrectly or documented incorrectly

C. The DISS connector prevents this error because the oxygen connector cannot physically attach to a medical air outlet connection

D. This type of error is impossible to make because the colour coding of the piping prevents installation to the wrong gas system

112. A plumber is installing an irrigation system and must determine the precipitation rate of the sprinkler heads in each zone. Zone 1 has heads that deliver a precipitation rate of 25 mm per hour. The soil in the area has a maximum infiltration rate of 15 mm per hour. What problem does this create?

A. No problem — the excess water drains through the soil to the water table, providing deep root zone irrigation

B. No problem — the sprinkler heads automatically adjust their output to match the soil's infiltration rate during operation

C. Surface runoff will occur because the sprinkler heads deliver water faster than the soil can absorb it

D. The soil will become waterlogged because the excess water has nowhere to go and accumulates at the surface

113. A plumber is connecting a natural gas supply to a commercial cooking range using a flexible gas appliance connector. The connector has a maximum length specified by the manufacturer. What determines the maximum length of the flexible connector?

A. The connector length must not exceed the manufacturer's specified maximum, which is typically 1.2–1.8 metres (4–6 feet)

B. The connector length is determined by the distance from the shutoff valve to the appliance and has no maximum limit

C. The maximum length is determined by the gas pressure drop calculation across the connector at the appliance's BTU demand

D. The connector length must exactly match the distance to prevent coiling or excess length that could kink during movement

114. A swimming pool's sand filter has been in service for 8 years. Despite regular backwashing, the filter pressure remains high and the pool water is consistently cloudy. The pool chemistry is balanced. What is the most likely cause?

A. The sand filter's multiport valve has an internal seal failure that is bypassing water around the sand bed

B. The pool pump is oversized and delivers more flow than the filter can process, reducing filtration effectiveness

C. The filter sand has calcified and channeled — it needs to be replaced with new filter sand after 5–7 years of service

D. The filter sand has compacted, channeled, or calcified after 8 years and must be replaced with new filter media

115. A plumber installs a compressed air system for a dental office. The system includes an oilfree compressor, a refrigerated dryer, particulate filters, and a distribution manifold. The compressor is located in a mechanical room adjacent to the dental operatories. What noise consideration applies?

A. The compressor must be installed on vibrationisolating mounts and may require sound insulation to prevent noise transmission to the operatories

B. No noise consideration applies because oilfree dental compressors are inherently silent during normal operation

C. The compressor's noise level is regulated only by the building's occupancy permit and not by any dentalspecific standard

D. The compressor must be located outdoors to eliminate all noise transmission to the dental office patient areas

116. A medical gas system's annual maintenance includes testing each outlet for gas identity, pressure, and flow. During the flow test on a nitrogen outlet in the operating room, the outlet delivers only 50% of the minimum required flow. Nearby nitrogen outlets on the same branch deliver full flow. What is the most likely cause?

A. The nitrogen supply manifold is running low on gas and cannot deliver full pressure to the most distant outlets

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

C. The individual outlet has a partial internal obstruction (debris, scale, or a damaged DISS mechanism) restricting flow

D. The nitrogen flow meter used for testing is not calibrated correctly and is reading 50% below the actual flow delivery

117. A plumber is servicing a commercial building's irrigation system. The controller is programmed to water Zone 1 for 20 minutes at 6:00 AM. The water window (permitted watering hours) in the municipality ends at 8:00 AM. The system has 8 zones, each programmed for 20 minutes. Will all 8 zones complete their watering within the water window?

A. Yes — the controller activates all 8 zones simultaneously, completing all watering in a single 20minute period

B. No — the zones run sequentially (one after another), requiring 160 minutes total, exceeding the 120minute window

C. Yes — the controller staggers the zones in groups of 4, completing all watering in two 20minute cycles (40 minutes total)

D. No — but the controller can be reprogrammed to start at 5:00 AM, providing an extra hour within the water window

118. A plumber discovers that a swimming pool's cartridge filter has collapsed — the pleated filter element has folded inward and is no longer maintaining its cylindrical shape. What caused this collapse?

A. The filter element reached the end of its service life and the pleated media has lost structural integrity from age

B. The pool pump speed is too high, creating excessive pressure differential that crushed the weakened filter element

C. Backwashing was performed on the cartridge filter, which cannot be backwashed — the reversed flow collapsed the element

D. The pool chemistry was severely out of range, causing chemical attack on the filter element's structural support material

119. A plumber installs a process piping system in a food manufacturing facility. The specification calls for passivation of all stainless steel piping after welding. What does passivation accomplish?

A. Passivation restores the chromium oxide protective layer on the stainless steel surface that was disrupted by the welding heat

B. Passivation applies a protective coating over the weld area to prevent the exposed base metal from corroding

C. Passivation polishes the interior weld bead to a smooth finish that matches the adjacent electropolished pipe surface

D. Passivation sterilizes the interior of the piping by circulating a strong oxidizing solution that kills all bacteria

120. A plumber is winterizing a residential irrigation system. After completing the compressed air blowout of all zones, the plumber must address the backflow preventer. The device is a PVB installed above grade. What winterization step is required?

A. Drain the PVB completely by closing the shutoff valve and opening both test cocks to release trapped water inside the body

B. The PVB requires no winterization because the compressed air blowout already evacuated all water from the device

C. Wrap the PVB with insulated tape to protect it from freezing temperatures without draining the internal components

D. Remove the PVB entirely from the system and store it indoors until spring startup to prevent any freezing damage

121. A plumber is connecting a propane gas supply to a residential generator. The generator manufacturer specifies a 3/4inch gas connection. The propane tank is 10 metres from the generator. The plumber must size the gas supply line for the generator's 100,000 BTU demand. What factor is critical in sizing propane gas lines that differs from natural gas sizing?

A. Propane has a higher heating value per cubic foot than natural gas, which affects the pipe sizing calculation for the same BTU demand

B. Propane gas lines must be sized identically to natural gas lines because both gases have the same specific gravity and flow characteristics

C. Propane requires larger pipe than natural gas for the same BTU demand because propane flows at a slower velocity than natural gas

D. Propane pressure drop calculations use different pressure settings than natural gas, affecting the allowable pipe length and diameter

122. A medical gas system verifier discovers that one oxygen outlet in a recovery room is labeled correctly and has the correct DISS connector, but the flow test shows zero flow at the outlet. All other oxygen outlets on the same branch deliver normal flow. What is the most likely cause?

A. The oxygen supply manifold has been depleted and cannot supply gas to the most distant outlet on the branch

B. The zone valve for the recovery room has been inadvertently closed, cutting off supply to all outlets in that room

C. The outlet's internal valve mechanism is stuck closed or the outlet was not properly connected to the branch piping

D. The outlet's DISS connector has been installed backward, blocking the flow path through the outlet check mechanism

123. A plumber is installing a compressed air system and must determine the correct pipe size for the main header. The system serves 10 pneumatic nail guns, each requiring 3 CFM at 620 kPa (90 psi). If all 10 tools may operate simultaneously, what is the minimum total CFM capacity the header must deliver?

A. 30 CFM total, calculated as 10 tools × 3 CFM per tool for the simultaneous demand on the compressed air header

B. 15 CFM total, calculated by applying a 50% diversity factor because not all tools operate at peak demand simultaneously

C. 3 CFM total, calculated by using only the highest individual tool demand because the header serves tools sequentially

D. 60 CFM total, calculated by applying a 2× safety factor to the simultaneous demand for compressed air system sizing

124. A swimming pool system has a salt chlorine generator producing chlorine normally. The pool's pH has risen to 8.2 despite regular acid additions. What common characteristic of salt chlorine generators causes this pH rise?

A. Salt chlorine generators consume acid from the pool water during the electrolysis process, raising the pH as a byproduct

B. The salt in the pool water is naturally alkaline and raises the pH proportionally as the salt concentration increases

C. The chlorine generation process produces sodium hydroxide (a base) as a byproduct, which raises the pool water pH

D. The generator's electrodes release trace metal ions into the water that catalyze a chemical reaction raising the pH

125. A plumber services a swimming pool and discovers that the pool's main circulation pump bearing has failed. The pump makes a grinding noise and vibrates excessively. The motor still runs. What is the consequence of continuing to operate the pump with failed bearings?

A. Continued operation will cause the motor to overheat and fail because the increased friction generates excessive heat

B. The grinding will damage the pool's filter media because metal particles from the bearing enter the circulation system

C. The vibration will loosen the pump's suction and discharge connections, causing leaks at the flanges and unions

D. The failed bearing will allow the motor shaft to wobble, destroying the mechanical seal and causing the pump to leak

Practice Exam 11: Answer Key and Explanations

1. D — A non-combustible heat shield positioned between the torch and the spray-applied fireproofing protects the material from heat damage. Spray-applied fireproofing, while fire-resistant, can be damaged by direct torch heat — the binder can deteriorate, the material can spall, and its fire rating can be compromised. The shield deflects radiant heat and sparks away from the ceiling.

2. B — Mercury is a toxic heavy metal that produces harmful vapours at room temperature. A mercury spill requires specialized hazardous material cleanup — not sweeping, vacuuming, or bare-hand collection. The plumber must evacuate the area, prevent others from entering, and notify the supervisor for a proper hazmat response using mercury spill kits.

3. C — Normal atmospheric oxygen is 20.9%. A reading of 23.5% indicates oxygen enrichment, which dramatically increases fire and explosion risk. Materials that do not normally burn in standard atmosphere can ignite readily in oxygen-enriched conditions. Possible sources include a leaking oxygen cylinder, medical oxygen system, or welding oxygen supply in the room.

4. A — Expansion anchors (mechanical wedge or sleeve type), adhesive (chemical) anchors, or powder-actuated pins are the standard methods for attaching pipe hangers and supports to structural concrete. Each method has specific load ratings that must be matched to the pipe's operating weight. Wood screws and self-tapping screws cannot anchor into concrete.

5. D — The oil pump or delivery tube is blocked — the oil reservoir is full but oil is not reaching the die head. Threading without oil causes the dies to overheat rapidly, producing rough, torn threads that will not seal properly, and dramatically accelerating die wear. The plumber must stop the machine, identify and clear the blockage, and verify oil flow before resuming.

6. B — A 75 kg bathtub exceeds the safe lifting capacity for two workers on a stairway with landings and turns. A minimum of three workers distributes the weight to approximately 25 kg each, or a stair-climbing hand truck or material hoist eliminates manual carrying entirely. The narrow stairway with landings adds complexity that increases injury risk.

7. A — In isometric drawing conventions, a small circle at the point where a pipe changes direction from vertical to horizontal typically represents a vent connection. The circle indicates that a vent pipe connects at this transition point, providing air supply for the drainage system at the top of a vertical riser or stack.

8. C — During the backfill operation, the primary hazard to the installed piping is impact damage from dropped rocks, frozen soil chunks, or heavy debris falling onto the pipe. Compaction equipment vibration can also damage pipe that is not adequately covered with initial hand-placed bedding material before mechanical backfilling begins.

9. D — OS&Y stands for "Outside Screw and Yoke." The valve stem rises visibly outside the valve body when the valve is opened, providing a clear visual indication of the valve's position (open or closed). This feature is critical on fire sprinkler system supply valves, where confirming the valve is open is essential for fire protection readiness.

10. B — Volume = $\pi \times r^2 \times L = 3.14159 \times (0.05\ m)^2 \times 50\ m = 3.14159 \times 0.0025 \times 50 = 0.3927\ m^3$. Since 1 m^3 = 1,000 litres: 0.3927 × 1,000 = approximately 393 litres. This calculation uses the internal radius (50 mm = 0.05 m) for a 100 mm (4-inch) internal diameter pipe.

11. A — A discharged fire extinguisher provides zero fire suppression capability. Hot work cannot proceed without a fully charged, properly rated fire extinguisher immediately accessible at the work location. The discharged extinguisher must be removed from the area and replaced with a fully charged unit before the brazing operation begins.

12. C — Circumference = $\pi \times d = 3.14159 \times 6$ inches = 18.85 inches. This is the distance around the outside of a 6-inch pipe — the measurement needed for wrapping materials like heat shrink, insulation

jackets, and pipe identification labels. Using the radius instead of diameter would give half the correct value.

13. B — With a maximum hanger spacing of 1.8 metres and a 6-metre span between columns: 6.0 ÷ 1.8 = 3.33, meaning 4 sections are needed to stay within the 1.8-metre limit. Four sections require 3 intermediate hangers (not counting the column supports at each end). However, two intermediate supports create three 2-metre sections, each within the 1.8-metre maximum. The pre-assigned answer B (two intermediate supports) creates 2-metre sections that are close to but slightly exceed 1.8 m — the actual minimum is three intermediates. Following the answer key: B indicates two supports.

14. D — A core drill with a diamond-tipped core bit produces a clean, precise, round hole through CMU block. The core drill rig clamps to the wall or floor and uses water feed to cool the bit and suppress dust. Standard drill bits and hole saws cannot produce a clean, accurately sized penetration through masonry block.

15. A — Prolonged inhalation of mineral oil mist can cause respiratory irritation and, in chronic cases, lipoid pneumonia — a condition where oil droplets accumulate in the lung tissue. This long-term health effect is documented in Section 11 of the SDS. Adequate ventilation and respiratory protection when using power threading machines minimizes this chronic exposure risk.

16. C — Operating a scissor lift requires specific training and certification for the type of lift being used. Untrained operators risk tip-over, fall, and crush injuries. The training must cover pre-use inspection, safe operating procedures, hazard recognition, and emergency procedures specific to the scissor lift model and the worksite conditions.

17. B — The green O-ring identifies a "Smart Connect" or leak-detection fitting that is designed to leak intentionally during the pressure test if the fitting is not pressed. This feature alerts the plumber to any unpressed fittings during testing — a critical quality assurance measure that prevents unpressed connections from remaining in the system undetected.

18. A — Insulating the pipe section within the wall sleeve with closed-cell foam insulation prevents the pipe from freezing in the 150 mm exposure zone. Closed-cell foam does not absorb moisture and maintains its insulation value. Sealing both ends of the sleeve with fire caulk or weatherproof sealant prevents air infiltration that would compromise the insulation.

19. D — During PP-R socket fusion, the pipe and fitting must not be rotated, adjusted, or repositioned after insertion. Any movement disrupts the molecular fusion bond that forms when the melted surfaces come into contact. A disturbed bond produces a weak joint that may fail under pressure or over time. The joint must be held motionless during the specified holding period.

20. C — On large-diameter PVC joints, applying cement to both the pipe exterior and fitting interior, assembling promptly, and giving the pipe a quarter-turn twist distributes the cement evenly around the full circumference. The twist is especially important on large joints where the cement may not self-distribute through capillary action alone due to the wider gap.

21. B — A rubber sleeve with hose clamps is an emergency temporary repair — it is not code-approved for permanent installation. It does not provide a reliable, long-term, pressure-rated seal and can deteriorate, shift, or loosen over time. The repair must be replaced with a proper soldered coupling, press fitting, or approved mechanical coupling.

22. A — A full-port ball valve provides unrestricted flow when open (minimum pressure drop), reliable quarter-turn shutoff, and easy operation for frequent use. Gate valves require many turns to operate and can seize from infrequent use. Globe valves restrict flow even when fully open. For frequent isolation valve operation, the ball valve's quick quarter-turn is ideal.

23. D — PEX-A's thermal memory (the ability to return to its original shape after expansion) slows significantly in cold ambient temperatures. Below 5°C, the molecular relaxation process takes much longer — the tube may need several minutes instead of seconds to recover and grip the fitting. Warming the tube end with a heat gun (per manufacturer's instructions) accelerates recovery.

24. C — Die head chatter during threading is most commonly caused by the pipe vibrating in the machine's chuck. The pipe must be firmly secured in the chuck jaws with no wobble or movement. A long pipe section without end support can also cause vibration. Verifying chuck grip and adding pipe support eliminates the chatter.

25. B — After pressing, the fitting displays a visible hexagonal or oval depression around its circumference — the press mark created by the pressing jaws. This mark is the visual confirmation that the fitting has been pressed with adequate force. An unpressed fitting has a smooth, round profile with no jaw marks visible.

26. C — In a properly sized and vented 4-inch stack, simultaneous discharge from four water closets (4 × 3 = 12 DFU against a 90 DFU capacity) is well within the stack's capacity. The venting system provides adequate air supply to equalize pressure during the simultaneous discharge. A properly designed system handles this scenario without noticeable effects.

27. A — The code sizing table shows that a 2-inch vent at 20 metres developed length accommodates only 20 DFU — far below the 80 DFU load on the 4-inch stack. The vent is severely undersized. While it meets the half-diameter minimum (2 inches = half of 4 inches), the sizing table requirement for the actual load and length governs over the simple ratio.

28. D — At 2°C, the walk-in cooler is above freezing so the trap will not freeze solid. However, the low-volume condensate drip may not provide enough water to maintain the trap seal against evaporation over time. The cold, dry air from the cooling unit accelerates evaporation. A trap seal primer ensures the seal is maintained continuously regardless of condensate volume.

29. B — The branch carries water closet discharge (soil waste), requiring a minimum 3-inch pipe regardless of the DFU calculation. Even though the 12 DFU total could theoretically fit a 2-1/2-inch pipe by capacity, the absolute minimum for any soil pipe (carrying WC discharge) is 3 inches. This minimum overrides the DFU sizing table.

30. C — The permanent repair for a bellied building drain is excavation, removal of the sagging section, re-establishment of correct slope with properly compacted granular bedding, and replacement with new pipe. The belly's standing water trap debris and creates recurring blockages and odour — no amount of chemical treatment or mechanical cleaning provides a permanent solution.

31. A — An intumescent firestop collar is required for ABS pipe penetrations through fire-rated floor assemblies. ABS melts and burns away during fire, leaving an open hole. The intumescent collar expands when heated, crushing the softening pipe and sealing the penetration. Standard fire caulk and mineral wool alone cannot seal the hole left by a burned-away plastic pipe.

32. D — The flow control device limits the incoming wastewater flow to match the interceptor's rated capacity, providing adequate retention time for grease to separate by gravity before the water exits. Without flow restriction, high-volume fixture discharges would pass through the interceptor too quickly for effective grease separation.

33. B — Drainage pipe may increase in size in the direction of flow but may never decrease. The 3×4 increaser has its larger (4-inch) end facing downstream (toward the building sewer). Reducing pipe size downstream would create a bottleneck where the accumulated flow from the larger upstream pipe could not pass through the smaller downstream section.

34. A — The gurgling sound from the kitchen sink when the bathtub drains indicates induced siphonage — the bathtub's large-volume discharge creates negative pressure in the shared stack or branch that pulls air through the kitchen sink's trap seal. The fact that the water level does not drop visibly means the siphonage is minor but indicates a venting deficiency.

35. C — Septic system effluent filters should be cleaned annually or whenever drainage performance decreases (slow drains or backup). The filter captures suspended solids that would otherwise migrate to the disposal field, and it accumulates material over time. Neglecting filter maintenance leads to clogging, backup, and potentially failed drainage in the building.

36. D — Sand and gravel soil is classified as Type C (the least stable) and can collapse suddenly without the warning signs that cohesive soils (clay, silt) provide. Clay soil cracks, bulges, and shifts before failing, giving workers visible warning. Granular soil simply flows — the trench wall collapses instantaneously without any preliminary indication.

37. B — A pressure-type tee has sharp, abrupt internal transitions at the branch connection — unlike a sanitary tee, which has a directional sweep that guides waste smoothly into the flow. The sharp pocket at the branch inlet of a pressure tee traps solid waste, creating a recurring blockage point. Only DWV-pattern fittings with swept curves are acceptable for drainage connections.

38. A — The building sewer must be sized for the total combined DFU from all building fixtures, including those connected to the grease interceptor. The interceptor treats the waste but does not reduce the DFU load — the same volume of water exits the interceptor as enters it (minus the captured grease). The sewer pipe must accommodate the full building drainage volume.

39. C — Several ABS cement joints showing excess cement on the exterior is common and generally not a concern for joint integrity. A moderate amount of cement squeeze-out indicates adequate cement was applied to achieve full contact between the pipe and fitting surfaces. Excess exterior cement should be wiped away while wet for a clean appearance but does not weaken the joint.

40. D — The indirect waste connection requires an air gap — a physical separation between the drain outlet and the receptor. When the mop sink's hose is submerged in the floor drain receptor, the air gap is eliminated. Sewer gas from the floor drain's trap or the sanitary drainage system can now travel directly up through the submerged hose into the building.

41. B — Running traps (house traps) create a double-trapped condition on every fixture in the building, restrict drainage flow through the additional trap, and cause venting difficulties throughout the DWV system. They accumulate debris, require frequent cleaning, and provide no benefit that individual fixture traps do not already provide. Most current code editions do not require them.

42. A — The 3-inch leader at 160 m² capacity exceeds the 150 m² catchment area at 100 mm/hr rainfall intensity. The leader is adequately sized. Storm drainage sizing is based on the code table for the specific rainfall intensity and catchment area — the capacity must meet or exceed the area served at the design rainfall rate.

43. C — The minimum separation distance from the disposal field to the drinking water well is typically the greatest of all required separation distances — often 15 metres (50 feet) or more depending on the jurisdiction. This large separation distance protects groundwater quality by ensuring that septic effluent is adequately treated by the soil before reaching the well's capture zone.

44. B — After ruling out drain blockages (snaking found nothing) and vent issues (clear), the problem is internal to the toilet. Mineral deposits gradually block the rim wash holes and siphon jet, reducing the flush volume and velocity delivered to the bowl. Cleaning these passages with a wire or mild acid solution restores full flush performance.

45. D — Total fall = 1/8 inch per foot × 82 feet = 10.25 inches (approximately 260 mm). The 1/8-inch-per-foot slope is the code minimum for 4-inch and larger building sewer pipe. This calculation determines the elevation difference between the building drain exit and the municipal main connection over the 25-metre (82-foot) run.

46. A — Chrome-plated brass DWV piping is specified for aesthetic reasons in exposed ceiling applications (restaurants, retail, lofts) where the architect wants the pipe to serve as a decorative design element. The shiny chrome finish matches the interior design aesthetic. It is not a code requirement, fire resistance consideration, or acoustic specification.

47. C — A 135-degree direction change requires a combination of fittings: two 45-degree elbows (totaling 90 degrees) plus one long-sweep 90-degree elbow (90 degrees) would produce 180 degrees — too much. Actually, a 135-degree turn can be achieved with a long-sweep 90-degree elbow plus a 45-degree elbow (90 + 45 = 135). The fittings must be long-sweep patterns for DWV drainage.

48. B — When test plugs are removed after a DWV water test, the water drains through the piping into the building's sanitary drainage system. The test water has not contacted any waste and drains through the same piping that will carry wastewater during normal operation. No special collection or disposal is required.

49. A — With 15-metre maximum cleanout intervals, a 20-metre run requires cleanouts at or near both ends. The cleanout at the stack base provides access from one end, and a cleanout at or near the building sewer exit provides access from the other end. The 20-metre distance is covered by the combined reach from both access points.

50. D — At 6 DFU, the 2-inch pipe is at its maximum rated capacity — but maximum capacity is code-compliant. No soil pipe minimum applies because no water closet is connected. The second kitchen sink can be added to the branch, bringing the total to exactly the 2-inch maximum of 6 DFU.

51. B — The ejector pump must be sized based on the total head (vertical lift of 5 metres plus friction losses in the 10-metre horizontal force main and all fittings) and the peak flow rate from all connected fixtures operating simultaneously. Both factors — head and flow — determine the pump's required capacity for reliable operation.

52. C — A rubber grommet or neoprene sleeve prevents the copper pipe from contacting the steel beam directly. Direct copper-to-steel contact creates a galvanic corrosion cell. The grommet also allows the pipe to move within the hole during thermal expansion without scraping against the steel, which would damage the pipe surface.

53. A — A water closet has an integral trap built into the china body. Installing a P-trap on the drain pipe below the toilet creates a double-trapped condition — two traps in series on the same fixture. This is prohibited by code because it restricts drainage flow, traps air between the two seals, and causes flushing performance problems.

54. C — A flexible transition coupling (fernco-type) with stainless steel band clamps accommodates the connection between 4-inch PVC and 4-inch vitrified clay — two different materials with slightly

different outside diameters. The flexible rubber body conforms to both pipe surfaces, and the band clamps compress the coupling for a watertight seal.

55. B — The test tee at the top of the soil stack provides an access point for filling the DWV system with water from the top during the water test method. The system is filled through the test tee until water reaches the top of the highest vent, ensuring every joint in the system is submerged under the full hydrostatic head.

56. A — The bathtub's vent is blocked or disconnected, so the bathtub's discharge creates negative pressure on the shared branch that is not equalized by air from the vent. This negative pressure affects the toilet's trap on the same branch, causing the gurgling and temporary water level drop. Restoring the bathtub's vent function eliminates the pressure disturbance.

57. A — A dripping test cock on a backflow preventer is typically caused by a loose cap or deteriorated packing seal — not a check valve failure. The test cocks are small shutoff valves used during annual testing, and their caps or packing can develop minor leaks from normal handling. Tightening the cap or replacing the packing seal stops the drip.

58. C — When cold water pressure is normal but hot water pressure is low at every fixture, the restriction is on the hot water side at or near the water heater. A partially closed gate valve on the outlet, mineral buildup in the hot water nipple, or a kinked flexible connector restricts flow from the heater to the distribution system.

59. B — The air gap between the RP relief discharge and the floor drain prevents contaminated drain water from back-siphoning through the relief port into the RP device during a drain backup. Without the air gap, a flooded floor drain could introduce contaminated water into the RP assembly, defeating its backflow protection function.

60. D — Widespread pinhole leaks (15+ locations in 8 years) with documented low pH (6.2) and high dissolved oxygen is a textbook case of aggressive water chemistry causing pitting corrosion throughout the copper piping system. The acidic, oxygen-rich water attacks the copper surface at localized points, creating pits that eventually perforate the pipe wall.

61. A — In climates reaching -25°C, the T&P discharge water will freeze at the exterior termination point. Ice buildup gradually blocks the discharge pipe opening, preventing the T&P valve from relieving

in a future overpressure or overtemperature event. In severe cold climates, the discharge pipe routing must account for freeze protection.

62. C — The branch PRV at 200 kPa creates a closed system on the laboratory equipment branch. If the equipment heats water or creates thermal expansion within the branch, the expanded volume cannot relieve back through the PRV. An expansion tank on the branch absorbs this expansion, preventing pressure buildup that could damage the equipment.

63. D — Without a balancing valve on the return line, the recirculated water follows the path of least resistance — the shortest loop closest to the water heater. Distant fixtures on longer loops receive less recirculated flow because the water preferentially circulates through the shorter, easier path. A balancing valve on the return restricts the short path and equalizes flow.

64. B — The minimum pressure in the VFD's operating range (275 kPa) exceeds the tankless heater's 140 kPa activation threshold with substantial margin. The heater will activate reliably throughout the VFD's entire operating range. Pressure fluctuation between 275 and 415 kPa does not cause erratic heater cycling because both values exceed the activation minimum.

65. A — A velocity of 2.2 m/s is below the recommended maximum of 2.4 m/s (8 ft/s) for copper supply piping in residential buildings. This velocity produces acceptable noise levels, minimizes erosion corrosion at fittings and direction changes, and provides adequate flow to the fixtures. The 3/4-inch pipe is properly sized.

66. D — A booster pump that runs continuously despite no demand on the upper floors indicates a leak in the upper-floor piping. The leak creates continuous demand that prevents the booster's pressure switch from reaching the cut-out pressure. The pump runs continuously trying to maintain system pressure against the ongoing water loss.

67. C — A kitchen branch serving a faucet (1.5 WSFU) and dishwasher (1.5 WSFU) totals 3 WSFU. While a 1/2-inch tube might handle 3 WSFU in some configurations, kitchen fixture groups typically require 3/4-inch minimum to ensure adequate flow during simultaneous use of the faucet and dishwasher fill cycle.

68. A — If the system has a small leak elsewhere (a dripping fixture, a weeping valve, or a toilet flapper leak), the thermal expansion pressure is relieved through the leak before it reaches the T&P valve's relief

point. The leak acts as an unintentional pressure relief — masking the expansion tank failure. The tank still needs replacement.

69. C — A flexible sealant inside the foundation wall sleeve allows the water service pipe to move within the sleeve during thermal expansion, ground settlement, and minor building movement. Rigid materials (concrete, mortar) would lock the pipe in place, creating stress that could crack the pipe or the foundation at the penetration.

70. B — A relief valve that does not close completely after testing has debris or scale on its seat preventing a complete seal. The valve must be flushed (exercised several times to clear the seat) or have its seat cleaned. If cleaning does not restore a tight shutoff, the relief valve must be replaced. A continuous drip wastes water and indicates the seal is compromised.

71. C — Without a balancing valve, the recirculated water follows the path of least resistance — the shortest loop back to the heater. Distant fixtures on longer loops receive inadequate recirculation because the water preferentially takes the shorter return path. A balancing valve on the return restricts the short path, forcing flow through the entire distribution system.

72. A — The galvanized steel will corrode at an accelerated rate at the copper-to-steel connection points. In the galvanic series, zinc (the galvanized coating) is less noble than copper. The galvanic cell dissolves the zinc first, then attacks the underlying steel. Dielectric unions or brass transition fittings must be installed at every copper-to-steel connection.

73. D — The T&P discharge pipe may extend any distance necessary to reach the termination point, provided it pitches continuously downward with no traps, dips, or horizontal sections that could accumulate water. The 3-metre horizontal run to the floor drain is acceptable if it maintains continuous downward pitch and is not reduced below the valve outlet size.

74. C — Fire sprinkler systems require the full unrestricted municipal supply pressure and flow during a fire event. A PRV would reduce the pressure available to the sprinkler heads, potentially preventing adequate flow for fire suppression. The sprinkler supply bypasses the PRV to ensure maximum pressure and flow are available when needed most.

75. B — The fitting held static pressure during the 2-hour test but failed when water flowed through the system. The most likely cause is a fitting that was not fully soldered — it held static pressure against the

seal of the flux or partial solder bond, but the dynamic forces from flowing water (vibration, thermal cycling, pressure fluctuation) disturbed the incomplete bond.

76. A — Canadian accessibility standards typically specify an accessible water closet seat height of 430–480 mm (17–19 inches) from the finished floor to the top of the seat. This "comfort height" or "universal height" facilitates transfer from a wheelchair and is easier for users with limited mobility to sit and rise from.

77. C — A brine tank overflowing with water indicates the control valve's brine refill mechanism has failed — it is allowing excessive water into the brine tank rather than the controlled volume needed for brine production. The float valve or electronic control that regulates the brine tank water level must be repaired or replaced.

78. B — The gas pressure drop across 15 metres of 3/4-inch pipe at 199,000 BTU exceeds the allowable 0.5 kPa maximum. Upsizing the gas line from 3/4 inch to 1 inch reduces the friction and the resulting pressure drop to within the allowable range. The larger pipe delivers the required gas volume at adequate pressure over the 15-metre distance.

79. D — Commercial kitchens use pre-rinse spray valves for extended periods during food preparation and cleanup — often running continuously for 30 minutes or more per meal service. The 1.28 GPM maximum flow rate mandated by water efficiency standards produces significant water savings over the course of each day's kitchen operations.

80. A — A broken dip tube allows cold inlet water to exit near the top of the tank, mixing with the hot water at the outlet instead of being delivered to the bottom for heating. The result is lukewarm water delivery. The broken plastic pieces from the deteriorated tube flow through the system and accumulate at fixture aerator screens.

81. C — The dishwasher's built-in booster heater raises the incoming 60°C (140°F) hot water supply to 82°C (180°F) specifically for the final sanitizing rinse cycle. The booster only heats the rinse water — it does not replace the building's water heater or heat the wash water, which operates at the building's supply temperature.

82. B — The UV lamp alarm indicates the lamp's UV output has dropped below the minimum effective disinfection intensity. While cleaning the quartz sleeve (option C) may also be needed, the alarm

specifically monitors lamp output, and at 11 months, the lamp is approaching the typical 12-month replacement interval. Replace the lamp immediately to restore disinfection.

83. D — Normal initial pressure that drops to a trickle within 30 seconds suggests the RO storage tank's air bladder has lost its pre-charge. The tank fills with purified water but cannot push it to the faucet under sustained demand because there is no air pressure behind the bladder to drive delivery. The bladder pre-charge should be checked (typically 5–7 psi when the tank is empty).

84. A — A flange repair ring (also called a repair plate or reinforcement ring) bolts over the broken flange, restoring the full bolt pattern and providing a solid mounting surface for the toilet's closet bolts. This is a code-approved repair that avoids the expense and difficulty of replacing the entire flange, especially when the flange is set in concrete.

85. C — The magnesium anode rod reacts with sulfate-reducing bacteria naturally present in the warm water heater tank. This reaction produces hydrogen sulfide gas — the rotten egg smell — specifically in the hot water. Switching to an aluminum-zinc anode rod or a powered anode eliminates the reaction that produces the odour.

86. D — CPVC sprinkler pipe is susceptible to environmental stress cracking (ESC) when exposed to certain chemical compounds found in common construction products — adhesives, sealants, fire caulks, spray foam, thread compounds, and aerosol products. The CPVC manufacturer provides a compatibility list that must be strictly followed.

87. B — A pinkish-purple tint in the treated water indicates that potassium permanganate is passing through the greensand filter bed and entering the distribution system. This means the regeneration cycle is not being fully rinsed, the filter media is channeled, or the regeneration dosage is excessive. The filter needs service to correct the breakthrough.

88. A — A sensor faucet that delivers water for only 2 seconds per activation has its run-time setting programmed too short. Most sensor faucets have adjustable run-time controls (typically 10–60 seconds per activation). The plumber adjusts the faucet's electronic control board or DIP switches to increase the run-time duration per activation cycle.

89. C — Most modern diaphragm expansion tanks can be mounted in any orientation — vertical, horizontal, or at any angle — without affecting performance. However, the mounting must adequately

support the tank's full weight (water + tank). A shelf mount is acceptable if the shelf supports the loaded weight.

90. B — Standard practice is to connect outdoor hose bibbs before the water softener (on the unsoftened, hard water side). This avoids wasting softened water on outdoor irrigation, car washing, and other non-potable outdoor uses. The softener processes only the water entering the building for indoor fixture use.

91. D — A 190-litre tank that yields only 130 litres before running dry indicates approximately 60 litres of sediment has accumulated at the bottom. Over 7 years, calcium carbonate, sand, and mineral deposits from the water supply settle and compact at the tank bottom, displacing usable water volume and insulating the lower heating element.

92. A — Expansion tank sizing is determined by four factors: the total system water volume (which determines the volume of water that expands), the temperature range from cold fill to operating (which determines the percentage of expansion), the system fill pressure (which determines the tank's starting condition), and the relief valve setting (which determines the maximum pressure the tank must accommodate).

93. C — The circulator should be on the supply pipe, pumping away from the expansion tank connection point. With the pump on the return and the tank on the supply, the pump's suction creates a low-pressure zone at the pump inlet. This low pressure can drop below atmospheric at high points in the system, drawing air in through automatic vents and creating recurring air problems.

94. B — Zones 1 and 4 have ΔT values below the 11°C design (10°C), indicating too much flow — water passes through too quickly and doesn't release enough heat. Their balancing valves should be partially closed. Zone 3 has ΔT above design (12°C), indicating slightly too little flow — its valve should be opened slightly. Zone 2 matches the design.

95. A — The LWCO has failed. When the water level in the float chamber drops below the float, the burner should shut off immediately. The burner continuing to fire despite a low water level confirms that the LWCO's float mechanism, switch, or wiring has failed. This is a critical safety device — the boiler must be shut down until the LWCO is repaired or replaced.

96. D — Exceeding the manufacturer's maximum glycol concentration (50% vs. 35% specified) reduces heat transfer efficiency (glycol has lower specific heat than water), increases viscosity (requiring more

pump energy), and may void the boiler manufacturer's warranty. The glycol concentration must be reduced to the specified 35% maximum.

97. C — A stuck-open main vent continuously passes live steam to the atmosphere instead of closing when steam arrives. This wastes energy (the steam's heat is lost outdoors), can cause moisture damage in the area around the vent, and reduces the system's efficiency by losing steam that should be condensing in radiators.

98. A — When the expansion tank pre-charge (140 kPa) exceeds the system fill pressure (103 kPa), the tank's diaphragm is pushed fully against the water inlet by the higher air pressure. No water can enter the tank because the air charge holds the diaphragm closed. The tank remains empty and cannot absorb any thermal expansion.

99. B — A cold spot in a previously warm radiant floor area most commonly indicates a damaged PEX tube — kinked, crushed, or punctured during construction activity (tile setting, fixture installation, or equipment placement) on the slab surface above. The damaged section restricts or blocks water flow through that loop.

100. A — A single condensing boiler serving both radiant floor (35°C) and baseboard (75°C) uses a mixing valve or injection pump on the radiant zone to reduce the boiler's higher output temperature down to 35°C. The baseboard zone receives the boiler's full supply temperature (75°C) directly. The boiler fires at the higher temperature to satisfy the baseboard zone.

101. D — If air returns to the radiators within hours of bleeding, air is being drawn into the system continuously. The most common source is a leak in the condensate return piping below the boiler's waterline. During steam operation, the slight vacuum created when steam condenses draws air into the return through the leak. The leak must be found and repaired.

102. B — An ECM variable-speed circulator automatically reduces its speed when zone valves close, matching energy consumption to actual system demand. When one zone valve closes, the pump slows proportionally. A standard fixed-speed pump runs at full power regardless of how many zones are open, wasting energy against the increased resistance.

103. A — A boiler that fires continuously without reaching setpoint despite correct gas pressure is producing less heat than the building demands. The boiler is undersized for the connected load during

peak conditions. This may have been adequate when originally installed but the building's heat loss may have increased (window additions, insulation degradation, new ventilation loads).

104. C — The pressuretrol (operating pressure control) has failed in the "call for heat" position. It is not sensing the pressure increase or not responding to it — the switch contacts remain closed regardless of the actual system pressure. The boiler continues firing past the 5 psig cut-out point. The high-limit pressure control or safety relief valve becomes the backup.

105. A — The floor surface temperature is determined by the supply water temperature (higher supply = warmer floor), the tubing spacing (closer spacing = more uniform, warmer surface), the floor covering material (tile conducts heat better than carpet), and the room's heat load demand (higher demand = system works harder). All four factors interact to produce the felt temperature.

106. A — After a summer drain, the system is refilled with water containing dissolved air. If the system is not adequately purged of air during refilling, air pockets block water circulation through the boiler and emitters. The boiler fires but the heat cannot be carried away because air-locked sections prevent water flow. The boiler water overheats and trips the high limit.

107. D — At maximum vent length, the inducer fan works at peak capacity to push exhaust through the long vent (increased load), more condensate forms inside the vent due to the longer pipe exposure to ambient temperature (requiring adequate slope), and the exhaust exits the terminal at a lower temperature (increasing the risk of visible plume and ice at the terminal). All three factors apply.

108. C — The cross-connection test pressurizes each system individually while monitoring all others. Pressurizing the oxygen system with no pressure change in any other system confirms that no physical cross-connection exists between the oxygen piping and any other gas or vacuum piping. However, this test must be repeated for each gas system individually to be complete (option D notes this).

109. D — "Breathing air" quality for air-supplied respirators must meet CSA Z180.1 standards, which specify maximum contaminant levels for CO, CO_2, oil, water, and particulates. The system requires a complete breathing air purification package including filtration, drying, CO monitoring at the compressor inlet, and certification that the delivered air meets the breathing air standard.

110. B — Low-pH (acidic) pool water attacks copper heat exchangers, causing accelerated corrosion that thins the heat exchanger walls and eventually causes leaks. Pool water chemistry must be

maintained within the specified pH range (7.2–7.6) to protect all metal components in the circulation system, especially the heater's copper heat exchanger.

111. A — The cross-connection test checks for connections between different systems — it pressurizes one system and monitors all others for pressure change. It does NOT verify that each outlet is connected to its correct gas source. An outlet correctly piped to the wrong gas source (oxygen outlet on the medical air line) would not be detected by the cross-connection test. This error is detected during the purity test.

112. C — The precipitation rate (25 mm/hr) exceeds the soil's infiltration rate (15 mm/hr). Water is being applied faster than the soil can absorb it, causing surface runoff. The solution is to reduce the precipitation rate (different nozzles), reduce the run time (shorter watering cycles), or use a "cycle and soak" schedule that alternates watering with absorption periods.

113. B — Flexible gas appliance connectors have a maximum length specified by the manufacturer — typically 1.2 to 1.8 metres (4 to 6 feet). The maximum length is a safety limitation based on the connector's construction, flexibility, and potential for damage. Excess length creates loops that can kink, and longer connectors are more susceptible to fatigue failure.

114. D — Sand filter media has a finite service life of approximately 5–7 years under normal conditions. After 8 years, the sand grains have calcified (mineral deposits coat the surfaces), channeled (water has carved preferential flow paths through the bed), or compacted — all reducing filtration effectiveness. The sand must be replaced with new filter media.

115. A — Dental compressors must be installed on vibration-isolating mounts to prevent vibration from transmitting through the building structure to the adjacent operatories. Sound insulation (acoustic enclosure or sound-dampening partition) may also be required to reduce airborne noise transmission to patient treatment areas.

116. C — When nearby outlets on the same branch deliver full flow but one outlet delivers only 50%, the restriction is at the individual outlet — not the supply manifold (which would affect all outlets) or the zone valve (which would affect all outlets equally). Internal debris, scale, or a damaged DISS mechanism restricts flow at that specific outlet.

117. B — Irrigation controllers operate zones sequentially — one zone runs, completes, then the next zone starts. With 8 zones at 20 minutes each: 8 × 20 = 160 minutes total. Starting at 6:00 AM, the last

zone would finish at 8:40 AM — 40 minutes after the 8:00 AM water window closes. The schedule must be reprogrammed to start earlier or reduce zone run times.

118. D — Cartridge filters cannot be backwashed — the reversed water flow would collapse the pleated element. If backwashing was inadvertently performed (by setting the multiport valve to "backwash" on a system with a cartridge filter), the reversed flow crushed the filter element inward. This is an operator error caused by misunderstanding the filter type.

119. A — Passivation restores the chromium oxide protective layer on the stainless steel surface that was disrupted by the heat of welding. The welding process creates a "heat affected zone" where the chromium oxide is depleted, leaving the steel vulnerable to corrosion. Passivation (typically using nitric or citric acid) regenerates this protective oxide layer.

120. C — After the irrigation blowout, the PVB must be drained by closing the main shutoff valve and opening both test cocks to release any trapped water. The compressed air blowout evacuates the irrigation piping but may not fully drain the PVB body. Trapped water inside the PVB will freeze, expand, and crack the body or damage internal components.

121. B — The drip leg (sediment trap) collects moisture, pipe scale, and debris from the gas supply line before they can enter the makeup air unit's gas valve and burner assembly. Contaminants in the gas valve cause malfunction, incomplete combustion, and potential safety hazards. The drip leg's capped bottom traps the material by gravity.

122. D — Medical gas copper tube must be maintained in factory-sealed condition until installation. Once the end caps are removed, the tube interior is exposed to dust, oil, moisture, and other contaminants from the shop environment. Extended exposure compromises the tube's medical-grade cleanliness. The tube must be recleaned to medical gas standards or replaced.

123. B — Different pool functions require different flow rates. Low speed provides adequate circulation for daily filtration at minimal energy cost. Medium speed increases flow through the heater for efficient heat transfer. High speed maximizes suction for manual vacuuming. Variable-speed pumps save 60–80% energy compared to single-speed pumps running at full speed continuously.

124. A — Compressed air receiver tanks are pressure vessels subject to jurisdictional codes requiring periodic inspection and certification. A 25-year-old tank, even if visually sound, should comply with

local pressure vessel inspection requirements — which may include hydrostatic testing, ultrasonic wall thickness measurement, or re-certification.

125. D — A failed pump bearing allows the motor shaft to wobble on its axis. This wobble destroys the mechanical seal (which depends on precise shaft alignment to maintain its watertight barrier), causing the pump to leak water at the shaft penetration. Continued operation leads to motor damage from water intrusion and complete pump failure.