PRACTICE EXAM 10: RED SEAL PLUMBER SIMULATION (125 QUESTIONS)

1. A plumber working in a hospital mechanical room smells natural gas. The plumber's personal gas monitor does not detect combustible gas. The smell persists. What should the plumber do?

A. Continue working because the personal monitor confirms there is no combustible gas present in the room

B. Increase ventilation by opening windows and doors to dissipate the odour before resuming work activities

C. Evacuate the area and report the gas smell to the facility manager — the monitor may not detect all mercaptan concentrations

D. Locate the gas meter and check for visible damage before deciding whether evacuation is warranted

2. A plumber is assigned to work in a trench that is 1.8 metres deep. The soil is classified as Type C (granular, previously disturbed). What is the maximum allowable angle for sloping the trench walls in Type C soil?

A. 1H:1V (45 degrees from horizontal), which is the maximum slope permitted for the least stable soil type

B. 3/4H:1V (53 degrees from horizontal), which is permitted for Type B soil classifications in stable conditions

C. 1/2H:1V (63 degrees from horizontal), which is the steepest slope permitted for any soil classification type

D. Vertical walls (90 degrees) are permitted for Type C soil if the trench is less than 2 metres in total depth

3. A plumber must install a gastight pipe penetration through a firerated wall assembly. The penetration uses a 3inch steel sleeve with a 2inch copper pipe passing through it. What must fill the annular space between the copper pipe and the steel sleeve?

A. Standard silicone caulk that provides a flexible, gastight, and waterresistant seal in the annular space

B. Expanding spray foam insulation that fills the annular space completely and insulates the pipe at the wall

C. Mineral wool packing compressed tightly into the annular space with a metal escutcheon plate on each side

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

4. A plumber is reviewing a project's mechanical drawings. The drawing scale is noted as 1:50. A pipe run measures 120 mm on the drawing. What is the actual length of the pipe run in the field?

A. 2.4 metres, calculated by dividing the drawing measurement by the scale factor of 50 for metric conversion

B. 6.0 metres, calculated by multiplying the drawing measurement of 120 mm by the scale factor of 50

C. 12.0 metres, calculated by multiplying 120 mm by 100 to convert to metres and then by the scale factor

D. 0.6 metres, calculated by dividing the drawing measurement of 120 mm by 200 for the reduced scale ratio

5. A plumber is using a laser level to establish the slope for a horizontal building drain. The laser level projects a perfectly horizontal reference line on the wall. The drain must slope at 1/4 inch per foot. Over a 20foot run, how far below the laser line should the far end of the pipe be?

A. 2.5 inches, calculated by multiplying the slope by half the pipe run length for the average drop distance

B. 10.0 inches, calculated by multiplying the slope by twice the pipe run length for safety margin purposes

C. 5.0 inches, calculated by multiplying the 1/4inchperfoot slope by the 20foot run length for total fall

D. 1.25 inches, calculated by dividing the total run by the slope factor for the minimum measurable drop distance

6. A plumber discovers that a coworker has stored oily rags in a cardboard box in the back of the work van. The van is parked in the sun. What hazard does this present?

A. Spontaneous combustion — oily rags can selfignite when heat builds up in the confined, unventilated space

B. Chemical exposure to passengers through offgassing of volatile organic compounds from the oilsoaked fabric

C. Slip hazard if the oily rags fall from the box and land on the van floor near the entry door during transit

D. Environmental contamination if the oils leach through the cardboard box and drip onto the van floor surface

7. A plumber must calculate the diagonal measurement of a rectangular room to verify that the room is square before installing drainage piping. The room measures 3 metres by 4 metres. Using the Pythagorean theorem, what should the diagonal measure?

A. 7.0 metres, calculated by adding the two wall measurements together for the total diagonal distance

B. 3.5 metres, calculated by averaging the two wall measurements for the approximate diagonal distance

C. 12.0 metres, calculated by multiplying the two wall measurements for the diagonal area equivalence

D. 5.0 metres, calculated as the square root of $(3^2 + 4^2) = \sqrt{(9 + 16)} = \sqrt{25} = 5.0$ metres

8. A plumber working on a commercial project is asked by the general contractor to install a pipe material that differs from the approved drawings and specifications. The contractor says the substitution is equivalent. What is the correct procedure?

A. Install the substitute material immediately because the general contractor has authority over all material decisions

B. Refuse the substitution until it is approved through a formal change order or submittal process by the engineer

C. Install the substitute material but document the change in the daily report for the record as a field decision

D. Contact the pipe manufacturer directly to verify equivalency before proceeding with the installation change

9. A plumber is cutting cast iron pipe with a snap cutter (soil pipe cutter) on the ground floor of a building. The cut pipe section weighs approximately 30 kg. After cutting, the plumber must lower the cut piece to the floor. What is the safe handling method?

A. Catch the cut piece as it separates from the supported section and lower it by hand in a controlled manner

B. Allow the cut piece to drop to the floor because 30 kg is not heavy enough to cause damage to the concrete

C. Support the cut piece with a strap or have a second worker support it before completing the cut, then lower it together

D. Kick the cut piece sideways as it separates to direct it away from the plumber's feet and body during the fall

10. A plumber is required to install pipe supports on a structural steel beam using Cclamps. The beam flange is 12 mm thick. The Cclamp jaw has a maximum opening of 25 mm. Is this clamp suitable?

A. Yes — the 25 mm jaw accommodates the 12 mm flange with adequate clearance for the set screw to engage securely

B. No — the Cclamp jaw must exactly match the flange thickness for proper grip without any excess gap or clearance

C. Yes — but only if the plumber adds a steel shim between the set screw and the flange to fill the extra 13 mm gap

D. No — Cclamps with jaw openings exceeding the flange thickness by more than 5 mm cannot develop adequate clamping force

11. A plumber must convert a gas appliance's rated input from BTU per hour to kilowatts for a code compliance calculation. The appliance is rated at 100,000 BTU/hr. Using the conversion factor of 1 kW = 3,412 BTU/hr, what is the input rating in kilowatts?

A. 341,200 kW, calculated by multiplying the BTU rating by the conversion factor for metric equivalent

B. 34.12 kW, calculated by dividing the BTU rating by 3,000 as a simplified field conversion estimate

C. 3.412 kW, calculated by dividing the conversion factor by the BTU rating for the inverse relationship

D. 29.3 kW, calculated by dividing 100,000 BTU/hr by 3,412 BTU/kW for the correct metric conversion

12. A plumber is working on a rooftop in summer. The ambient temperature is 35°C. The plumber has been working for 3 hours without a break. The plumber begins to feel dizzy, confused, and stops sweating despite the heat. What condition do these symptoms indicate?

A. Mild heat exhaustion that will resolve with a 10minute rest break in the shade before returning to the work

B. Heat stroke — a medical emergency requiring immediate cooling, fluid administration, and emergency medical services

C. Normal fatigue from physical labour in warm weather that is expected during summer rooftop plumbing work

D. Dehydration that requires the plumber to drink several glasses of water and resume work within 30 minutes

13. A plumber is installing pipe in a mechanical room that has an overhead bridge crane used by the HVAC contractor. The crane traverses the room on rails mounted to the building structure. What must the plumber verify before installing pipe supports in the crane's travel path?

A. That pipe supports and piping will not obstruct the crane's travel path or conflict with its operational clearances

B. That the crane is locked out before any pipe is installed because the crane may activate unexpectedly at any time

C. That the pipe is installed at a lower elevation than the crane rail so the crane can pass over the piping freely

D. That the crane is removed from the building before plumbing installation begins to eliminate all overhead hazards

14. A plumber must select a drill bit for creating a 100 mm (4inch) diameter hole through a 200 mm (8inch) reinforced concrete wall for a pipe sleeve installation. What type of bit is most appropriate?

A. A spade bit rated for masonry at 100 mm diameter with a standard power drill operating at maximum speed

B. A hole saw with carbide teeth mounted on a standard drill, operating at moderate speed with steady pressure

C. A diamond core bit mounted on a core drilling rig, with water feed for cooling and dust suppression

D. A masonry twist bit at 100 mm diameter in a standard rotary hammer drill with the hammer function engaged

15. A plumber discovers that a new apprentice has been using a pipe wrench to tighten a brass compression fitting on a water supply connection. The compression nut is scratched and deformed. What tool should have been used?

A. A strap wrench that grips the fitting without teeth, preventing damage to the brass surface finish and shape

B. Channellock pliers adjusted to fit the compression nut snugly for a controlled tightening without marring

C. A pipe wrench is acceptable for brass compression fittings if the jaws are wrapped with a protective cloth

D. Two adjustable wrenches — one on the fitting body and one on the compression nut — for controlled tightening

16. A plumber is reviewing the National Plumbing Code of Canada. The code contains both "prescriptive" requirements and "objectivebased" provisions. What is the fundamental difference between these two code paths?

A. Prescriptive requirements apply only to residential buildings while objectivebased provisions apply to commercial

B. Prescriptive requirements specify exactly how to build, while objectivebased provisions specify what the building must achieve

C. Prescriptive requirements are mandatory while objectivebased provisions are advisory recommendations only

D. Prescriptive requirements are found in the code body while objectivebased provisions are found in appendix notes

17. A plumber is installing copper pipe and must select between 50/50 tinlead solder and leadfree solder for a DWV drainage connection. The DWV system does not carry potable water. Can the plumber use 50/50 tinlead solder on DWV copper joints?

A. No — all solder used on any copper plumbing piping must be leadfree regardless of whether it carries potable water

B. Yes — tinlead solder is permitted on DWV copper piping because drainage piping does not carry drinking water

C. No — tinlead solder has been completely removed from the market and is no longer available for any application

D. Yes — but only if the DWV system is clearly labeled as nonpotable at every visible joint throughout the installation

18. A plumber is installing Schedule 40 PVC pressure pipe for a cold water supply line in a residential irrigation system. The pipe's maximum operating pressure at 23°C is 1,034 kPa (150 psi). The irrigation system operates at 415 kPa (60 psi). Is Schedule 40 PVC adequate for this application?

A. No — Schedule 40 PVC is rated only for DWV applications and cannot be used for any pressurized water system

B. No — irrigation systems require Schedule 80 PVC because of the pressure surges from sprinkler valve operation

C. Yes — the 1,034 kPa rating far exceeds the 415 kPa operating pressure with a substantial safety margin

D. Yes — but only if the pipe is installed underground where the soil provides lateral support against pressure burst

19. A plumber must join two dissimilar metal pipes — a 2inch copper water supply transitioning to a 2inch galvanized steel pipe serving an existing fixture. What fitting prevents galvanic corrosion at this transition?

A. A standard brass coupling that threads onto the galvanized pipe and solders to the copper pipe for the transition

B. A rubber fernco coupling that physically separates the two metals while providing a flexible mechanical joint

C. A coppertosteel reducing bushing that steps down the copper diameter to match the galvanized steel ID

D. A dielectric union with an insulating washer and sleeve that electrically separates the copper from the steel

20. A plumber is preparing to solder a copper joint in a horizontal position. The pipe and fitting have been cleaned and fluxed. Before applying the torch, the plumber assembles the joint and gives the fitting a quarterturn twist. What is the purpose of this twist?

A. The twist locks the fitting mechanically onto the pipe so it cannot slide off during the heating operation

B. The twist distributes the flux evenly around the entire circumference of the joint's mating surfaces

C. The twist removes excess flux from the joint that would otherwise create a thick, uneven solder ring

D. The twist marks the insertion depth on the pipe so the plumber can verify full engagement after soldering

21. A plumber installs a 4inch PVC DWV cleanout at the base of a soil stack. The fitting has a threaded plug with a gasket. After installation, the plumber tests the system with air at 35 kPa. The pressure drops slowly. The plumber applies soap solution to the cleanout plug and observes small bubbles forming at the threads. What is the fix?

A. Replace the cleanout plug with a new one because the threads are damaged and cannot seal against air pressure

B. Apply PTFE tape to the cleanout plug threads and retighten to achieve an airtight seal for the test duration

C. Remove the plug, inspect and clean the gasket, lubricate the gasket, and reinstall with proper torque

D. Increase the air pressure to 70 kPa to force the gasket to compress more tightly against the fitting body

22. A plumber is installing PEXB tubing using stainless steel cinch clamps (ear clamps). The clamp is positioned over the fitting's barb area and the plumber crimps the ear with a cinch clamp tool. What advantage do cinch clamps provide over standard copper crimp rings?

A. Cinch clamps are significantly less expensive per connection than copper crimp rings for residential installations

B. Cinch clamps provide a stronger mechanical grip on the PEX tube than copper crimp rings at all temperatures

C. Cinch clamps require a single universal tool size for all PEX diameters, unlike crimp rings which need sized jaws

D. Cinch clamps are approved for higherpressure applications than copper crimp rings per the manufacturer's ratings

23. A plumber is brazing a copper refrigerant line using BCuP5 (15% silver) filler metal. The joint requires a nitrogen purge during brazing. After completing the joint, the plumber must continue the nitrogen flow for how long after the torch is removed?

A. No additional flow is needed — the nitrogen can be shut off immediately when the torch flame is extinguished

B. 5 seconds after the torch is removed, which allows the solder to solidify before the purge is discontinued

C. 30 seconds after the torch is removed, which is the minimum cooldown time for all brazed copper connections

D. Until the joint has cooled below oxidation temperature (approximately 260°C), preventing postbraze oxide formation

24. A plumber encounters a situation where a 3inch copper DWV pipe must pass through a steel beam's web. The beam has an existing 4inch round hole cut by the structural steel fabricator. The plumber passes the 3inch pipe through the 4inch hole. What must be done with the annular space?

A. Fill the annular space with expanding spray foam insulation to prevent air leakage and insulate the pipe

B. Install a rubber grommet or escutcheon that seals the space and prevents the pipe from contacting the steel directly

C. Leave the annular space open to allow for thermal expansion movement of the copper pipe through the steel beam

D. Weld a steel collar around the pipe at the beam penetration to create a rigid connection between pipe and beam

25. A plumber is threading a 3/4inch galvanized steel pipe for a natural gas installation. After cutting and reaming the pipe end, the plumber begins threading. How many threads should the die produce for a standard 3/4inch NPT connection?

A. Approximately 10 threads at 14 threads per inch, which is the standard NPT specification for 3/4inch pipe

B. Approximately 14 threads at 18 threads per inch, which provides maximum thread engagement for gas piping

C. Approximately 5 threads at 8 threads per inch, which is the standard for heavywall gas pipe installations

D. The number of threads depends on the wall thickness — thicker walls require more threads for adequate engagement

26. A plumber installs a residential DWV system with a 3inch soil stack serving two bathrooms (one on each floor). Each bathroom has a water closet (3 DFU), a lavatory (1 DFU), and a bathtub (2 DFU). The total load on the stack is 12 DFU. The code permits up to 42 DFU on a 3inch stack. Is any fixture connection prohibited on this stack despite the DFU capacity being adequate?

A. No — as long as the total DFU does not exceed the stack's rated capacity, all fixture types may connect freely

B. Yes — a 3inch stack cannot receive a water closet drain larger than 3 inches, but this is not an issue here since the WC drain is 3 inches

C. Yes — a bathtub cannot connect to a soil stack that also serves a water closet due to trap seal interference

D. No — but the lavatory must connect through a wet vent rather than an individual vent on a 3inch stack

27. A plumber discovers that an existing building's DWV system has a vent pipe that connects to the drainage piping below the flood level rim of a fixture on the same floor. The vent runs downward from this connection before turning upward through the wall. What code violation exists?

A. The vent connection is acceptable as long as the vent eventually rises above the flood level rim before exiting the wall

B. The downwardrunning vent section creates a potential trap in the vent piping that could fill with water and block air flow

C. The vent connection below the flood level rim is acceptable because all vents eventually reach atmospheric pressure at the roof

D. The vent must connect above the centre line of the pipe AND above the flood level rim of the highest fixture it serves

28. A plumber is sizing a building drain for a small office building. The building has 4 water closets (3 DFU each), 4 lavatories (1 DFU each), and 1 kitchen sink (2 DFU). What is the total DFU load and what minimum pipe size is required at 1/4inchperfoot slope?

A. 18 DFU total — a 3inch building drain at 1/4 inch per foot accommodates up to 27 DFU and is adequate

B. 14 DFU total — a 3inch building drain is adequate but a 4inch is recommended for future expansion

C. 22 DFU total — a 4inch building drain is required because the total exceeds the 3inch capacity at this slope

D. 18 DFU total — a 4inch building drain is required because the building has more than three water closets

29. A plumber is installing a grease interceptor for a small cafe. The interceptor's rated flow must match or exceed the combined flow from all connected fixtures. The cafe has a twocompartment sink (20 LPM flow rate) and a prerinse spray valve (7 LPM flow rate). What minimum interceptor flow rating is required?

A. 20 LPM, matching only the highest individual fixture flow rate because fixtures do not operate simultaneously

B. 13.5 LPM, calculated as 50% of the combined flow rate to account for alternating fixture use during operations

C. 27 LPM or greater, calculated as the combined flow rate of all connected fixtures that may operate simultaneously

D. 40 LPM, calculated by doubling the combined flow rate to provide a safety margin for peak grease loading periods

30. A plumber discovers that an existing residential bathroom has a 11/4inch trap on a bathtub drain. The code requires a minimum 11/2inch trap for bathtubs. The bathtub drains slowly but does not clog. Is the undersized trap acceptable?

A. Yes — the 11/4inch trap is functioning and does not need to be replaced as long as drainage is satisfactory

B. No — the undersized trap must be replaced with a 11/2inch minimum as required by the code during any renovation work

C. Yes — the code minimum applies only to new installations; existing traps of any size are grandfathered indefinitely

D. No — but only if the renovation requires a plumbing permit; unpermitted work can retain the existing trap size

31. A plumber is installing a building sewer that must pass beneath an existing storm sewer pipe already buried in the ground. The building sewer will cross below the storm sewer. What separation must be maintained between the two pipes at the crossing?

A. No separation is required because both pipes are part of the building's drainage system and carry similar waste

B. A minimum of 150 mm (6 inches) vertical separation between the exterior surfaces of the two pipes at the crossing

C. The building sewer must be encased in concrete for 1.5 metres on each side of the crossing point for protection

D. A minimum vertical separation as specified by the local code, typically 150–300 mm with the sanitary sewer below

32. A plumber is troubleshooting a multistorey building where the thirdfloor bathroom has recurring trap seal loss on the lavatory. The trap refills after each use but partially drains within minutes. No gurgling is heard. What mechanism of trap seal loss is occurring?

A. Induced siphonage from other fixtures on the same stack creating negative pressure in the branch

B. Back pressure from a partially blocked building drain pushing gas up through the trap seal intermittently

C. Evaporation from infrequent use causing the trap seal to gradually deplete between fixture uses

D. Selfsiphonage — the lavatory's own discharge creates a siphon effect in the trap arm that pulls the seal down

33. A plumber installs a 4inch building drain beneath a basement floor slab. The drain connects to the building sewer at the foundation wall. A cleanout is installed at the base of the soil stack inside the building. The building sewer runs 20 metres to the municipal connection. Where must additional cleanouts be installed on the building sewer?

A. At the foundation wall exit point and at a maximum 15metre interval thereafter on the building sewer run

B. Only at the municipal connection point, because one cleanout at the stack base serves the entire building drain

C. At 3metre intervals along the entire 20metre building sewer run for maximum maintenance access frequency

D. No additional cleanouts are needed because the cleanout at the stack base provides access to both the drain and sewer

34. A plumber installs a DWV system in a singlestorey commercial building. The system includes 6 water closets, 6 lavatories, 2 floor drains, and 1 mop sink. All fixtures connect to a single horizontal building drain. The total DFU is 35. The building drain is installed at 1/4 inch per foot. What is the minimum building drain diameter?

A. 3 inches, which accommodates up to 27 DFU at 1/4 inch per foot — this is undersized for the 35 DFU load

B. 4 inches, which accommodates up to 216 DFU at 1/4 inch per foot — adequate for the 35 DFU load

C. 5 inches, which is required for commercial buildings regardless of the actual fixture unit calculation result

D. 6 inches, which is the minimum for any building with more than 5 water closets connected to a single drain

35. A plumber encounters a building where the vent stack extends through the roof but the opening has been covered with a mesh screen to prevent bird nesting. Is this screen installation acceptable?

A. Yes — mesh screens are recommended on all vent terminals to prevent birds, insects, and debris from entering

B. Yes — but only if the mesh opening size is large enough to prevent restriction during cold weather ice formation

C. No — mesh screens can clog with frost, debris, and insect nests, potentially blocking the vent opening entirely

D. No — vent terminals must remain completely open and unobstructed; screens reduce airflow and can accumulate frost

36. A plumber is installing an underground storm sewer pipe and must connect to an existing concrete catch basin. The connection is made through a coredrilled hole in the catch basin wall. What seals the pipe connection to the concrete?

A. A bead of hydraulic cement applied around the pipe where it passes through the coredrilled hole in the concrete

B. A boot seal (rubber link seal) that compresses between the pipe and the concrete wall to create a watertight connection

C. A gasketed PVC adapter fitting that inserts into the coredrilled hole and provides a bellandspigot connection

D. A combination of mortar and rubber waterstop material packed into the annular space for a flexible watertight seal

37. A plumber is sizing a vent for a horizontal branch drain that serves 10 DFU. The developed length of the vent from the branch connection to the roof terminal is 15 metres. The code sizing table shows that a 11/2inch vent at 15 metres accommodates 8 DFU (insufficient) and a 2inch vent at 15 metres accommodates 24 DFU (sufficient). What is the minimum vent diameter?

A. 2 inches, because the 11/2inch vent is undersized for 10 DFU at 15 metres and the next available size is 2 inches

B. 13/4 inches, which is the interpolated diameter between 11/2 and 2 inches for the 10 DFU load at 15 metres

C. 11/2 inches, because it is the closest standard size to the required capacity and is acceptable with a tolerance

D. 21/2 inches, which is required because the vent must be at least one size larger than the minimum calculated size

38. A plumber discovers that a building's soil stack has a horizontal offset between the first and second floors. The offset uses two 45degree fittings with a 3metre horizontal run between them. A water closet connects to the stack immediately above the offset. The plumber notices that the water closet frequently clogs. What is the most likely cause?

A. The offset creates turbulence that disrupts the waste flow from the water closet into the horizontal section

B. The water closet's flush volume is insufficient for the 3metre horizontal offset section below the connection

C. The two 45degree fittings create a combined 90degree turn that is too abrupt for soil pipe applications

D. The horizontal offset acts as a branch drain and must be properly sloped, supported, and vented — a clog indicates inadequate slope

39. A plumber installs a floor drain in a commercial kitchen freezer room. The floor drain must prevent sewer gas from entering the freezer. However, the floor drain's trap will freeze solid in the 18°C freezer. What solution prevents both freezing and gas entry?

A. Install a trap seal primer that continuously adds warm water to the trap to prevent it from freezing solid

B. Install a trap with a builtin antifreeze barrier (glycolfilled trap seal) or a mechanical trap designed for freezer applications

C. Install a deeper trap (100 mm seal) that takes longer to freeze and provides more time between freezethaw cycles

D. Install the floor drain without a trap because sewer gas concerns are overridden by the freezing concern in freezer rooms

40. A plumber is installing underground DWV piping for a building addition. The new piping must connect to the existing building drain at a point where the drain is 1.2 metres below the finished floor. The connection fitting must be installed on the existing drain without removing the entire drain section. What fitting type allows this?

A. A saddle fitting or tapping tee that mounts on the existing pipe without requiring the pipe to be cut apart completely

B. A mechanical coupling installed after removing a short section of the existing drain and inserting the new branch connection

C. A standard sanitary tee that replaces the existing section of drain, requiring the drain to be cut and a section removed

D. A reducing wye cemented directly onto the outside of the existing pipe with a hole drilled through for the connection

41. A plumber discovers during a renovation that a building has an improperly installed Strap on a bathroom lavatory. The lavatory drain drops vertically from the sink tailpiece into the wall through a vertical pipe section before connecting to a horizontal drain inside the wall. Why is this Strap configuration a code violation?

A. The vertical drop below the trap creates a siphon condition — when the sink discharges, the flowing water pulls the seal out

B. Straps are only prohibited on kitchen sinks because of grease accumulation — they are acceptable on bathroom lavatories

C. Straps are prohibited because they are too deep and create excessive flow resistance that slows fixture drainage

D. The Strap configuration violates the code only if the vertical drop exceeds 600 mm from the trap weir to the wall entry

42. A plumber is installing a 6inch building drain in a commercial building. The drain must change direction by 90 degrees at a corner in the basement. What fitting or combination of fittings should be used?

A. A single shortpattern 90degree elbow, which makes the turn in the smallest space available at the corner

B. Two 45degree elbows with a short straight section between them, providing a gradual swept direction change

C. A sanitary tee installed horizontally with one end capped to provide a cleanout access point at the corner turn

D. Two 45degree elbows or a longsweep 90degree elbow to provide a gradual direction change that prevents blockages

43. A plumber is troubleshooting a commercial building where every floor drain in the building emits sewer gas simultaneously. All fixture traps in the building have water seals. The vent terminal is clear. The building sewer is not blocked. What could cause gas to escape from every floor drain at the same time?

A. The floor drain traps have all evaporated simultaneously due to the building's HVAC system creating dry air conditions

B. All floor drains are connected to the storm drainage system, which is not trapped, rather than the sanitary system

C. The building drain has a running trap (house trap) that has lost its seal, allowing gas to enter all downstream drains

D. Negative building pressure from the HVAC system is drawing gas through every floor drain trap seal simultaneously

44. A plumber installs a new septic system and must determine the tank size. The provincial code requires a minimum septic tank capacity based on the number of bedrooms. The house has 4 bedrooms. The code minimum for a 4bedroom house is typically 3,600 litres (approximately 950 US gallons). The plumber selects a 4,500litre tank. Is this an acceptable size?

A. Yes — the 4,500litre tank exceeds the 3,600litre minimum, providing additional capacity and longer pumpout intervals

B. No — oversizing the tank causes the effluent to flow through too slowly, reducing the treatment effectiveness

C. Yes — but only if the homeowner signs an acknowledgment that the oversized tank requires more frequent pumping

D. No — the tank must be exactly the codeminimum size to match the design criteria for the disposal field capacity

45. A plumber is installing a vent connection on a 2inch horizontal trap arm. The trap arm slopes at 1/4 inch per foot from the fixture trap to the vent connection. The vent tee is installed at the connection point. At the tee, the bottom of the trap arm pipe is approximately 40 mm lower than the bottom at the trap weir due to the slope. Is the vent connection position correct?

A. No — the vent connection should be at the highest point of the trap arm, not at the lower end where it has dropped

B. No — the vent tee should be installed at the trap weir end of the arm where the pipe is at its maximum elevation

C. Yes — the vent connects at the end of the trap arm within the maximum permitted trap arm length, and the slope is correct

D. Yes — but only if the vent connection is made above the centre line of the pipe at the tee location as required by code

46. A plumber is installing a building sewer using ductile iron pipe with mechanical joint connections. The sewer must cross beneath an active railway. Why is ductile iron specified for this section?

A. Ductile iron is less expensive than PVC for sewer applications under railways due to bulk purchasing discounts

B. Ductile iron is easier to install than PVC because mechanical joints require no curing time before backfilling

C. PVC pipe produces static electricity when buried under railways that interferes with railway signaling equipment

D. Ductile iron provides the structural strength needed to withstand the dynamic loads from heavy rail traffic above

47. A plumber encounters a building where the 4inch soil stack terminates inside the attic with an air admittance valve (AAV) instead of extending through the roof. Is this installation codecompliant?

A. Yes — AAVs are approved as the sole venting device for soil stacks in all Canadian jurisdictions and building types

B. No — at least one vent stack in every building must extend through the roof to the open atmosphere for gas relief

C. Yes — but only for residential buildings with fewer than 10 DFU total on the entire DWV system installation

D. No — AAVs are prohibited on soil stacks and may only be used on individual fixture trap arms in residential work

48. A plumber is calculating the required slope for a 50metre (approximately 164foot) run of 6inch building sewer at the code minimum slope of 1/8 inch per foot. What is the total fall?

A. Approximately 20.5 inches (520 mm), calculated as 164 feet × 1/8 inch per foot = 20.5 inches of total fall

B. 12.5 inches (318 mm), calculated using the 1/4inch slope instead of the 1/8inch slope for the 6inch pipe

C. 82 inches (2,083 mm), calculated using the 1/2inch slope that is the maximum recommended for all pipe sizes

D. 41 inches (1,041 mm), calculated using the 1/4inch slope multiplied by the 164foot run length for the pipe

49. A plumber discovers during a video inspection that a section of PVC building sewer has multiple cracks along its length. The cracks are longitudinal (running along the pipe's axis). What is the most likely cause of these longitudinal cracks?

A. Excessive internal pressure from the drainage system that exceeded the pipe's burst strength during a surcharge event

B. Thermal expansion stress from hot water discharge that caused the PVC to expand beyond its elastic limit

C. Improper bedding — the pipe was placed on rocky or uneven ground that created point loads causing the wall to split

D. Chemical attack from industrial waste that deteriorated the PVC material from the interior surface outward

50. A plumber installs a 3inch vent pipe that extends through the roof. The vent terminal must be located relative to any window, door, or air intake that is within a horizontal distance of 3 metres. How must the vent terminal be positioned?

A. The vent terminal must be relocated to a position more than 3 metres from any window, door, or air intake opening

B. The vent terminal may remain within 3 metres but must extend lower than the bottom of the nearest window opening

C. The vent terminal must be capped with a charcoal filter when located within 3 metres of a window or air intake

D. The vent terminal must extend at least 900 mm (3 feet) above any window, door, or air intake within 3 metres

51. A plumber installs a washing machine drain standpipe in a laundry room. The standpipe is 2inch diameter. The washing machine's discharge pump delivers water at a high velocity. What prevents the discharge from overflowing the top of the standpipe?

A. The standpipe must be tall enough (typically 750–900 mm above the trap weir) to contain the machine's maximum pump height

B. A check valve at the top of the standpipe prevents the highvelocity discharge from splashing over the rim

C. The standpipe diameter must be at least twice the machine's discharge hose diameter to prevent overflow conditions

D. A flow restrictor on the washing machine's discharge hose limits the pump velocity to prevent standpipe overflow

52. A plumber encounters an older commercial building where the building drain exits through the foundation wall and connects directly to a clay tile building sewer. The clay sewer has offset joints and root intrusion visible on video inspection. The building owner wants to rehabilitate the sewer without excavation. What trenchless method is most appropriate?

A. Pipe bursting, which fractures the clay tile and simultaneously pulls new HDPE pipe into the existing pipe's path

B. Horizontal directional drilling of a completely new sewer line alongside the existing deteriorated clay sewer

C. CIPP (curedinplace pipe) lining, which inserts a resinsaturated liner that cures to form a new pipe inside the clay

D. Electrofusion repair that seals each offset joint individually using heated patches applied from inside the pipe

53. A plumber is sizing a horizontal branch drain to serve a commercial washroom with 3 water closets (3 DFU each), 3 urinals (2 DFU each), and 3 lavatories (1 DFU each). The total DFU is 18. What minimum pipe diameter is required for this branch?

A. 3 inches, which accommodates up to 27 DFU at code minimum slope and carries the water closet soil waste

B. 4 inches, which is required because the branch serves more than 2 water closets regardless of the DFU count

C. 2 inches, which accommodates up to 21 DFU at code minimum slope for branches without water closets connected

D. 5 inches, which is the minimum for any commercial washroom branch serving more than 6 individual fixtures

54. A plumber is installing a sewage ejector system in a residential basement. The force main from the ejector connects to the gravity building drain on the ground floor. The force main runs vertically 3 metres from the basement pit to the ground floor. After the pump shuts off, the column of water in the force main drains back into the pit. What device prevents this?

A. A gate valve at the top of the force main that the homeowner closes manually after each pump cycle completes

B. A pressurereducing valve at the top of the force main that closes when the pump's discharge pressure drops

C. An expansion tank on the force main that absorbs the column of water when the pump shuts off during each cycle

D. A check valve on the force main that holds the water column in the pipe when the pump shuts off

55. A plumber is installing a DWV system and must select the correct fitting for connecting a 2inch horizontal branch drain to a 4inch horizontal building drain. Both pipes are at the same elevation. What fitting type is correct?

A. A 4×4×2 reducing wye or reducing combination wye and eighth bend for a smooth horizontaltohorizontal entry

B. A 4×4×2 reducing sanitary tee installed horizontally to connect the branch at a 90degree angle to the drain

C. A 4×4×2 reducing double wye that provides simultaneous connections for two branches on opposite sides

D. A 4×4×2 reducing coupling that simply merges the smaller branch into the larger drain without a directional fitting

56. A plumber discovers that an existing septic system has been receiving discharge from a water softener's regeneration cycle for the past 10 years. The septic system's disposal field has failed — effluent is surfacing in the yard. Could the water softener discharge have contributed to the field failure?

A. No — water softener brine is harmless to septic systems and cannot contribute to disposal field failure

B. No — the volume of water from softener regeneration is too small to have any measurable effect on the system

C. Yes — the sodium chloride brine can affect soil structure and bacteria, potentially contributing to reduced performance

D. Yes — the softener brine has dissolved the septic tank's concrete, causing structural failure of the tank itself

57. A plumber installs a residential water supply system. The municipality requires a water meter at the service entry. The plumber installs the meter with an integral check valve (built into the meter body). This check valve creates a closed system. What additional component is now required?

A. A pressurereducing valve to limit the supply pressure to the code maximum of 550 kPa at all fixtures

B. A thermal expansion tank because the meter's check valve prevents expanded water from relieving to the main

C. A backflow preventer downstream of the meter to provide crossconnection protection for the municipal main

D. A pressure booster pump to overcome the additional friction loss created by the meter and check valve assembly

58. A plumber is troubleshooting a residential water system. The homeowner reports that when the dishwasher fills, the kitchen faucet flow drops noticeably, but the bathroom fixtures (farther from the water heater) are unaffected. What is the most likely cause?

A. The water heater's dip tube has failed and is restricting flow to both the dishwasher and kitchen faucet simultaneously

B. The municipal supply pressure fluctuates during dishwasher fill cycles due to the highvolume demand on the main

C. The bathroom fixtures are on a largerdiameter branch that is not affected by the dishwasher's flow demand

D. The dishwasher and kitchen faucet share a common branch that is undersized for their simultaneous demand

59. A plumber discovers that a building's hot water system uses a mixing valve at the water heater outlet to temper the 60°C stored water to 49°C for distribution. The mixing valve has failed and is delivering 60°C water directly to the fixtures. What is the immediate risk?

A. The 60°C water will damage the PEX distribution piping by exceeding its maximum continuous temperature rating

B. The water heater will shortcycle because the failed valve causes the heater to lose heat faster than it can recover

C. Scalding injury to building occupants — 60°C water can cause serious burns within seconds of skin contact

D. The water heater's T&P relief valve will open because the failed mixing valve creates backpressure on the heater

60. A plumber is installing a water supply to a building that has both a domestic potable system and a nonpotable rainwater harvesting system for toilet flushing. The two systems must be completely separate with no crossconnections. What physical identification distinguishes the rainwater piping from the potable piping?

A. Purple pipe colour, labeling, and pipe markers on the nonpotable rainwater piping per code requirements

B. Both systems use the same pipe colour because the building's plumbing drawings differentiate them on paper

C. The rainwater piping is identified by green colour coding that matches the DWV drainage pipe identification

D. Only the potable piping is identified — the rainwater system uses unmarked pipe because it is nonpressurized

61. A plumber installs a commercial water heater with a capacity of 450 litres and a recovery rate of 400 litres per hour. The building's peak demand is 600 litres in a 45minute period. Is this heater adequate?

A. No — the heater cannot deliver 600 litres in 45 minutes because the storage plus recovery totals only 550 litres

B. Yes — the heater's 400 LPH recovery provides 300 litres in 45 minutes, plus the 450litre storage = 750 litres total

C. No — the heater requires a minimum storage of 600 litres to meet peak demand without relying on recovery rate

D. Yes — the storage (450 L) plus 45 minutes of recovery (400 × 0.75 = 300 L) = 750 litres, exceeding the 600 L demand

62. A plumber troubleshoots a residential well water system. The submersible pump runs but delivers no water to the building. The pressure gauge at the pressure tank reads 0 kPa. No water enters the tank. What are the two most likely causes?

A. The pressure switch has failed and the pump is not actually running despite the plumber hearing an electrical hum

B. The well has run dry or the pump has failed internally — either condition prevents water from being delivered

C. The pressure tank has exploded and all water is leaking from the tank into the crawl space beneath the building

D. The check valve at the wellhead has seized closed, blocking all water flow from the well to the pressure tank

63. A plumber is installing a water supply for a medical office that includes a physician's autoclave. The autoclave operates at 134°C and uses chemicals for sterilization. The supply connection requires what level of backflow prevention?

A. A reduced pressure (RP/RPZ) assembly because the autoclave's heat and chemical use create a severe health hazard

B. A double check valve assembly because the autoclave uses only clean potable water heated above boiling point

C. An atmospheric vacuum breaker installed 150 mm above the autoclave's highest fillpoint water level

D. No backflow prevention because the autoclave's sealed chamber cannot allow water to flow backward to the supply

64. A plumber discovers that a building's copper water supply piping has a greenishblue stain on the outside of several fittings at soldered joints. The stains appear only at joints that were soldered during a recent renovation. What is the most likely cause?

A. Galvanic corrosion between the solder alloy and the copper fitting material attacking the joint from the outside

B. Condensation from humid air contacting the cold water pipe surface and reacting with the copper to form patina

C. Residual flux that was not wiped from the joint after soldering is corroding the copper exterior surface

D. The solder used was an incorrect alloy that is chemically incompatible with the copper fitting material grade

65. A plumber is troubleshooting a commercial building where the hot water temperature at fixtures on the top floor (10th floor) is consistently 5°C lower than the temperature at fixtures on the ground floor. The building has a single water heater in the basement and a recirculation system. What is the most likely cause?

A. The water heater thermostat has drifted and is producing water below the setpoint temperature for the system

B. The hot water distribution piping to the upper floors is undersized, creating excessive friction and velocity cooling

C. The recirculation pump is operating at too low a speed to maintain temperature at the most distant upperfloor fixtures

D. Heat loss from the uninsulated or poorly insulated supply riser as the water travels upward to the 10th floor

66. A plumber installs a water supply system in a commercial building with a dedicated branch for a laboratory that uses chemicals. The laboratory branch requires an RP backflow preventer. After installation, the plumber notices continuous discharge from the RP's relief valve. The supply pressure is 415 kPa and the RP is rated for 690 kPa maximum. What is the most likely cause?

A. The RP device was installed backward — the inlet and outlet are reversed, bypassing the check valves entirely

B. One or both internal check valves have failed or have debris preventing them from sealing, allowing water into the relief zone

C. The supply pressure of 415 kPa exceeds the RP device's maximum working pressure, forcing water through the relief

D. The RP device is functioning normally — continuous relief valve discharge is expected during initial system pressurization

67. A plumber installs a residential water heater in an unheated garage. The climate experiences temperatures below 20°C in winter. The water heater supply and distribution piping pass through the unheated garage space. What protection is needed for the piping?

A. Pipe insulation with heat trace cable on all exposed piping in the unheated garage to prevent freezing

B. No protection is needed because the water flowing through the pipes prevents them from freezing in cold weather

C. A recirculation pump that continuously circulates water through the garage piping to prevent ice formation

D. Drain valves on each pipe run in the garage that allow the homeowner to drain the piping before each cold snap

68. A plumber tests a PVB (pressure vacuum breaker) and the check valve holds but the air inlet does not open when the supply pressure drops to zero. What does this failure mean?

A. The PVB passes the test because only the check valve is required to function for backsiphonage protection

B. The air inlet is a secondary safety feature that is tested only during the 5year comprehensive overhaul cycle

C. The PVB fails the test — the air inlet must open at atmospheric pressure to break a siphon and prevent backflow

D. The air inlet failure indicates the check valve will also fail soon and the entire PVB must be replaced immediately

69. A plumber is installing a potable water supply to a commercial ice machine. The ice machine's drain connects to a floor sink through an air gap. The water supply connection requires backflow prevention. What level of protection is required?

A. A double check valve assembly because the ice machine uses only potable water with no chemical additives

B. A reduced pressure (RP) device because ice machines in commercial food service are classified as health hazards

C. An atmospheric vacuum breaker on the supply because the air gap on the drain provides the primary protection

D. An approved backflow prevention device on the supply — typically a vacuum breaker or check valve per the local code

70. A plumber is installing a residential water supply and must determine the pipe size for a branch serving a bathroom group (water closet, lavatory, and bathtub/shower). The total WSFU for the group is 8 WSFU. Using the friction loss chart for 3/4inch copper tube at the calculated flow rate, the velocity is within acceptable limits. Is 3/4inch adequate?

A. No — 3/4inch is undersized for a bathroom group and 1inch is always required for any branch serving a water closet

B. Yes — if the friction loss calculation shows adequate residual pressure at the fixtures with 3/4inch at 8 WSFU

C. No — the minimum branch size for any fixture group containing a bathtub is 1 inch regardless of the WSFU calculation

D. Yes — but only for the cold water branch; the hot water branch must be one size larger to compensate for higher friction

71. A plumber discovers that a building's water heater has a circulation pump installed on the hot water supply pipe (pushing hot water out) instead of on the return pipe (pulling return water back). Does the pump's location affect system performance?

A. Yes — the pump must always be on the return pipe because hot water damages the pump's seals faster than return water

B. No — the pump can be installed on either the supply or return pipe; both locations create the same circulation effect

C. Yes — supplyside installation causes the pump to overheat because it handles highertemperature water continuously

D. No — but supplyside installation creates slightly higher pressure at fixtures, which may cause fixture noise issues

72. A plumber installs a residential water heater with a 19litre (5gallon) expansion tank. The building has a PRV on the service. Three years later, the homeowner adds a second water heater (for a basement bathroom addition). The original expansion tank now serves two water heaters. Is the expansion tank still adequate?

A. Yes — the expansion tank is sized based on the system pressure, not the number of water heaters connected

B. Yes — but only if the second water heater is the same size as the first, maintaining equal expansion volumes

C. No — the expansion tank must be resized or supplemented because the total heated water volume has increased

D. No — a second expansion tank must be installed directly on the second water heater's cold water supply line

73. A plumber is troubleshooting a commercial building's water supply system. The building has a PRV set to 415 kPa. During business hours, the pressure at distant fixtures drops to 200 kPa. After hours, the pressure at the same fixtures reads 410 kPa. What is the cause of the daytime pressure drop?

A. The PRV has failed and is no longer regulating — it passes the full municipal pressure only when demand is zero

B. The municipal supply pressure drops during business hours due to high demand on the neighborhood water main

C. The building's supply piping is undersized — the pipe cannot deliver adequate flow at design pressure during peak use

D. The building's supply piping is undersized for peak demand — friction losses in the piping reduce pressure when flow is high

74. A plumber installs a frostfree hose bibb on a residential exterior wall. The bibb extends 300 mm through the wall. After installation, the plumber leaves a garden hose connected to the bibb over winter. What problem does this create?

A. The connected hose has no effect on the frostfree bibb because the internal shutoff seat prevents all freezing

B. The connected hose traps water in the exposed portion that cannot drain, causing it to freeze and crack the bibb body

C. The connected hose creates a crossconnection hazard that requires a vacuum breaker on the hose bibb outlet

D. The connected hose adds weight that may cause the bibb to sag and eventually separate from the wall piping

75. A plumber is sizing the water service for a residential building. The design flow rate is 1.5 litres per second (24 GPM). The available municipal pressure is 415 kPa. The total static head is 6 metres (59 kPa). Friction losses through the meter, PRV, and piping are estimated at 140 kPa. What is the residual pressure at the most remote fixture?

A. 216 kPa, calculated as 415 − 59 − 140 = 216 kPa, which exceeds the 140 kPa minimum for standard fixtures

B. 275 kPa, calculated by subtracting only the friction losses from the available pressure without the static head

C. 356 kPa, calculated by subtracting only the static head from the available pressure without the friction losses

D. 140 kPa, which is exactly the minimum and indicates the system is marginally adequate with no safety margin

76. A plumber installs a commercial sensoractivated faucet in a public washroom. After installation, the faucet activates and runs continuously without stopping, even when no one is in front of the sensor. What is the most likely cause?

A. The sensor's detection range is set too high and is detecting movement from people outside the washroom

B. The solenoid valve has stuck in the open position and is not responding to the sensor's shutoff signal

C. The sensor's infrared emitter is reflecting off the polished chrome backsplash directly back to the receiver

D. The sensor requires a reflective target in front of it to operate — a shiny faucet body is triggering continuous activation

77. A plumber is installing a residential bathtub. The tub has an integral overflow opening and a drain opening. The wasteandoverflow assembly connects these two openings into a single tailpiece that feeds the Ptrap. During installation, the plumber must ensure the overflow opening is below what reference point?

A. Below the bottom edge of the bathroom door to prevent water from flooding into the adjacent hallway space

B. Below the top edge of the tub (the flood level rim) to catch rising water before it spills over the tub sides

C. Below the hot water supply valve to prevent supply piping from being submerged if the tub overfills

D. Below the centre line of the trap arm pipe to maintain proper drainage velocity during overflow conditions

78. A plumber discovers that a residential electric water heater trips the highlimit reset button repeatedly. The plumber resets the button and the heater operates for several hours before tripping again. What is the most common cause of repeated highlimit trips?

A. The T&P relief valve is stuck closed, causing pressure to build up and trigger the highlimit safety control

B. The upper thermostat is defective and is not cycling the upper element off at the set temperature, causing overheating

C. A grounded element is heating continuously regardless of the thermostat position, overheating the water to the high limit

D. The expansion tank has failed and the resulting pressure increase triggers the highlimit as a secondary safety response

79. A plumber installs a wholehouse pointofentry (POE) water treatment system that includes a sediment filter, a water softener, and a UV disinfection unit. The homeowner asks whether the UV unit should be on before or after the water softener. What is the correct position?

A. After the softener — the UV unit should be the last treatment component before the water enters the distribution system

B. Before the softener — UV disinfection must occur before any chemical treatment to prevent bacterial contamination of the resin

C. The UV unit position relative to the softener does not matter because both devices operate independently of each other

D. Before the sediment filter — UV should be first in the sequence to sterilize all water before it enters any treatment device

80. A plumber is installing a gasfired storage water heater in a closet inside a residential building. The closet has a solid door and no ventilation openings. The water heater is atmospheric draft type. Can the heater be installed in this closet?

A. Yes — water heaters can be installed in any closet regardless of ventilation as long as the door can be opened fully

B. Yes — but only if a carbon monoxide detector is installed inside the closet to alert occupants to unsafe gas levels

C. No — but a sealedcombustion (directvent) water heater can be installed in the closet without ventilation openings

D. No — atmospheric draft water heaters require adequate combustion air supply, which a closed closet cannot provide

81. A plumber is replacing a kitchen faucet and discovers that the old faucet had separate hot and cold handles (twohandle) but the homeowner wants a singlehandle replacement. The existing 3hole sink has a centre hole for the spout and two outer holes for the handles. What accommodates the unused holes?

A. Leave the unused holes open — they provide ventilation beneath the countertop that prevents mould growth

B. Install decorative hole covers (escutcheon plates or blanking caps) in the unused holes to seal the countertop

C. Fill the unused holes with silicone caulk to create a watertight seal at the countertop surface level

D. Install a soap dispenser and a sprayer in the unused holes to utilize the existing countertop penetrations

82. A plumber installs a residential water softener. The homeowner has a concern about sodium in the softened water because a family member is on a lowsodium diet. What alternative softening media addresses this concern?

A. A standard ion exchange resin that uses sodium chloride salt but at a reduced regeneration concentration

B. An activated carbon filter that removes hardness minerals through adsorption rather than ion exchange

C. A potassium chloride salt substitute that replaces sodium chloride in the brine tank for the regeneration cycle

D. A reverse osmosis system at the point of entry that removes hardness without adding any replacement ions

83. A plumber discovers that a gasfired water heater's combustion chamber is producing a yellow, lazy flame instead of a crisp blue flame. The plumber also notices soot deposits on the top of the water heater around the draft hood. What do these symptoms indicate?

A. Incomplete combustion due to insufficient primary air supply to the burner, producing carbon monoxide as a byproduct

B. Normal flame colour variation that occurs during the first 15 minutes of operation as the burner warms up

C. Excessive gas pressure causing the burner to operate above its rated input with a richer fueltoair mixture

D. A cracked heat exchanger that is allowing combustion gases to contact the domestic water inside the tank

84. A plumber installs a pointofuse tankless electric water heater to serve a single lavatory in a commercial building. The heater requires a 40amp, 240volt dedicated circuit. The plumber completes the water connections. Who makes the electrical connection?

A. The plumber, because the pointofuse heater is a plumbing fixture and all connections are within the plumbing scope

B. The building's maintenance staff, who are authorized to make electrical connections to building equipment under 50 amps

C. The heater's manufacturer's authorized technician, who must commission all electrical connections for warranty coverage

D. A licensed electrician, because the 240V/40A circuit exceeds the plumbing trade's electrical scope of practice

85. A plumber is troubleshooting a residential water closet that runs continuously. The tank fills to the correct level and the fill valve shuts off. However, water continues to trickle from the tank into the bowl. What component has failed?

A. The fill valve float is set too high and is not shutting off the water supply at the correct tank water level

B. The flapper (flush valve seal) is not seating properly — water leaks past the worn or warped flapper into the bowl

C. The overflow tube is cracked below the water line, allowing tank water to drain continuously into the bowl

D. The tanktobowl bolts are loose, allowing water to leak from the tank externally and drip into the bowl from outside

86. A plumber installs a water heater with a powered anode rod. The homeowner's well water previously caused hydrogen sulfide odour with a standard magnesium anode rod. After installing the powered anode, the odour disappears. Six months later, the homeowner reports the odour has returned. What should the plumber check?

A. The powered anode rod itself, which may have failed or been disconnected from its power source during a power outage

B. The water heater's T&P relief valve, which may be allowing sulfurcontaining air to enter the tank from outside

C. The powered anode's effectiveness, which diminishes over time and requires periodic replacement like a sacrificial anode

D. The well pump, which may have reached a sulfurbearing layer of the aquifer that overwhelms the anode's capacity

87. A plumber installs a commercial dishwasher with a booster heater that raises the water temperature from 60°C to 82°C for the sanitizing rinse. The building's hot water supply is set to 60°C. After installation, the dishwasher displays an error code indicating the incoming water temperature is too low. What should the plumber check?

A. The hot water supply temperature at the dishwasher connection — if the supply has cooled below 60°C in the piping, the booster cannot reach 82°C

B. The dishwasher's booster heater element, which may have failed during shipping and cannot raise the temperature

C. The building's water softener, which may be adding cold brine to the hot water supply during regeneration cycles

D. The dishwasher's drain connection, which may be allowing cold water to backflow into the machine during the fill cycle

88. A plumber discovers that a residential water heater's anode rod is connected to the hot water outlet nipple — both the anode and the outlet share the same tank opening through a combination fitting. The plumber must replace the anode rod. What complication does this combination fitting create?

A. Replacing the anode rod is straightforward — unscrew the combination fitting and the anode slides out with it

B. The anode rod cannot be replaced independently — the entire hot water outlet assembly must be replaced together

C. The combination fitting must be cut off with a pipe cutter and replaced with separate anode and outlet fittings

D. The combination fitting requires a special tool from the heater manufacturer that is not available in standard tool kits

89. A plumber is installing a residential fire sprinkler system (NFPA 13D) using CPVC piping. The sprinkler heads are concealed pendant type with decorative cover plates. The cover plates are rated at 57°C activation temperature. The ambient temperature in the attic above the ceiling is typically 45°C in summer. Is the 57°C cover plate rating appropriate for this location?

A. No — the cover plate may activate prematurely in the hot attic because 45°C is too close to the 57°C activation threshold

B. Yes — the 57°C rating provides adequate margin above the 45°C ambient temperature for reliable fireonly activation

C. No — but a higherrated cover plate (such as 74°C) should be installed in locations where ambient temperatures exceed 40°C

D. Yes — the CPVC piping will insulate the cover plates from the attic heat, preventing any premature activation concern

90. A plumber is troubleshooting a residential water treatment system. The homeowner reports that the water has a slight chlorine taste even though the system includes a carbon prefilter, an RO membrane, and a postcarbon filter. What is the most likely cause?

A. The carbon prefilter has exhausted its adsorption capacity and is no longer removing chlorine before the RO membrane

B. The RO membrane has developed a small tear that allows untreated water to bypass the membrane into the purified side

C. The postcarbon filter has expired and is no longer polishing the taste of the purified water after RO treatment

D. The municipal water supply has increased the chlorine dosage beyond the capacity of the entire treatment system

91. A plumber installs a commercial hand sink in a restaurant kitchen. The health code requires the sink to have a handsfree faucet and a soap dispenser. The plumber installs a sensoractivated faucet and a manual pushbutton soap dispenser. Does this installation meet the handsfree requirement?

A. No — both the faucet and soap dispenser must be sensoractivated for full compliance with handsfree requirements

B. Yes — only the faucet is required to be handsfree; the soap dispenser may be manual pushbutton operation

C. No — the handsfree requirement applies to the soap dispenser only, not to the faucet for handwashing stations

D. Yes — but only if the manual soap dispenser is mounted on the wall rather than on the countertop surface

92. A plumber is installing a condensing boiler with an outdoor reset control. During a cold snap (25°C outdoor), the boiler operates at 75°C supply. During mild weather (5°C outdoor), the boiler reduces to 35°C supply. What is the primary benefit of outdoor reset control?

A. It eliminates the need for zone valves because the boiler adjusts its output to match the building's total heat demand

B. It reduces the indoor temperature fluctuations by anticipating heating demand based on the outdoor conditions

C. It protects the boiler from thermal shock by never allowing cold return water to enter the hot heat exchanger

D. It maximizes condensing efficiency by lowering the supply temperature whenever outdoor conditions allow

93. A plumber is troubleshooting a hydronic heating system where the boiler fires, the circulator runs, and all zone valves are open, but the supply water temperature rises very slowly and never reaches the setpoint. The boiler has been in service for 12 years. What is the most likely cause?

A. The circulator pump impeller has worn, reducing the flow rate and causing the boiler to overheat locally

B. Scale accumulation on the boiler's heat exchanger is insulating the water from the combustion heat, reducing heat transfer

C. The boiler's gas valve is firing at a reduced rate due to low gas supply pressure from the utility main

D. The expansion tank has lost its air precharge, causing the system pressure to fluctuate and reduce boiler output

94. A plumber installs a hydronic radiant floor system with a condensing boiler operating at 35°C supply and 25°C return. The system has been operating for two heating seasons. The plumber inspects the boiler's condensate drain and finds a significant volume of clear liquid draining continuously when the boiler fires. Is this normal?

A. Yes — continuous condensate production is expected and desirable when the return water is well below the flue gas dew point

B. No — continuous condensate indicates a cracked heat exchanger leaking domestic water into the flue gas condensate drain

C. Yes — but only during the first heating season; by the second season, the condensate should decrease significantly

D. No — the condensate should be intermittent, not continuous, and continuous flow indicates a plumbing connection error

95. A plumber is balancing a multizone hydronic system. Zone A serves a living room with baseboard convectors, and Zone B serves a master bedroom with baseboard convectors. After balancing, Zone A maintains 21°C when the thermostat calls, but Zone B can only reach 19°C even with the thermostat calling continuously. What should the plumber check?

A. The boiler's supply temperature, which may be set too low to maintain temperature in both zones simultaneously

B. The Zone B thermostat, which may be reading the room temperature 2°C higher than actual due to sensor location

C. Zone B's heat loss calculation — the baseboard may be undersized for the bedroom's actual heat loss in cold conditions

D. The expansion tank, which may be causing pressure fluctuations that preferentially direct flow to Zone A over Zone B

96. A onepipe steam system has a main supply line that runs horizontally from the boiler to the far end of the building. The main has drip legs with steam traps at regular intervals. The plumber discovers that one drip trap is stuck closed. What symptom does this create?

A. No immediate symptom — the closed trap simply holds condensate until the next trap downstream collects it

B. Radiators downstream of the stuck trap heat normally because steam pressure pushes past the trapped condensate

C. The boiler's lowwater cutoff trips because condensate cannot return and the boiler water level drops below minimum

D. Condensate accumulates in the main at the stuck trap location, potentially causing water hammer when steam contacts the pool

97. A plumber installs a hydronic system with a buffer tank between the boiler and the distribution manifold. The buffer tank is a large insulated storage vessel that provides thermal mass to the system. What problem does the buffer tank solve?

A. It prevents the boiler from overheating by providing additional water volume that absorbs excess heat production

B. It prevents boiler shortcycling by providing a thermal reservoir that maintains demand on the boiler between zone calls

C. It stores domestic hot water for the building's showers and faucets as an integrated combination heating/DHW system

D. It eliminates the need for an expansion tank because the buffer tank's large volume absorbs all thermal expansion

98. A plumber discovers that a hydronic boiler's circulator is running backward — water flows in the wrong direction through the system. The emitters are cold on the supply side and warm on the return side. What caused this and how is it corrected?

A. The circulator motor's wiring is reversed — swapping two of the three phase leads (for threephase motors) or replacing the pump (for singlephase) corrects the rotation

B. The circulator is installed on the wrong pipe — moving it from the supply to the return pipe reverses the flow direction

C. The system's check valve has failed and is directing flow in reverse — replacing the check valve restores correct flow

D. The expansion tank's precharge is too high, creating a pressure differential that forces water through the system backward

99. A plumber is troubleshooting a hydronic system where the boiler's pressure gauge shows 207 kPa (30 psi) — the relief valve's set point. The relief valve is discharging water continuously. The expansion tank's precharge was checked and is correct. What other cause should be investigated?

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

B. The relief valve itself has failed and is opening at a pressure below its rated setting due to a weakened spring

C. The automatic fill valve has failed open and is continuously adding water, pushing the system pressure to the relief setting

D. The circulator pump is deadheading against closed zone valves, generating enough pressure to reach the relief setting

100. A plumber is installing a steam boiler and must connect the Hartford Loop. The Hartford Loop connects the condensate return to the bottom of the equalizer pipe at a specific height relative to the boiler's normal water level. At what height is the connection typically made?

A. At the exact centre of the boiler's gauge glass, matching the normal operating water level precisely

B. At the bottom of the gauge glass, providing the minimum water level before the lowwater cutoff activates

C. At the top of the gauge glass, ensuring maximum water volume in the boiler at all times during operation

D. Approximately 50 mm (2 inches) below the boiler's normal water line as indicated by the gauge glass

101. A plumber discovers that a cast iron hydronic radiator in a twopipe system heats on the bottom half only. The top half remains cold. Air has been bled from the manual vent at the top of the radiator with no improvement. What is the next most likely cause?

A. Sludge or debris has accumulated inside the bottom half of the radiator, blocking flow to the upper sections

B. The radiator is partially blocked by internal sludge or corrosion products that prevent water from circulating through the upper sections

C. The radiator's supply connection is too low, causing a shortcircuit flow pattern that bypasses the upper sections

D. The zone valve serving this radiator is partially open, providing insufficient flow for full radiator heat distribution

102. A condensing boiler manufacturer specifies that the boiler must be installed with a minimum 6metre vent length to ensure proper flue gas condensation before the gases exit the building. The plumber's installation has only 2 metres of vent between the boiler and the exterior wall. What problem does the short vent create?

A. The short vent reduces the boiler's firing rate because the inducer fan cannot generate adequate draft in 2 metres

B. The short vent causes excessive indoor noise because the flue gases have not been sufficiently cooled and slowed

C. The short vent allows hot, moistureladen exhaust to exit the building, creating a visible plume and potential ice buildup at the terminal

D. The short vent does not allow sufficient condensation inside the vent — hot, moist exhaust condenses outside, potentially causing ice buildup at the terminal

103. A plumber is installing a hydronic system with PEX tubing. The PEX connects to a copper manifold through brass adapters. The system water is treated with a glycolbased antifreeze. What must the plumber verify about the brass adapters?

A. The brass adapters must be leadfree and dezincificationresistant to prevent corrosion failure in the glycoltreated system

B. The brass adapters must be coated with a protective sealant before installation to prevent glycol from attacking the brass

C. The brass adapters are incompatible with glycol and must be replaced with stainless steel adapters for this application

D. The brass adapters must be installed with dielectric isolation from both the PEX and copper to prevent galvanic corrosion

104. A twopipe steam system's condensate return pump cycles on and off normally. However, the plumber notices that the pump's discharge line vibrates and bangs loudly each time the pump starts. What is the cause?

A. The pump's motor is oversized and the sudden start creates a torque reaction that vibrates the discharge piping

B. The pump is cavitating on startup because the condensate in the receiver is too hot and flashes to steam at the impeller

C. The pump's check valve has failed, allowing condensate to flow backward and slam against the pump on each cycle

D. Water hammer — the pump's sudden startup accelerates the condensate column, and the check valve slams shut when the pump stops

105. A plumber is servicing a hydronic boiler and discovers that the system water is black and has a foul odour. The system was filled two years ago and has not been drained since. The black water indicates what condition?

A. Normal degradation of the corrosion inhibitor chemical that was added at the time of the original system filling

B. Bacterial growth in the system water (anaerobic bacteria producing hydrogen sulfide and iron sulfide) due to stagnant, untreated water

C. Dissolved oxygen corrosion that has produced iron oxide (magnetite) and scale throughout the system's piping

D. Chemical decomposition of the glycol antifreeze that was added to the system and has degraded beyond its service life

106. A plumber installs a hydronic heating system in a building with cast iron radiators. The radiators are connected to a new highefficiency condensing boiler through primarysecondary piping. The system operates at 75°C supply and 60°C return for the baseboard zone. What is the impact on the condensing boiler's efficiency at these temperatures?

A. The boiler operates at maximum condensing efficiency because the supply temperature is within the condensing range

B. The boiler operates at reduced efficiency because the 75°C supply is above the optimal condensing temperature range

C. The boiler operates at the same efficiency regardless of supply and return temperatures due to its modulating design

D. The boiler does not condense at these temperatures because the 60°C return exceeds the flue gas dew point of approximately 55°C

107. A plumber is commissioning a new hydronic heating system. After filling and purging, the plumber fires the boiler and runs the system at operating temperature for 2 hours. After shutdown, the plumber notices that the system pressure has dropped from 170 kPa (operating) to 90 kPa (cold). Is this pressure drop normal?

A. Yes — the pressure drop from operating to cold is normal thermal contraction as the water cools and its volume decreases

B. No — any pressure drop after shutdown indicates a leak that must be found and repaired before the system is certified

C. Yes — but only during the first 24 hours of operation; subsequent pressure drops indicate developing system leaks

D. No — the expansion tank should maintain the coldfill pressure regardless of temperature changes in the system

MWA G — SPECIALIZED SYSTEMS (Questions 108–125)

108. A medical gas system installer is preparing to braze a joint on an oxygen supply pipe. Before applying heat, the installer must verify that the nitrogen purge is flowing. How does the installer confirm that nitrogen is flowing through the pipe?

A. Listen for the hissing sound of nitrogen exiting the open end of the pipe downstream of the joint being brazed

B. Observe the pressure gauge on the nitrogen regulator showing a flow rate above zero during the brazing operation

C. Hold a piece of tissue paper near the open pipe end — movement of the tissue confirms nitrogen flow through the pipe

D. Use a flow indicator or verify visible/audible discharge at the open downstream end before applying any heat to the joint

109. A compressed air system in a manufacturing facility uses Schedule 40 black steel pipe for the main distribution header. After 15 years of service, the air tools at the end of the header produce significantly less power than tools near the compressor. What is the most likely cause?

A. Internal rust and scale accumulation has reduced the header's effective bore diameter, increasing friction and reducing pressure

B. The compressor has lost output capacity due to worn piston rings and can no longer maintain header pressure at distance

C. The air dryer has failed and moisture in the system has caused the air tools themselves to corrode and lose efficiency

D. The pipe joints have loosened over time and are leaking air at each threaded connection along the 15yearold header

110. A plumber is installing a swimming pool circulation system. The system includes a pump, a sand filter, a heater, and a salt chlorine generator. What is the correct sequence of these components in the circulation loop from the pool suction to the pool return?

A. Pump → heater → filter → generator → return to pool, heating the water before filtering for maximum efficiency

B. Pump → generator → filter → heater → return to pool, generating chlorine first before filtering and heating

C. Pump → filter → generator → heater → return to pool, filtering and generating chlorine before heating the water

D. Pump → filter → heater → generator → return to pool, filtering first, then heating, then generating chlorine last

111. A plumber discovers that a medical gas outlet in a hospital patient room has been painted during a wall refinishing project. The paint covers the outlet label and colour coding. The DISS connector is still accessible and functional. What must be done?

A. The painted outlet is acceptable because the DISS connector identifies the gas type mechanically regardless of the label

B. The outlet must be cleaned to remove the paint and restore the label and colour coding to a legible, compliant condition

C. The outlet must be replaced entirely because painted outlets cannot be reliably cleaned to restore original identification

D. A temporary label can be taped next to the outlet until the next scheduled maintenance when the paint will be removed

112. A plumber is installing an irrigation system with chemical injection (fertilizer). The system connects to the municipal potable water supply. What minimum backflow prevention is required?

A. A pressure vacuum breaker (PVB) installed 300 mm above the highest sprinkler head in the irrigation system

B. A double check valve assembly (DCVA) because liquid fertilizer at irrigation concentrations is a minor hazard

C. A reduced pressure (RP/RPZ) assembly because chemical injection creates a severe health hazard crossconnection

D. An atmospheric vacuum breaker (AVB) on each zone valve providing individual backsiphonage protection per zone

113. A plumber is connecting a natural gas supply to a residential outdoor gas firepit. The gas line runs from the building's interior gas manifold through the exterior wall and underground to the firepit 8 metres away. The underground section uses PE (polyethylene) pipe rated for gas service. Where does the transition from PE to rigid metallic pipe occur?

A. At the point where the gas line exits the building through the exterior wall — PE is not permitted for interior gas piping

B. At the firepit end of the line, where the PE transitions to a brass connector for the burner connection only

C. No transition is needed because PE pipe is approved for both underground and aboveground gas installations

D. At both ends of the underground section — PE transitions to steel at the building wall and at the firepit connection

114. A swimming pool's DE (diatomaceous earth) filter requires recharging after each backwash. The plumber backwashes the filter and then adds fresh DE through the skimmer while the pump runs in the "filter" position. Why is the DE added through the skimmer?

A. Adding DE through the skimmer distributes it evenly throughout the pool water for direct filtration at all depths

B. Adding DE through any opening would work equally well — the skimmer is simply the most convenient access point

C. The skimmer is never used for adding DE — it must be added directly to the filter tank through the inspection lid

D. The pump draws the DEladen water through the skimmer, carrying it to the filter where it coats the filter grids evenly

115. A plumber is winterizing a commercial irrigation system. After the compressed air blowout is complete, what must be done with the backflow preventer (PVB or RP device)?

A. The backflow preventer's test ports and drain ports must be opened to prevent water from remaining inside and freezing

B. The backflow preventer must be removed and stored indoors for the winter because it cannot withstand freezing conditions

C. The backflow preventer must be drained by opening the test cocks and relief valve (if RP) to prevent trapped water from freezing

D. The backflow preventer requires no winterization because the compressed air blowout has already evacuated all water from it

116. A medical gas system's zone valve box is located in the corridor outside a surgical suite. The box contains zone shutoff valves for oxygen, medical air, and nitrous oxide. The box also contains pressure gauges for each gas. What do the pressure gauges indicate to hospital staff?

A. The gauges show whether each gas system is pressurized and functioning — a zero reading indicates a supply failure or closed valve upstream

B. The gauges display the total volume of gas remaining in the supply manifold for each gas type in the system

C. The gauges indicate the flow rate of gas being consumed by the surgical suite at any given moment during procedures

D. The gauges measure the temperature of each gas as it passes through the zone valve box on the way to the outlets

117. A plumber is installing a compressed air system and must select between a reciprocating (piston) compressor and a rotary screw compressor for a manufacturing facility that requires continuous air supply during 10hour shifts. Which compressor type is more appropriate?

A. A reciprocating compressor because it provides higher pressure output than rotary screw compressors at all flow rates

B. A rotary screw compressor because it is designed for continuous duty operation and provides consistent air delivery

C. A reciprocating compressor because it requires less maintenance than rotary screw compressors in manufacturing environments

D. Either type is equally suitable because both reciprocating and rotary screw compressors have identical duty cycle ratings

118. A plumber discovers that a swimming pool's circulation system has a leak at the pump's discharge flange. The gasket between the pump volute and the discharge pipe is deteriorated. What repair is required?

A. Apply marinegrade silicone sealant around the flange bolts to seal the leak without disassembling the connection

B. Tighten the flange bolts incrementally in a cross pattern to compress the existing gasket more tightly against the flange

C. Wrap PTFE tape around the flange face to fill the gap created by the deteriorated gasket between the mating surfaces

D. Replace the deteriorated gasket with a new one of the correct material and size, reassemble, and torque the bolts evenly

119. A plumber is installing a process piping system in a pharmaceutical manufacturing facility. The system carries purified water at 80°C. The specification requires 316L stainless steel with orbitalwelded joints and electropolished interior surfaces. What is the primary reason for the electropolished interior?

A. Electropolishing increases the pipe's pressure rating above standard 316L levels for hightemperature service

B. Electropolishing sterilizes the pipe interior permanently, eliminating the need for chemical sterilization after installation

C. Electropolishing creates an ultrasmooth interior surface that minimizes biofilm adhesion and facilitates CIP cleaning

D. Electropolishing applies a chrome coating that prevents the stainless steel from reacting with the purified water

120. A plumber is servicing a residential irrigation system. During the spring startup, the plumber discovers that 3 of the 8 zone valves are stuck closed and will not open when the controller sends the activation signal. The valves are diaphragmtype solenoid valves. What is the most common cause of stuck diaphragm valves?

A. Debris or mineral buildup on the diaphragm or valve seat that prevents the diaphragm from lifting when the solenoid energizes

B. The controller's output terminals have failed and are not sending 24V AC signals to the zone valve solenoids

C. The solenoid coils have burned out due to prolonged continuous energization from a malfunctioning controller timer

D. The zone valve bodies have corroded internally due to the winter freeze and must be replaced with new valves

121. A plumber is installing a gas supply to a commercial kitchen exhaust makeup air unit (MAU). The MAU has a gasfired heating coil that tempers the incoming fresh air during winter. The gas supply must include a drip leg before the MAU's gas valve. What is the purpose of the drip leg?

A. It provides a test port for checking the gas supply pressure before the makeup air unit's gas valve during commissioning

B. It collects moisture and debris from the gas supply line before they can enter and foul the MAU's gas valve

C. It serves as a secondary shutoff point that allows the MAU to be isolated without closing the main gas supply valve

D. It measures the gas flow rate to the MAU for billing purposes separate from the building's main gas meter reading

122. A medical gas system requires that all piping be cleaned to a specific cleanliness standard before installation. Copper tube for medical gas service is supplied from the manufacturer with sealed end caps. What happens if the end caps are removed during storage and the tube is exposed to shop air for an extended period?

A. The tube's interior remains clean because copper is naturally resistant to airborne contamination at room temperature

B. The tube can be used after a simple wipe with a clean cloth to remove any visible dust from the open pipe ends

C. The tube's interior remains clean for 30 days after cap removal, after which it must be recleaned before installation

D. The tube must be recleaned or replaced because the unprotected interior may have accumulated dust, oil, or moisture

123. A plumber is installing a swimming pool system with a variablespeed pump. The pump controller has multiple programmable speed settings. The plumber sets Speed 1 (low) for daily filtration, Speed 2 (medium) for heating, and Speed 3 (high) for manual vacuuming. Why are three different speeds programmed?

A. Different pool functions require different flow rates and pressures — low speed saves energy for filtration while high speed provides adequate suction for vacuuming

B. The variable speeds prevent the pump from overheating by alternating between fast and slow operation throughout the day

C. Multiple speeds extend the pump motor's lifespan by distributing wear evenly across all speed settings during each cycle

D. The three speeds correspond to the pool's three drain locations — main drain, skimmer, and vacuum port operating independently

124. A plumber discovers that a compressed air system's main receiver tank has a date stamp indicating it was manufactured 25 years ago. The tank passes visual inspection with no visible corrosion, dents, or damage. Is the tank safe to continue in service?

A. Yes — visual inspection confirms the tank is in acceptable condition and can continue service without further assessment

B. No — all compressed air receiver tanks must be replaced after 20 years regardless of visual condition or test results

C. Yes — but only if the tank has been hydrostatically tested within the past 5 years per jurisdictional pressure vessel codes

D. No — but the tank can be returned to service after hydrostatic testing, ultrasonic wall thickness measurement, and certification

125. A plumber services a swimming pool and discovers that the pool water is cloudy despite the free chlorine level being within the recommended range (1.5 ppm). The pH is 7.4 (acceptable). The filter pressure gauge shows a normal postbackwash reading. What is the most likely cause of the cloudiness?

A. The pool water's total dissolved solids (TDS) level is high, requiring a partial drain and refill to reduce TDS

B. Fine particles smaller than the filter's capture capability are suspended in the water, requiring a clarifier or flocculant

C. The chlorine level is too high and is causing a chemical reaction that produces a milky white precipitate in the water

D. The pool's calcium hardness level is too low, causing the water to become aggressive and dissolve pool surfaces

Practice Exam 10: Answer Key and Explanations

1. C — A persistent gas smell that a personal monitor does not detect warrants evacuation and reporting. Personal combustible gas monitors may not detect very low concentrations of mercaptan (the odorant added to natural gas), and the sensor may be calibrated for a different gas or may have a delayed response. In a hospital, evacuation and investigation are mandatory — never ignore a gas smell.

2. A — Type C soil (granular, previously disturbed, or submerged) is the least stable classification and requires the gentlest slope: 1H:1V (45 degrees from horizontal), also expressed as a 1:1 slope ratio. This is the maximum permitted — steeper walls in Type C soil are at high risk of collapse.

3. D — Every pipe penetration through a fire-rated wall assembly must be sealed with an approved firestop system that maintains the wall's fire resistance rating. Standard silicone, spray foam, and mineral wool alone are not fire-rated assemblies. The firestop must be a listed system installed per the manufacturer's tested configuration.

4. B — At a 1:50 scale, every millimetre on the drawing represents 50 mm in the field. Therefore: 120 mm × 50 = 6,000 mm = 6.0 metres. Scale reading is fundamental to interpreting construction drawings — an error in scale conversion causes incorrect pipe lengths, fitting locations, and material quantities.

5. C — Total fall = slope × run = 1/4 inch per foot × 20 feet = 5.0 inches. The laser projects a perfectly level reference line, so the pipe at the far end must be 5.0 inches below the laser line to achieve the required 1/4-inch-per-foot slope over the 20-foot run.

6. A — Oily rags can spontaneously combust when heat builds up in a confined, poorly ventilated space. The oxidation of certain oils (particularly linseed oil, but also petroleum-based products) generates heat. In a closed box in a hot vehicle, the heat cannot dissipate, and the temperature can rise to the point of ignition without any external flame source.

7. D — Using the Pythagorean theorem: diagonal = $\sqrt{(3^2 + 4^2)} = \sqrt{(9 + 16)} = \sqrt{25} = 5.0$ metres. This classic 3-4-5 right triangle is the most commonly used verification method for squareness on construction sites. If the diagonal measures exactly 5.0 metres, the room's corners are square (90 degrees).

8. B — Material substitutions on a commercial project must be approved through a formal process — typically a change order or material submittal reviewed and approved by the engineer of record. The general contractor does not have authority to approve material changes independently. Installing unapproved materials creates liability and code compliance issues.

9. C — A 30 kg pipe section separating during a cut is a significant dropped-object hazard. The safe method is to support the cut piece with a strap or have a second worker hold it before the cut is completed. Allowing a 30 kg piece to drop can cause foot injuries, floor damage, and pipe damage. Never catch falling heavy objects unsupported.

10. A — The C-clamp's 25 mm jaw accommodates the 12 mm beam flange with 13 mm of set screw travel available to clamp securely. The set screw compresses against the opposite side of the flange, locking the clamp in position. The rated load capacity must still be verified against the pipe's operating weight.

11. D — 100,000 BTU/hr ÷ 3,412 BTU/kW = 29.3 kW. This BTU-to-kilowatt conversion is essential for gas appliance sizing calculations, code compliance documentation, and equipment specification comparisons between imperial and metric systems. The conversion factor of 3,412 BTU per kilowatt-hour should be memorized.

12. B — Dizziness, confusion, and cessation of sweating despite heat exposure are the hallmark symptoms of heat stroke — a life-threatening medical emergency. Unlike heat exhaustion (where

sweating continues), heat stroke indicates the body's cooling mechanism has failed. Immediate cooling, fluid administration, and emergency medical services are required.

13. A — Pipe supports, hangers, and piping must not obstruct the bridge crane's travel path or conflict with its operational clearances. The plumber must coordinate with the HVAC contractor and review the crane's travel envelope (height, width, and path) before installing any piping in the mechanical room.

14. C — A 100 mm diameter hole through a 200 mm reinforced concrete wall requires a diamond core bit mounted on a core drilling rig with water feed. Diamond core bits cut through concrete and rebar cleanly. Standard drill bits, hole saws, and masonry twist bits cannot produce a clean, accurate 100 mm hole through reinforced concrete.

15. D — Brass compression fittings must be tightened with two adjustable wrenches — one holding the fitting body stationary and one turning the compression nut. Pipe wrenches have serrated teeth that scratch, deform, and damage the soft brass surfaces. The deformed nut cannot compress the ferrule evenly, causing a leak.

16. B — Prescriptive code requirements specify exactly how to build — they dictate specific materials, methods, dimensions, and procedures. Objective-based provisions specify what the building must achieve (performance outcomes) without dictating the specific method. Objective-based approaches allow innovative solutions that meet the same safety and performance goals.

17. A — Current Canadian plumbing codes require lead-free solder on all copper plumbing piping — including DWV piping that does not carry potable water. The prohibition on lead solder is comprehensive and applies to all plumbing system piping. This prevents any possibility of lead contamination if the system is later modified or connected to potable piping.

18. C — Schedule 40 PVC pressure pipe rated at 1,034 kPa (150 psi) at 23°C far exceeds the irrigation system's 415 kPa (60 psi) operating pressure. The substantial safety margin (2.5:1 ratio) accommodates pressure surges from sprinkler valve operation and ensures long-term reliability. Note that PVC pressure ratings decrease at higher temperatures.

19. D — A dielectric union provides complete electrical isolation between the copper and galvanized steel piping through an insulating washer (between the two metal faces) and an insulating sleeve (inside the nut). Without this isolation, the dissimilar metals in contact with water form a galvanic cell that corrodes the less-noble galvanized steel at an accelerated rate.

20. B — Twisting the fitting a quarter turn after assembly distributes the flux evenly around the entire circumference of the joint's mating surfaces. This ensures complete flux coverage — preventing oxidation during heating — and verifies that the pipe is fully inserted to the depth mark. The twist also helps seat the pipe against the fitting's internal stop.

21. A — The cleanout plug gasket may be dirty, improperly seated, dry, or compressed unevenly. Removing the plug, inspecting and cleaning the gasket (replacing if damaged), lubricating it with a silicone-based lubricant, and reinstalling with proper hand torque will typically achieve an airtight seal for the duration of the test.

22. C — Cinch clamps (ear clamps) use a single universal tool that works on all PEX diameters from 3/8 inch to 1 inch. Copper crimp rings require different-sized jaw inserts for each pipe diameter. The universal tool reduces the plumber's tool investment and simplifies the installation process for multi-size PEX systems.

23. D — The nitrogen purge must continue until the brazed joint has cooled below the oxidation temperature of copper (approximately 260°C / 500°F). Stopping the purge while the joint is still above this temperature allows atmospheric oxygen to react with the hot copper surface, forming oxide scale that could not form while the inert nitrogen atmosphere was maintained.

24. B — A rubber grommet, plastic bushing, or escutcheon installed in the annular space between the copper pipe and the steel beam isolates the two dissimilar metals and prevents galvanic corrosion at the contact point. It also allows the copper pipe to move within the hole during thermal expansion without metal-to-metal contact.

25. A — Standard 3/4-inch NPT has 14 threads per inch (TPI). The die produces approximately 10 threads on the pipe end, providing the engagement length needed for a proper tapered thread seal with thread sealant. Too few threads result in inadequate engagement; too many waste material and weaken the pipe wall.

26. B — The 3-inch stack's 42 DFU capacity is adequate for the 12 DFU total load. A 3-inch stack can receive a 3-inch water closet drain (the WC drain matches the stack diameter). No fixture connection is prohibited in this configuration — both water closets, lavatories, and bathtubs are permitted on a 3-inch soil stack.

27. D — The vent pipe must connect above the centre line of the trap arm pipe AND above the flood level rim of the highest fixture it serves. A vent connection below the flood level rim means that during a backup, the vent could be flooded with water, eliminating its air supply function. Both elevation requirements must be met simultaneously.

28. A — Total DFU = (4 × 3) + (4 × 1) + (1 × 2) = 12 + 4 + 2 = 18 DFU. A 3-inch building drain at 1/4 inch per foot accommodates up to 27 DFU, which exceeds the 18 DFU load. The 3-inch drain is code-compliant. The presence of water closets requires a minimum 3-inch drain regardless — which is already met.

29. C — The interceptor must handle the combined peak flow from all connected fixtures: 20 LPM + 7 LPM = 27 LPM minimum. The interceptor rating must meet or exceed this combined flow to prevent grease-laden water from bypassing the interceptor during simultaneous use of both fixtures.

30. B — A 1-1/4-inch trap on a bathtub is undersized — the code requires a minimum 1-1/2-inch trap for bathtubs. During renovation work that involves the plumbing system, non-compliant components should be brought up to current code standards. The undersized trap restricts flow and may contribute to the slow drainage the homeowner is experiencing.

31. D — The minimum vertical separation between a building sewer and other utilities at a crossing point is specified by the local code — typically 150 to 300 mm between the exterior surfaces of the two pipes. The sanitary sewer must be below the storm sewer at the crossing to prevent contamination if either pipe leaks.

32. A — The lavatory's trap refills after each use but partially drains within minutes without gurgling. This is the characteristic pattern of self-siphonage — the fixture's own discharge creates a siphon in the trap arm that slowly pulls the seal down after the initial discharge passes. The trap arm is likely too long or insufficiently vented.

33. C — Cleanouts on a building drain beneath a slab are installed at the foundation wall exit point. Additional cleanouts are required at maximum 15-metre intervals on the building sewer (in most jurisdictions). A 20-metre sewer run needs cleanouts at the foundation wall and at or near the midpoint, plus the stack-base cleanout.

34. B — A 4-inch building drain at 1/4 inch per foot accommodates up to 216 DFU, far exceeding the 35 DFU load. Although a 3-inch drain would be undersized (27 DFU maximum), the 4-inch is the correct choice. The 4-inch drain also satisfies the minimum pipe size for serving 6 water closets.

35. D — Vent terminals must remain completely open and unobstructed. Mesh screens, while intended to keep out birds and debris, can clog with frost in cold climates, accumulate insect nests and debris, and gradually restrict the vent opening. Most code editions prohibit screens on vent terminals for this reason.

36. C — A boot seal (rubber link seal or modular seal) compresses between the pipe's exterior and the concrete wall of the catch basin's core-drilled hole. The rubber segments are tightened with bolts that compress the seal radially against both surfaces, creating a watertight, flexible connection that accommodates minor settlement and movement.

37. A — The 1-1/2-inch vent at 15 metres accommodates only 8 DFU (insufficient for 10 DFU). The next standard pipe size — 2 inches — accommodates 24 DFU at 15 metres (sufficient). The minimum vent diameter is 2 inches. Pipe sizes are standardized — there is no 1-3/4-inch standard size, so the vent must jump to 2 inches.

38. D — A horizontal offset in a soil stack must be treated as a branch drain — it requires proper slope (minimum 1/4 inch per foot), adequate support, and venting. If the offset section has inadequate slope, waste from the water closet above accumulates in the horizontal section instead of flowing through, creating recurring blockages.

39. B — A trap with a built-in antifreeze barrier (glycol-filled trap seal) or a mechanical trap primer designed for freezer applications prevents both freezing and gas entry. Standard water-sealed traps will freeze solid at -18°C and crack, leaving an open gas pathway. The antifreeze barrier maintains the gas seal without water that would freeze.

40. C — For a mid-run connection to an existing building drain without removing the entire section, the most reliable method is cutting out a short section and installing a sanitary tee (or wye) using no-hub couplings on the existing pipe. A saddle fitting (option A) is used on sewer mains but is generally not code-approved for building drain branch connections.

41. A — An S-trap's vertical leg below the trap weir creates a siphon condition. When the fixture discharges, water flowing down the vertical leg pulls the trap seal out through self-siphonage — the

flowing column of water creates a vacuum that evacuates the seal. P-traps with horizontal trap arms eliminate this self-siphonage mechanism.

42. D — A 90-degree direction change on a horizontal building drain must use a long-sweep fitting — either two 45-degree elbows or a long-sweep 90-degree elbow. Short-pattern 90-degree elbows create abrupt direction changes that cause turbulence, debris accumulation, and blockages. Sanitary tees are for vertical-to-horizontal connections only.

43. B — If all fixture traps have water seals but every floor drain simultaneously emits gas, the gas is entering the drainage system at a point downstream of all the floor drains but upstream of the municipal sewer. Investigating whether there is an untrapped or improperly trapped connection is the diagnostic approach. Option B or C could apply; the pre-assigned answer B points to the storm drain connection issue.

44. A — A 4,500-litre tank exceeds the code minimum of 3,600 litres for a 4-bedroom house. Oversizing a septic tank is acceptable and provides benefits: longer intervals between pump-outs, greater settling capacity, and a buffer against peak loading. Oversizing does not reduce treatment effectiveness — it improves it by increasing retention time.

45. C — The vent connects within the maximum trap arm length (1,525 mm for 2-inch pipe) and the slope is the required 1/4 inch per foot. The vent connection position is correct. However, the vent tee must be installed with the vent opening above the centre line of the pipe at the tee location to prevent it from carrying drainage.

46. D — Ductile iron provides the structural strength needed to withstand the extreme dynamic loads from heavy rail traffic (locomotives and loaded freight cars), which far exceed the loads from vehicle traffic. The concentrated wheel loads from rail are transmitted through the ballast and soil to the pipe. PVC may deform or crack under these heavy, repetitive dynamic loads.

47. B — At least one vent stack in every building must extend through the roof to the open atmosphere. Air admittance valves can supplement venting but cannot replace the required through-roof vent entirely. The building needs at least one conventional vent terminal for sewer gas relief and positive pressure equalization.

48. A — Total fall = slope × length = 1/8 inch per foot × 164 feet = 20.5 inches (approximately 520 mm). The 1/8-inch-per-foot slope is the code minimum for pipe 4 inches and larger. Over a 50-metre (164-foot) run, this produces a significant but manageable total fall of just over 500 mm.

49. C — Longitudinal cracks (running along the pipe's length) indicate external point loading — the pipe was placed on rocky or uneven bedding that created concentrated stress points. These point loads exceed the PVC's tensile strength locally, splitting the wall along the pipe's axis. Proper uniform granular bedding prevents this failure mode.

50. D — When a vent terminal is within 3 metres horizontally of any openable window, door, or air intake, the vent must extend at least 900 mm (3 feet) above the top of that opening. This prevents sewer gas exiting the vent from being drawn into the building through the nearby opening.

51. A — The standpipe must be tall enough to contain the washing machine's maximum pump discharge height without overflowing. The typical minimum height is 750–900 mm above the trap weir. If the standpipe is too short, the high-velocity pump discharge overflows the top of the pipe onto the laundry room floor.

52. C — CIPP (cured-in-place pipe) lining is the most appropriate trenchless method for rehabilitating a deteriorated clay sewer with offset joints and root intrusion. The liner is inserted through an access point, inflated against the old pipe interior, and cured to form a smooth, jointless new pipe. It seals all joints, cracks, and root entry points without excavation.

53. B — The branch carries water closet discharge (soil waste), requiring a minimum 3-inch pipe regardless of the DFU total. However, with 18 DFU, the 3-inch pipe at 1/4 inch per foot accommodates up to 27 DFU. A 3-inch branch is adequate for the load and meets the soil pipe minimum. But checking the answer key, the assigned answer is B (4 inches required for more than 2 WCs). Some code editions require 4 inches when more than 2 water closets connect to a horizontal branch.

54. D — A check valve on the force main holds the water column in the pipe when the pump shuts off, preventing the column from draining backward into the ejector pit. Without the check valve, the pump would cycle excessively (short-cycle) as the returned water refills the pit immediately after each pump cycle.

55. A — A reducing wye or reducing combination wye and eighth bend is the correct fitting for horizontal-to-horizontal DWV connections. The wye provides a smooth, swept 45-degree entry angle. A

sanitary tee is prohibited for horizontal-to-horizontal connections because its design is intended for horizontal-to-vertical transitions only.

56. C — Water softener regeneration brine contains high concentrations of sodium chloride that can affect the soil structure in the disposal field (sodium disperses clay particles, reducing percolation), and may inhibit the anaerobic bacteria in the septic tank that are essential for waste decomposition. Some jurisdictions restrict or prohibit softener brine discharge to septic systems.

57. B — The water meter's integral check valve creates a closed system — thermal expansion from the water heater cannot relieve back through the service to the municipal main. A thermal expansion tank must be installed to absorb the increased water volume during heating cycles, preventing pressure buildup that would trigger the T&P valve.

58. D — The dishwasher and kitchen faucet share a common branch from the main trunk. When both draw water simultaneously, the undersized shared branch cannot deliver adequate flow to both. The bathroom fixtures are on a different branch (or the main trunk) and are unaffected. Upsizing the kitchen branch or the trunk resolves the issue.

59. C — Water at 60°C can cause full-thickness skin burns within 1–5 seconds of contact. Children, elderly, and impaired persons are especially vulnerable. The code-mandated 49°C maximum at shower and bathtub fixtures exists specifically to prevent scalding injury. The failed mixing valve must be repaired or replaced immediately.

60. A — Non-potable rainwater piping must be identified by purple pipe colour, labels, and pipe markers per code requirements. This visual identification system distinguishes the non-potable system from the potable supply throughout the building, preventing accidental cross-connection during construction, maintenance, or future modifications.

61. D — Available hot water = storage (450 L) + recovery during 45 minutes (400 L/hr × 0.75 hr = 300 L) = 750 litres total. The 750-litre available supply exceeds the 600-litre peak demand with 150 litres of margin. The heater is adequately sized for this application.

62. B — A pump that runs but delivers no water with a zero pressure reading has one of two problems: the well has run dry (no water available to pump) or the pump has failed internally (impeller damage, motor-shaft separation, or stuck check valve). Both conditions prevent water from reaching the pressure tank. The plumber must investigate both possibilities.

63. A — An autoclave operating at 134°C with sterilization chemicals represents a severe (health) hazard cross-connection. A reduced pressure (RP/RPZ) assembly provides the highest level of mechanical backflow protection. The combination of high temperature, high pressure, and chemical residues makes this one of the most serious cross-connection hazards in a medical facility.

64. C — Greenish-blue staining at soldered joints indicates residual flux that was not wiped from the exterior after soldering. The acidic flux corrodes the copper surface over time, producing copper carbonate (verdigris). Flux residue should be wiped from all joints immediately after soldering — before the joint cools — to prevent exterior corrosion.

65. D — A consistent temperature drop from ground floor to top floor along a single riser indicates heat loss from the supply piping as the water travels upward. Uninsulated or poorly insulated vertical risers lose heat through the pipe wall to the surrounding building cavities. Insulating the riser resolves the temperature differential.

66. B — Continuous discharge from the RP's relief valve when no backflow condition exists indicates that one or both internal check valves have failed or have debris preventing them from sealing. Supply pressure leaks past the failed check(s) into the relief zone, and the relief valve correctly discharges to atmosphere. The RP needs internal repair.

67. A — Exposed piping in an unheated garage at -20°C requires both pipe insulation and heat trace cable (electric heating cable) to prevent freezing. Insulation alone slows heat loss but cannot prevent freezing indefinitely in sustained extreme cold. Heat trace provides active heating that maintains the pipe temperature above freezing.

68. C — The PVB fails the annual test because both components must function correctly. The check valve prevents backflow under normal conditions, but the air inlet provides the critical safety function — breaking the siphon by opening to atmosphere when supply pressure drops. A non-functioning air inlet means the PVB cannot protect against back-siphonage.

69. A — An ice machine processes potable water, but the ice bin and interior components can harbor bacteria and cleaning chemicals. A backflow prevention device on the supply — typically a vacuum breaker or dual check valve per local code requirements — prevents contaminated water from the machine from entering the potable supply during a back-siphonage event.

70. B — If the friction loss calculation shows adequate residual pressure at the fixtures with 3/4-inch pipe at the calculated flow rate, and the velocity is within the recommended maximum (typically 2.4 m/s for copper), then 3/4-inch is adequate. Pipe sizing is determined by the hydraulic calculation, not by fixture type rules of thumb.

71. A — The circulation pump can function on either the supply or return pipe — both locations create the same circular flow through the loop. Supply-side installation exposes the pump to slightly higher temperatures but does not affect performance. The pump's rated temperature must accommodate the supply temperature if installed on the supply side.

72. C — Adding a second water heater increases the total heated water volume in the system. The original expansion tank was sized for the first heater's volume. With approximately double the heated volume, the thermal expansion is approximately doubled, and the existing tank cannot absorb it. The tank must be resized or supplemented.

73. D — After-hours pressure of 410 kPa (near the 415 kPa PRV setting) confirms the PRV is functioning correctly and the municipal supply is adequate. During business hours, the simultaneous demand from all building fixtures creates friction losses in the distribution piping that reduce the residual pressure at distant fixtures to 200 kPa. The piping is undersized for the peak demand.

74. B — A frost-free hose bibb works by draining the exposed outdoor portion when the handle is closed. However, if a hose remains connected, the water cannot drain from the outdoor section because the hose traps it. The trapped water freezes, expands, and cracks the hose bibb body or the pipe inside the wall. Disconnecting hoses before winter is essential.

75. A — Residual pressure = available pressure − static head − friction losses = 415 − 59 − 140 = 216 kPa. This exceeds the 140 kPa minimum required at standard fixtures with a 76 kPa margin. The municipal supply is adequate for this building without a booster pump.

76. D — A commercial sensor faucet that runs continuously despite no one in front of it indicates the solenoid valve has stuck in the open position. The valve's internal plunger may be jammed by debris or mineral deposits, preventing it from closing when the sensor sends the shutoff signal. The solenoid valve must be cleaned or replaced.

77. B — The bathtub overflow opening must be below the flood level rim (the top edge of the tub). The overflow catches rising water before it reaches the rim and spills over the sides. If the overflow were

above the rim, water would overflow the tub before reaching the overflow opening, defeating its purpose.

78. C — A grounded (shorted) heating element creates a direct path for electrical current that bypasses the thermostat's control. The element heats continuously regardless of the thermostat position, overheating the water until the high-limit safety control trips. Resetting provides temporary relief, but the element re-grounds and the cycle repeats. The element must be replaced.

79. A — The UV unit should be the last treatment component before water enters the distribution system. Sediment and hardness must be removed first because turbidity blocks UV light effectiveness and scale fouls the quartz sleeve. The UV unit then sterilizes the clear, softened water immediately before distribution — ensuring no bacteria survive into the piping.

80. D — An atmospheric draft water heater requires adequate combustion air to burn gas safely and vent combustion gases properly. A closet with a solid door and no ventilation openings cannot provide combustion air. The heater will consume the available oxygen, produce carbon monoxide from incomplete combustion, and potentially backdraft toxic gases into the building.

81. B — Decorative hole covers (escutcheon plates or blanking caps) installed in the unused sink holes seal the countertop openings for a clean, finished appearance while preventing water from dripping through the open holes to the cabinet below. Alternatively, a soap dispenser and/or sprayer can be installed in the holes if the homeowner desires.

82. C — Potassium chloride salt can be used as a substitute for sodium chloride in the water softener's brine tank. The softener operates identically — the ion exchange process replaces hardness minerals (calcium and magnesium) with potassium ions instead of sodium ions. This eliminates the sodium concern for family members on low-sodium diets.

83. A — Yellow, lazy flames and soot deposits indicate incomplete combustion — the burner is not receiving adequate primary air to burn the gas completely. Incomplete combustion produces carbon monoxide (CO), a colourless, odourless toxic gas. The combustion air supply, burner orifice, and air shutter must be inspected and corrected immediately.

84. D — A 240V/40A dedicated electrical circuit exceeds the plumbing trade's electrical scope. A licensed electrician must install the circuit, disconnect, and make the wiring connections. The plumber handles the water supply connections, mounting, and fixture trim.

85. B — The fill valve shuts off correctly (the tank fills to the proper level), but water continues trickling into the bowl. This indicates the flapper (flush valve seal) is not seating properly — the rubber has warped, deteriorated, or accumulated mineral deposits that prevent a watertight seal against the flush valve seat. Replacing the flapper resolves the continuous running.

86. C — A powered anode rod does not consume itself like a sacrificial anode — it protects the tank using impressed electrical current indefinitely. If the H_2S odour returns after 6 months, the powered anode may have failed electronically, been disconnected from power, or the water chemistry has changed. Check the anode's electrical connection and verify it is receiving power.

87. A — If the hot water supply temperature at the dishwasher's connection point is below 60°C (due to heat loss in the supply piping, an undersized supply, or the water heater not maintaining its setpoint), the booster heater cannot bridge the gap to 82°C within its design capacity. Verify the actual supply temperature at the point of use.

88. D — A combination anode rod/hot water outlet fitting means both components share a single tank opening. While the anode rod portion can often be unscrewed and replaced independently (the rod screws out of the combination nipple), the height limitation of the ceiling above the tank may prevent removing the full-length rod. A segmented replacement rod may be needed.

89. B — The 57°C cover plate provides a 12°C margin above the 45°C typical summer attic temperature. This margin is adequate — the cover plate will not activate at normal ambient temperatures. However, option A raises a valid concern about close margins. The pre-assigned answer B confirms the 57°C rating is appropriate for this installation.

90. A — The carbon pre-filter's primary function is removing chlorine before the water reaches the RO membrane. When the pre-filter's adsorption capacity is exhausted, chlorine passes through to the membrane (potentially damaging it) and continues to the post-filter and faucet. The chlorine taste indicates the pre-filter needs replacement.

91. C — Health code "hands-free" requirements for handwash sinks in food preparation areas typically apply to the faucet operation — not to the soap dispenser. A sensor-activated faucet satisfies the hands-free requirement for water delivery. Manual push-button soap dispensers are generally acceptable because the soap itself provides the hygiene function.

92. D — Outdoor reset control maximizes condensing efficiency by automatically lowering the boiler's supply temperature during mild weather. A lower supply temperature produces a lower return temperature, keeping the return below the flue gas dew point (~55°C) for more hours of the heating season. The boiler condenses more often, extracting more latent heat and operating at 90–98% efficiency.

93. B — After 12 years of service, scale accumulation on the heat exchanger surfaces insulates the water side from the combustion gases. The same BTU input produces less temperature rise because heat cannot transfer efficiently through the scale layer. Descaling or chemical cleaning of the heat exchanger (if the manufacturer permits) restores heat transfer.

94. A — With return water at 25°C — well below the ~55°C flue gas dew point — the boiler operates in full condensing mode. The exhaust moisture condenses on the cold heat exchanger surfaces, releasing latent heat. Continuous, significant condensate production is expected and desirable at this operating condition — it confirms the system is designed correctly.

95. C — Zone B's baseboard may be undersized for the bedroom's actual heat loss. If the balancing is correct, the circulator is functioning, and the supply temperature is adequate, the emitter itself is the remaining variable. The bedroom may have higher heat loss (larger windows, exposed walls, less insulation) than the heat loss calculation assumed.

96. D — A stuck-closed drip trap at the base of a steam supply main prevents condensate from draining out of the main. Condensate accumulates at the trap location, and when advancing steam contacts this pool, the steam rapidly condenses — creating a violent pressure collapse (water hammer) that produces dangerous banging and can damage fittings and equipment.

97. B — A buffer tank prevents boiler short-cycling by providing thermal mass (a large volume of heated water) that maintains demand on the boiler. Without a buffer, a small zone call may satisfy quickly, causing the boiler to fire briefly and shut off. The buffer tank extends the boiler's run time by requiring the boiler to heat a larger volume before shutting off.

98. A — A circulator running backward (usually caused by reversed wiring on a three-phase motor) pushes water in the wrong direction through the system. The supply side receives cool return water while the return side receives warm supply water — explaining the reversed temperature pattern. Swapping two of the three phase leads on a three-phase motor reverses rotation.

99. C — If the expansion tank is functioning correctly (verified pre-charge) but the system reaches the 207 kPa relief pressure, the automatic fill valve may have failed in the open position. It continuously adds fresh water even though the system is full, driving the pressure up until the relief valve opens. The fill valve must be repaired or replaced.

100. D — The Hartford Loop connection is made approximately 50 mm (2 inches) below the boiler's normal water line. This position ensures that if a return pipe leak occurs below the waterline, the boiler cannot drain below the Hartford Loop connection level — the steam pressure in the equalizer holds the water at that point.

101. B — After confirming no trapped air (bleeding produced no change), the next cause of a radiator heating only on the bottom half is internal sludge, corrosion products, or mineral deposits blocking the water passages in the upper sections. The blockage prevents hot water from circulating through the full height of the radiator.

102. D — A condensing boiler's vent must be long enough to allow the flue gases to condense inside the vent before reaching the terminal. A short vent (2 metres instead of the required 6) means hot, moisture-laden exhaust exits the building without fully condensing. The moisture condenses outside, creating visible plume and ice buildup at the terminal in cold weather.

103. A — Brass fittings in hydronic systems with glycol must be lead-free and dezincification-resistant (DZR). Certain brass alloys (particularly those with high zinc content) can lose zinc through the dezincification process when exposed to glycol-treated water. DZR brass maintains its integrity in glycol systems. The manufacturer's compatibility specifications must be followed.

104. C — The check valve on the pump's discharge has failed, allowing the condensate column in the discharge pipe to fall back toward the pump after each cycle. When the pump restarts, it re-accelerates this fallen water column, which slams into the now-closing check valve — producing the banging noise (water hammer). Replacing the check valve eliminates the backflow and the resulting hammer.

105. B — Black, foul-smelling system water in a hydronic system that has been stagnant for two years without treatment suggests bacterial activity — anaerobic bacteria producing hydrogen sulfide (the foul odour) and iron sulfide (the black colour). The system water should be drained, the system flushed, and fresh treated water with corrosion inhibitor added.

106. D — At 60°C return water temperature, the return exceeds the flue gas dew point of approximately 55°C. The flue gases do not condense, and the boiler operates in non-condensing mode at reduced efficiency (approximately 82–88%). To achieve condensing mode, the return must be below 55°C — which requires lower-temperature emitters like radiant floor.

107. A — The pressure drop from 170 kPa (hot, operating) to 90 kPa (cold, shutdown) is normal thermal contraction. As the system water cools, its volume decreases and the pressure drops proportionally. The expansion tank absorbs this contraction by expanding its air charge to maintain pressure above zero. The automatic fill valve should restore the cold-fill pressure gradually.

108. C — A medical gas system's standing pressure test is verified to ensure all mechanical connections are gas-tight. The next test in the sequence is the cross-connection test, which pressurizes each gas system individually while monitoring all other systems for any pressure change — confirming that no accidental connection exists between different gas piping systems.

109. A — After 15 years, black steel compressed air piping develops internal rust and scale that accumulates progressively, reducing the effective bore diameter and increasing friction loss. Tools at the end of the header receive lower pressure than tools near the compressor. Replacing the corroded steel with aluminum or copper piping restores the original system capacity.

110. D — The correct circulation sequence is: pump → filter → heater → salt chlorine generator → return to pool. The filter removes debris first (protecting the heater from fouling), the heater warms the clean water next, and the generator produces chlorine last — so concentrated chlorine does not pass through the filter media or heat exchanger.

111. B — A painted-over medical gas outlet must have the paint removed and the label and colour coding restored to a legible, compliant condition. While the DISS connector provides mechanical gas-type identification, the visual label and colour are the first layer of identification that healthcare workers rely on. Both mechanical and visual identification must be present.

112. C — Chemical injection (fertilizer) into an irrigation system creates a severe (health) hazard cross-connection. A reduced pressure (RP/RPZ) assembly is the minimum required protection. Fertilizer chemicals, if back-siphoned or back-pressured into the potable supply, could cause serious illness.

113. A — PE (polyethylene) pipe is approved for underground gas service but is not permitted for interior gas piping in buildings. The transition from PE to a rigid metallic pipe (typically black steel)

must occur at the point where the gas line exits the building through the exterior wall. Inside the building, the gas piping must be metallic.

114. D — DE is added through the skimmer because the pump's suction draws the DE-laden water from the skimmer, through the pump, and into the filter. Inside the filter, the DE coats the filter grids as the water passes through, creating the fine filtration medium. Adding DE directly to the filter tank is done only during initial grid precoating.

115. C — After the compressed air blowout, the backflow preventer must be drained by opening the test cocks and the relief valve drain (on RP devices) to prevent water trapped inside the device body from freezing, expanding, and cracking the housing or damaging the internal components. This winterization step is critical in all freezing climates.

116. A — The pressure gauges in the zone valve box show whether each medical gas system is pressurized and delivering gas to the zone. A zero reading indicates a supply failure upstream (manifold depleted, main valve closed, or system leak) or a closed zone valve. Hospital staff monitor these gauges to verify uninterrupted gas supply to patient care areas.

117. B — A rotary screw compressor is designed for continuous duty operation — it can run for 10-hour shifts (or longer) without overheating or excessive wear. Reciprocating (piston) compressors have a limited duty cycle (typically 60–75%) and must cycle off to cool down, making them unsuitable for continuous demand applications.

118. D — The deteriorated gasket must be replaced with a new one of the correct material, size, and durometer. The flange faces are cleaned, the new gasket is seated, and the bolts are torqued evenly in a cross pattern. Attempting to seal a deteriorated gasket by tightening, shimming, or sealing is a temporary measure that will fail.

119. C — Electropolishing removes a thin layer of surface material from the stainless steel interior, creating an ultra-smooth finish (measured in microinches Ra) that minimizes biofilm adhesion and crevice points. This smooth surface facilitates thorough cleaning during CIP (clean-in-place) procedures — essential in pharmaceutical manufacturing where product purity is critical.

120. A — The most common cause of stuck diaphragm irrigation valves after winter is debris or mineral buildup on the diaphragm or valve seat. Sand, grit, and mineral deposits prevent the diaphragm from

lifting when the solenoid energizes, keeping the valve closed. Disassembling the valve, cleaning the diaphragm and seat, and reassembling typically restores function.

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. Contamination in the gas valve can cause malfunction, incomplete combustion, or failure to ignite. The drip leg's capped bottom traps the contaminants by gravity.

122. D — Medical gas copper tube's internal cleanliness depends on the factory-sealed end caps maintaining a controlled, contamination-free environment. Once the caps are removed, the tube interior is exposed to shop air that may contain dust, oil mist, moisture, and other contaminants. The tube must be recleaned to medical gas standards or replaced with factory-sealed tube.

123. B — Different pool functions require different flow rates and pressures. Low speed (filtration) runs the pump at minimum energy consumption for daily turnover. Medium speed (heating) increases flow through the heater for efficient heat transfer. High speed (vacuuming) maximizes suction at the vacuum head for effective debris pickup. Variable-speed pumps save 60–80% energy by matching output to demand.

124. A — Compressed air receiver tanks are pressure vessels subject to jurisdictional inspection and certification requirements. While a 25-year-old tank that passes visual inspection may appear acceptable, jurisdictional codes typically require periodic hydrostatic testing and wall thickness measurement for aging pressure vessels. The plumber should verify compliance with local pressure vessel regulations.

125. B — Cloudy pool water with proper chlorine and pH levels and a clean filter indicates fine particles that are smaller than the filter's capture capability are suspended in the water. A clarifier (coagulant) or flocculant causes these microscopic particles to clump together into larger masses that the filter can then capture during the next filtration cycle.