PRACTICE EXAM 13: RED SEAL PLUMBER SIMULATION (125 QUESTIONS)

1. A plumber is preparing to solder a copper joint on a horizontal pipe running along a woodframed wall. The stud directly behind the joint is 40 mm from the pipe. Before applying the torch, the plumber positions a heat shield between the pipe and the wood. During soldering, the plumber notices smoke rising from behind the heat shield. What should the plumber do?

A. Continue soldering quickly to finish the joint before the wood ignites, then inspect for damage after the torch is off

B. Stop soldering immediately, remove the heat shield, inspect for ignition or charring, and extinguish any smouldering material

C. Spray the wood stud with water from a spray bottle while continuing to solder the joint to completion on schedule

D. Reposition the heat shield closer to the wood and resume soldering because the shield was placed too far from the stud

2. A plumber is working in a mechanical room where a boiler has been shut down for maintenance. The gas supply valve has been closed. The plumber must solder a copper pipe located 600 mm from the gas supply piping. Before lighting the torch, what precaution must be verified regarding the gas system?

A. The gas supply valve position is sufficient — no additional verification is needed beyond confirming the valve is closed

B. A combustible gas detector should be used to confirm zero gas concentration in the mechanical room air before ignition

C. The boiler's draft hood must be covered to prevent gas from entering the room through the flue pipe during soldering

D. The gas piping must be leaktested and confirmed gasfree before any ignition source is introduced in the mechanical room

3. A plumber must install an underground water service through soil that has been identified as contaminated with petroleum hydrocarbons from a previous fuel storage tank leak. The standard water service material is polyethylene (PE). Can PE pipe be installed in petroleumcontaminated soil?

A. No — PE pipe can absorb petroleum hydrocarbons through its wall, contaminating the potable water inside the service

B. Yes — PE pipe is chemically resistant to all petroleum products and will not be affected by the contaminated soil

C. No — but only because PE pipe is not approved for underground water service installation in any soil condition

D. Yes — but the pipe must be wrapped in a protective plastic sleeve to prevent direct contact with the contaminated soil

4. A plumber is using a powderactuated tool to install pipe supports on a concrete ceiling. The tool uses .22 calibre charges to drive hardened pins into the concrete. What PPE is required specifically for this tool beyond standard construction PPE?

A. A fullbody leather apron to protect against concrete fragments propelled downward during the pin driving operation

B. A face shield with side protection because the powderactuated tool produces highvelocity fragments during firing

C. Hearing protection is mandatory for the operator and all workers within the blast zone of the powderactuated tool

D. A respirator with organic vapour cartridges to filter the chemical fumes produced by the .22 calibre powder charges

5. A plumber calculates the offset travel for a rolling offset (a pipe that must move horizontally and vertically simultaneously). The horizontal offset is 400 mm and the vertical rise is 300 mm. Using the Pythagorean theorem, what is the diagonal distance between the two fitting centres?

A. 700 mm, calculated by adding the horizontal offset and the vertical rise together for the total diagonal distance

B. 500 mm, calculated as $\sqrt{(400^2 + 300^2)} = \sqrt{(160{,}000 + 90{,}000)} = \sqrt{250{,}000} = 500$ mm diagonal distance

C. 350 mm, calculated by averaging the horizontal offset and vertical rise for the approximate diagonal centre distance

D. 250 mm, calculated by subtracting the vertical rise from the horizontal offset for the net diagonal displacement

6. A plumber is reviewing the project specifications for a commercial building and encounters a section titled "Division 22 — Plumbing." The specification states: "All domestic hot water piping shall be insulated with 25 mm thick fibreglass insulation with allservice jacket." What does "allservice jacket" (ASJ) refer to?

A. A metal jacket made of aluminum or stainless steel that protects the insulation from physical damage during operation

B. A kraft paper and foil laminate that wraps the insulation for a finished appearance and serves as a vapour barrier

C. A hightemperature fabric wrap that allows the insulation to be used on steam piping up to 200°C service temperature

D. A white kraft paper and foil laminate vapour retarder jacket that provides a clean, finished appearance and moisture protection

7. A plumber discovers that a coworker has propped open a fire door in a corridor to make it easier to transport pipe from the storage area to the work location. The building is occupied. What is the correct response?

A. Close the fire door immediately — propping open a fire door in an occupied building defeats the fire separation and violates life safety codes

B. Leave the door propped open because the plumber's work is temporary and the door will be closed at the end of the day

C. Notify building security to make the decision about the fire door because it is outside the plumber's area of responsibility

D. Install a temporary fire barrier across the opening to provide equivalent fire protection while the door remains propped open

8. A plumber must install a pipe penetration through a floor that has a 2hour fire rating. The pipe is 3inch copper. What firestopping is appropriate for a metallic (copper) pipe through a firerated floor?

A. An intumescent collar designed for plastic pipe that crushes the pipe as it melts during fire exposure conditions

B. No firestopping is required because copper pipe is noncombustible and does not contribute fuel to a fire event

C. An approved firestop sealant or device listed for use with metallic pipe penetrations through the specific firerated assembly

D. A steel thimble (sleeve) alone provides adequate fire protection for copper pipe through any firerated floor assembly

9. A plumber is installing pipe in a building that is under renovation. Existing asbestos insulation has been identified on some piping in the ceiling space. The asbestos has not yet been abated. The plumber's new piping must be routed through the same ceiling space. Can the plumber proceed?

A. Yes — the plumber can work in the ceiling space as long as the asbestoscontaining materials are not disturbed directly

B. No — the plumber must not work in the area until the asbestos has been properly abated by a licensed abatement contractor

C. Yes — but only if the plumber wears a P100 respirator and disposable coveralls while working near the asbestos

D. No — but the plumber can route the piping through an alternative path that avoids the ceiling space entirely

10. A plumber needs to determine the expansion of a 30metre straight run of copper pipe heated from 10°C to 80°C. The coefficient of linear expansion for copper is 0.0000168 per °C. What is the total expansion?

A. Approximately 3.5 mm, calculated using the formula for thermal expansion of steel pipe instead of copper piping

B. Approximately 17 mm, calculated by using only half the temperature differential in the expansion formula calculation

C. Approximately 70 mm, calculated by using the coefficient for PVC pipe instead of the coefficient for copper pipe

D. Approximately 35 mm, calculated as 30 m × 0.0000168/°C × 70°C = 0.03528 m = approximately 35 mm total

11. A plumber is assigned to work on the roof of a 4storey commercial building to install a vent terminal. The roof has no parapet wall or guardrail. The plumber must work within 2 metres of the roof edge to reach the vent penetration location. What fall protection is required?

A. A personal fall arrest system (harness and lanyard) anchored to an approved anchor point, or a guardrail at the roof edge

B. No fall protection is required because the plumber is only working temporarily at the roof edge for a brief installation

C. Safety glasses and a hard hat provide adequate protection for brief rooftop work near unprotected edges

D. A safety watch (a coworker standing at the roof edge to warn the plumber of proximity) replaces fall arrest equipment

12. A plumber must install a 2inch copper water supply pipe through a structural steel beam with a precut 3inch round hole. The beam's web is 12 mm thick. What must be installed between the copper pipe and the steel beam at the penetration?

A. A welded steel collar that permanently fixes the copper pipe to the beam for maximum structural support at the penetration

B. Expanding spray foam insulation to fill the annular space and provide thermal insulation at the beam penetration

C. A nonmetallic grommet, sleeve, or bushing that prevents direct coppertosteel contact and allows thermal movement

D. A firestop collar that expands during fire to crush the copper pipe and seal the opening through the structural beam

13. A plumber encounters a project drawing that uses the abbreviation "NIC." The plumber is unfamiliar with this abbreviation. What does "NIC" typically mean on construction drawings?

A. "No Inspection Certificate" — the work covered by this abbreviation does not require inspection by the authority

B. "Not In Contract" — the work or item is shown on the drawings for reference but is not included in this contractor's scope

C. "New Installation Complete" — the item has already been installed by a previous contractor and requires no additional work

D. "NonIntegral Component" — the item is optional and the contractor may include or exclude it at their discretion

14. A plumber is installing domestic hot water piping in a highrise residential building. The specification requires all hot water piping to be insulated. The plumber installs fibreglass pipe insulation with ASJ jacket on all horizontal runs but does not insulate the vertical risers inside the mechanical shaft. Is this installation complete?

A. Yes — vertical risers in mechanical shafts do not require insulation because the shaft provides adequate thermal protection

B. Yes — insulation is required only on horizontal runs where heat loss is greatest due to the larger surface area contact

C. No — but only the first 3 metres of vertical riser from the water heater requires insulation per energy code minimums

D. No — the specification states "all hot water piping," which includes vertical risers in mechanical shafts throughout the building

15. A plumber is working on a construction site where a tower crane operates overhead. The plumber must install exterior underground piping in the crane's swing radius. What coordination is required?

A. The plumber must communicate with the crane operator and establish a safe work zone before entering the crane's swing radius

B. No coordination is needed because the tower crane operator is responsible for avoiding all workers on the ground below

C. The plumber must wear a hard hat rated for crane operations that can withstand a dropped load from crane height

D. The plumber must wait until the crane is completely shut down and locked out before any work within the swing radius

16. A plumber calculates the volume of a cylindrical water storage tank. The tank has an internal diameter of 1.2 metres and a height of 2.0 metres. Using $V = \pi \times r^2 \times h$, what is the tank's capacity in litres?

A. Approximately 4,524 litres, calculated by using the diameter instead of the radius in the volume formula

B. Approximately 1,131 litres, calculated by dividing the correct volume by 2 due to a unit conversion error

C. Approximately 2,262 litres, calculated as $\pi \times (0.6)^2 \times 2.0 = \pi \times 0.36 \times 2.0 = 2.262$ $m^3 = 2{,}262$ litres

D. Approximately 7,540 litres, calculated by multiplying the correct volume by π a second time in the conversion

17. A plumber is installing a 1inch copper water supply using propress fittings. After pressing several fittings, the plumber realizes that one fitting was pressed without removing the factoryinstalled green "Smart Connect" indicator clip. Is this a problem?

A. Yes — the clip must be removed before pressing because it interferes with the pressing jaw's ability to fully compress the fitting

B. No — the Smart Connect clip is designed to be left in place during pressing and falls off automatically during the press cycle

C. Yes — the clip prevents the Oring from seating properly and the fitting must be cut out and replaced with a new fitting

D. No — the clip is simply a visual indicator that breaks during pressing; its presence does not affect the joint's integrity

18. A plumber must join two sections of CPVC hot water supply pipe. CPVC requires a specific solvent cement that is different from standard PVC cement. What happens if the plumber accidentally uses standard PVC cement on CPVC pipe?

A. The PVC cement may not properly soften the CPVC material, producing a weak joint that can fail under pressure or temperature

B. The PVC cement creates a stronger bond on CPVC than CPVCspecific cement because PVC cement has a higher solvent content

C. The PVC cement dissolves the CPVC pipe wall excessively, creating an oversized socket that the fitting cannot seal properly

D. Nothing — PVC and CPVC cements are chemically identical and can be used interchangeably on both pipe materials

19. A plumber is brazing a 1inch copper joint using an oxyacetylene torch. The flame has a long, feathery inner cone with a yellowish outer envelope. What type of flame is this and is it correct for brazing?

A. An oxidizing flame that produces a clean, oxidefree joint surface ideal for brazing copper pipe with BCuP alloy

B. A neutral flame that provides the correct balance of heat and atmosphere for all copper brazing applications

C. A carburizing (reducing) flame — the excess acetylene produces carbon that can contaminate the joint; adjust to neutral

D. A cutting flame that is too hot for brazing and will melt through the copper pipe wall before the filler metal flows

20. A plumber is installing Schedule 80 PVC pipe for a chemical waste drainage system in a laboratory. Schedule 80 PVC differs from Schedule 40 PVC in wall thickness. How does the thicker wall of Schedule 80 affect the pipe's characteristics?

A. Schedule 80 has a smaller internal diameter than Schedule 40 at the same nominal size due to the thicker wall

B. Schedule 80 has a larger outside diameter than Schedule 40, requiring different fitting sizes for each schedule

C. Schedule 80 has identical internal and external dimensions to Schedule 40 — only the pipe material formula differs

D. Schedule 80 is lighter than Schedule 40 because the thicker wall uses a lowerdensity PVC compound for weight reduction

21. A plumber must install a dielectric fitting between copper water supply piping and a galvanized steel water heater nipple. The plumber has two options: a dielectric union and a dielectric nipple (brass nipple with a plastic liner). Which provides superior longterm isolation?

A. Both provide identical isolation — the choice is based solely on cost and installation convenience at the transition

B. The dielectric union is inferior because its rubber gasket deteriorates over time, losing its insulating properties

C. The dielectric nipple is inferior because the plastic liner can crack under thermal cycling at the water heater connection

D. The dielectric union provides superior isolation because it completely interrupts both electrical and physical metal contact

22. A plumber encounters an existing copper pipe system where a previous repair used a compression fitting with a brass ferrule. The compression fitting is located inside a wall cavity behind drywall. Is this concealed compression fitting installation acceptable?

A. Yes — compression fittings with brass ferrules are approved for concealed installation in all Canadian plumbing code jurisdictions

B. No — compression fittings are approved for exposed and accessible locations only; they must not be concealed in walls

C. Yes — but only if the compression fitting is wrapped with anticorrosion tape before being concealed behind the drywall

D. No — but a mechanical coupling with a rubber gasket can replace the compression fitting for approved concealed installation

23. A plumber is soldering a 3/4inch copper joint. After applying flux and assembling the joint, the plumber heats the fitting with the torch. When solder is applied to the joint, it melts but forms a dull, grainy appearance rather than a bright, shiny fillet. What does this indicate?

A. The solder is the wrong alloy for copper pipe and must be replaced with a copperspecific soldering wire product

B. The flux has expired and must be replaced with fresh flux that provides adequate oxide protection during heating

C. The fitting was overheated — the flux burned off before the solder was applied, leaving the copper surface oxidized

D. The solder was applied correctly — dull, grainy fillets indicate a properly completed leadfree solder joint on copper

24. A plumber is installing PEXB tubing using copper crimp rings and a crimp tool. After crimping a 3/4inch ring, the plumber checks the crimp with a go/nogo gauge. The ring passes through the "go" side but does not fit into the "nogo" side. What does this result indicate?

A. The crimp is undersized — the ring was not compressed enough and must be recrimped or the connection replaced

B. The crimp is within the acceptable range — passing the "go" and failing the "nogo" confirms proper compression

C. The crimp is oversized — the ring was compressed too much and must be cut off and replaced with a new connection

D. The go/nogo gauge is not calibrated for 3/4inch rings and cannot provide a reliable result for this pipe size

25. A plumber must join a 4inch PVC DWV pipe to a 4inch ABS DWV pipe at a connection point in a renovation. The plumber does not have transition cement or mechanical couplings available. Can standard PVC or ABS solvent cement be used to join these two different materials?

A. Yes — standard PVC cement bonds both PVC and ABS materials equally well at the molecular level during fusion

B. Yes — ABS cement can bond to PVC pipe because ABS cement has a broader chemical compatibility than PVC cement

C. No — the plumber must use only a greenlabeled transition cement or a listed rubber mechanical coupling for this connection

D. No — PVC and ABS cannot be connected by any method and the plumber must replace one material to match the other

26. A plumber is installing a DWV system in a commercial building with a flat roof. The vent terminal must extend above the roof surface. The code requires a minimum extension of 150 mm (6 inches) above the roof. The building is located in Saskatoon, Saskatchewan, where heavy snowfall is common. Should the vent extend higher than the code minimum?

A. Yes — in heavy snowfall regions the vent should extend higher to prevent snow from burying and blocking the terminal

B. No — the 150 mm code minimum is adequate for all climate zones including heavy snowfall regions across Canada

C. Yes — but only if the vent diameter is less than 3 inches, which is more susceptible to snow blockage than larger vents

D. No — the roof slope and drainage design prevent snow from accumulating to a depth that would block a 150 mm vent

27. A plumber discovers that an existing building's 3inch soil stack has a 90degree shortturn elbow at the base where it transitions from vertical to horizontal. What code issue does this fitting create?

A. Shortturn 90degree elbows are acceptable at stack bases because the verticaltohorizontal transition requires a tight turn

B. Shortturn 90degree elbows are acceptable only if the stack serves fewer than 20 DFU at the transition point

C. A longsweep 90degree elbow or two 45degree elbows must be used at a stack base to prevent blockages and turbulence

D. A sanitary tee must be used at every stack base regardless of the direction change angle required at the transition point

28. A plumber is sizing a storm drainage system for a commercial building roof. The roof has a total area of 600 m². The local design rainfall intensity is 75 mm/hr. The code sizing table shows: 4inch leader = 200 m² at 75 mm/hr; 5inch leader = 425 m² at 75 mm/hr; 6inch leader = 800 m² at 75 mm/hr. How many 4inch leaders are needed to drain this roof?

A. Two 4inch leaders (2 × 200 = 400 m²), which is insufficient but represents the minimum number of roof penetrations

B. Three 4inch leaders (3 × 200 = 600 m²), which exactly matches the roof area at the design rainfall intensity

C. Four 4inch leaders (4 × 200 = 800 m²), which provides a safety margin above the 600 m² roof area requirement

D. One 6inch leader (800 m²), which provides the full capacity needed with a single roof penetration for simplicity

29. A plumber encounters a residential building where the washing machine drain connects to a laundry tub (washtub) rather than a dedicated standpipe. The washing machine discharge hose hooks over the rim of the laundry tub and the water drains through the tub's trap to the building drain. Is this an acceptable installation?

A. No — washing machine discharge must always connect to a dedicated standpipe with its own Ptrap and vent connection

B. No — the washing machine discharge overwhelms the laundry tub's drain capacity and causes overflow during peak cycles

C. Yes — but only if the discharge hose is permanently clamped to the tub rim to prevent it from falling to the floor

D. Yes — discharging to a laundry tub is an accepted alternative to a standpipe, provided the tub is properly trapped and vented

30. A plumber is installing a building sewer that will receive discharge from a grease interceptor serving a restaurant. The interceptor has been properly sized and installed. However, the plumber notices that the interceptor's discharge pipe connects to the building sewer through a standard wye fitting with no

additional treatment. Is any additional device needed between the interceptor outlet and the building sewer?

A. No — the grease interceptor provides the required treatment; no additional device is needed between the outlet and the sewer

B. Yes — a sampling manhole or inspection chamber must be installed between the interceptor and the sewer for monitoring

C. Yes — a backwater valve must be installed on the interceptor outlet to prevent sewer backup into the interceptor tank

D. Yes — a secondary grease trap must be installed between the interceptor and the sewer as a backup treatment stage

31. A plumber is troubleshooting a commercial building where a floor drain in the basement emits sewer gas. The drain has a functioning trap with an adequate water seal. The vent is clear and connected properly. A smoke test shows no leaks in the DWV piping. What other source could produce the sewerlike odour at this drain?

A. The floor drain's cleanout plug is loose or missing, allowing gas to escape from the cleanout opening near the drain

B. The sewer gas is entering through the building's foundation wall from the municipal sewer through soil porosity

C. Bacteria growing in the organic biofilm coating the drain pipe interior near the trap produce hydrogen sulfide gas

D. The municipal sewer main is producing excessive gas that overcomes the trap seal through positive pressure events

32. A plumber installs a 4inch building drain at 1/4 inch per foot slope. The drain runs 12 metres (approximately 40 feet) beneath the basement floor slab. Halfway through the run, the plumber encounters a large boulder that cannot be removed. The plumber must offset the drain around the boulder. What fitting combination creates the offset?

A. Two 45degree elbows with a straight section between them, maintaining the same slope through the offset section

B. Two standard 90degree elbows with a vertical riser between them to go over the boulder from above the obstruction

C. A single 90degree longsweep elbow that redirects the drain around one side of the boulder in a single fitting

D. A cleanout fitting installed at the boulder location that provides access while the drain routes around the obstruction

33. A plumber discovers that a building's existing DWV system has a vent pipe that is smaller than the drain it serves. The drain is 4 inches and the vent is 11/4 inches. The vent's developed length is 6 metres and the total DFU on the drain is 60. The code sizing table shows: 11/4" vent at 6 m = 10 DFU; 11/2" at 6 m = 24 DFU; 2" at 6 m = 60 DFU. What is the minimum required vent size?

A. 11/2 inches, because it is the minimum vent size that exceeds half the drain

B. 11/4 inches is adequate because the short developed length compensates for the small diameter at this DFU load

C. 3 inches, which matches 75% of the drain diameter for all commercial DWV vent sizing applications per code

D. 2 inches, which accommodates exactly 60 DFU at 6 metres developed length and meets the halfdiameter minimum

34. A plumber installs a floor drain in a restaurant's food preparation area. The floor drain must have a specific feature to prevent solid food waste from entering the drainage system. What feature is required?

A. A removable strainer basket or sediment bucket that catches food solids while allowing liquid to flow through to the trap

B. A grease interceptor built into the floor drain body that separates grease from the food preparation waste water

C. A backwater valve that closes when solid food waste attempts to enter the drain during food preparation activities

D. A mechanical grinding device that pulverizes food waste before it enters the trap and downstream drainage piping

35. A plumber is installing underground DWV piping beneath a building addition's concrete slab. The slab will be 150 mm (6 inches) thick. The pipe is 4inch PVC at 1/4 inch per foot slope. The plumber must ensure adequate cover over the pipe. What is the minimum concrete cover over the top of the pipe?

A. No minimum cover is specified — the pipe must simply be below the finished floor level and properly supported

B. 25 mm (1 inch) minimum cover is standard for all underground pipe beneath concrete slabs in building construction

C. The pipe must be fully encased in concrete with a minimum of 50 mm (2 inches) of cover over the top of the pipe

D. The pipe must have sufficient cover to prevent damage during slab loading — typically a minimum of one pipe diameter

36. A plumber encounters a building where the 4inch building sewer exits the foundation wall at an elevation that is higher than the municipal sewer connection at the property line. The elevation difference is 300 mm over a 15metre run. What is the effective slope of this building sewer?

A. Approximately 1 inch per foot, which exceeds the maximum recommended slope and may cause solids stranding

B. 300 mm over 15 m = 20 mm per metre = approximately 1/4 inch per foot, which is an acceptable slope for a 4inch sewer

C. The sewer has no slope because the 300 mm drop is insufficient over 15 metres for gravity drainage to function

D. 300 mm over 15 m = 2% grade, which converts to approximately 1/4 inch per foot — an acceptable slope for this pipe

37. A plumber installs a DWV system in a building where the architect has specified that no vent piping may penetrate the roof membrane. The roof is a highperformance commercial membrane with a 30year warranty. What venting alternative eliminates roof penetrations?

A. An island vent (loop vent) that connects all fixture vents to a single horizontal loop inside the ceiling space

B. A circuit vent that connects multiple fixture drains to a single vent and then to the soil stack inside the building

C. Individual vents routed through the exterior wall and extending upward along the building's exterior facade surface

D. Air admittance valves (AAVs) installed at each fixture or on each branch, eliminating the need for vent roof penetrations

38. A plumber is troubleshooting a residential DWV system where the homeowner reports that the kitchen sink drain gurgles and drains slowly after the dishwasher completes its drain cycle. The sink and dishwasher share a 2inch horizontal branch. When only the sink is used (no dishwasher running), drainage is normal. What is the most likely cause?

A. The shared 2inch branch is adequate for either fixture alone but undersized for the combined simultaneous discharge

B. The dishwasher's drain pump creates a vacuum in the shared branch that siphons air through the kitchen sink trap

C. The kitchen sink's individual vent is blocked, causing it to be affected by the dishwasher's highvolume discharge

D. The dishwasher's drain hose is connected below the kitchen sink's trap, creating a crossconnection between the two

39. A plumber installs a sewage ejector system for a basement bathroom. The sealed pit is connected to the building's DWV system through a vent pipe that extends to the roof. The force main from the ejector pump connects to the gravity building drain on the floor above. What prevents sewer gas from entering the basement through the ejector pit?

A. The check valve on the force main seals the pit from the gravity system when the pump is not running during idle periods

B. The float switch inside the pit creates an airtight seal between the pit interior and the basement atmosphere

C. The sealed, gasketed pit cover and the vent connection together prevent sewer gas from escaping into the basement

D. The water in the ejector pit's Ptrap creates a liquid seal that blocks gas from entering the basement from the sewer

40. A plumber discovers that an existing septic system has a distribution box that is cracked and leaking effluent into the surrounding soil before it reaches the disposal field trenches. What consequence does this leak have?

A. The leak reduces the total effluent volume reaching the trenches, causing the soil in the disposal field to dry out

B. The leaked effluent saturates the soil around the distribution box, potentially contaminating groundwater at this concentrated point

C. The leak has no environmental consequence because the effluent is already treated in the septic tank before reaching the box

D. The cracked box actually improves effluent distribution by allowing additional soil contact before the field trenches

41. A plumber is installing a cleanout on a 4inch horizontal building drain at a point where the drain changes direction by 90 degrees. The cleanout must provide access for drain cleaning equipment in both the upstream and downstream directions. What fitting accomplishes this?

A. A single sanitary tee with a threaded plug facing upstream, which provides bidirectional access at the tee branch

B. A single wye fitting with a threaded plug facing upstream, plus a separate downstream cleanout on the other side

C. A standard cleanout fitting facing upstream only — the 90degree elbow itself provides natural access downstream

D. A twoway cleanout fitting (or cleanout tee) that provides independent access in both the upstream and downstream directions

42. A plumber encounters a building where the 3inch soil stack terminates at the attic with an air admittance valve (AAV) instead of extending through the roof. The building also has a 2inch vent stack that extends through the roof to the open atmosphere. Does this configuration meet code?

A. Yes — the code requires at least one vent to extend through the roof; the 2inch stack satisfies this while the AAV supplements

B. No — the AAV must be replaced with a conventional vent because AAVs are prohibited on soil stacks in all installations

C. Yes — but only for buildings with fewer than 6 DFU on the entire system, which is rarely the case for soil stacks

D. No — both the soil stack and the vent stack must extend through the roof to provide adequate sewer gas relief

43. A plumber is sizing a horizontal fixture branch drain for a commercial kitchen with a 3compartment pot sink (4 DFU), a prerinse spray sink (3 DFU), and a hand sink (1 DFU). The total is 8 DFU. No water closets connect to this branch. What minimum pipe size is required?

A. 11/2 inches, which handles up to 3 DFU at code slope — insufficient for the 8 DFU total on this kitchen branch

B. 21/2 inches, which handles up to 12 DFU at code slope — sufficient with margin for the 8 DFU kitchen branch

C. 2 inches, which handles up to 6 DFU at code slope — insufficient for 8 DFU, but the next standard size handles the load

D. 3 inches, which handles significantly more than 8 DFU and is the common selection for commercial kitchen branches

44. A plumber installs a 4inch PVC building sewer at 1/8 inch per foot slope. The sewer connects to a municipal sanitary sewer at the property line. The municipal sewer is at a depth of 2.5 metres. The building drain exits the foundation at a depth of 1.5 metres. The horizontal distance from the building to the property line is 20 metres. Is the 1/8inch slope feasible given the available elevation change?

A. No — 1/8 inch per foot over 20 metres produces a fall of only 82 mm, far less than the 1,000 mm difference available

B. Yes — the available 1,000 mm of elevation change over 20 metres provides more than enough fall for 1/8inch slope

C. No — the 1,000 mm of available fall requires a minimum slope of 1/2 inch per foot, which exceeds the code minimum

D. Yes — but only if the sewer is installed at exactly 1/8 inch per foot with a vertical drop at the municipal connection

45. A plumber encounters a building where the building drain has a running trap (house trap) with an integral fresh air inlet (FAI) connected to the upstream side. The FAI extends to the exterior wall and terminates with a screen. What is the purpose of this fresh air inlet?

A. The FAI provides ventilation for the occupants by drawing fresh air from outside into the building through the drain system

B. The FAI provides makeup water to the running trap to prevent the seal from evaporating during dry weather conditions

C. The FAI provides combustion air for gasfired appliances in the building by drawing air through the drainage piping system

D. The FAI provides air to the building drain upstream of the running trap, allowing the drainage system to breathe

46. A plumber is installing a DWV system and must select the correct fitting for connecting a 2inch horizontal branch drain to a 4inch vertical soil stack. The branch connects above the highest fixture on the stack. What fitting is appropriate?

A. A 4×4×2 sanitary tee, installed with the branch sweeping in the direction of drainage flow on the vertical stack

B. A 4×4×2 double wye that provides connections on both sides of the stack for symmetrical branch loading

C. A 4×4×2 combination wye and eighth bend that provides a gradual entry from the horizontal branch into the vertical stack

D. A 4×4×2 reducing coupling that simply connects the branch to the stack without any directional fitting consideration

47. A plumber discovers during a video inspection that a section of building sewer has an orangeburg (bituminous fibre) pipe. This material was commonly installed from the 1940s through the 1970s. What condition is this pipe likely to exhibit after 50+ years of service?

A. The orangeburg pipe has petrified and become extremely rigid, making it nearly impossible to cut or modify

B. The pipe is in excellent condition because bituminous fibre is virtually indestructible in underground applications

C. The pipe has likely deformed, collapsed, or deteriorated — orangeburg degrades and loses structural integrity over time

D. The pipe has been strengthened by mineral deposits that have coated the interior and reinforced the pipe walls

48. A plumber installs a 3inch vent that passes through a cold attic space before exiting the roof. To prevent frost closure, the code requires the vent to increase in diameter as it passes through the attic. What is the typical increase?

A. The vent must double in diameter (3inch to 6inch) where it enters the attic for maximum frost closure protection

B. The vent must increase by at least one pipe size (3inch to 4inch) before passing through the roof in the cold attic

C. The vent must decrease in diameter through the attic to increase air velocity and prevent condensation from forming

D. No diameter change is required — the standard practice is to insulate the existing vent within the attic space only

49. A plumber is troubleshooting a residential DWV system where the secondfloor bathtub drains very slowly. The plumber snakes the drain line and finds no blockage. The vent is clear when tested with compressed air. The trap is clean. What other condition could cause the slow drainage?

A. The bathtub drain's tailpiece diameter is undersized — a 11/4inch tailpiece instead of the required 11/2inch for a tub

B. The bathtub's popup or triplever drain mechanism is partially blocking the drain opening inside the tub itself

C. The building's water supply pressure is too low, reducing the volume of water available to flush the drain effectively

D. The bathtub's overflow assembly has a partial blockage that creates backpressure on the drain during drainage events

50. A plumber is installing a building drain in a commercial building. The drain must accommodate 150 DFU at a slope of 1/4 inch per foot. The code table shows: 3inch at 1/4" = 42 DFU; 4inch at 1/4" = 216 DFU. What minimum drain size is required?

A. 4 inches, because 216 DFU capacity exceeds the 150 DFU load and 3inch (42 DFU) is far too small for this application

B. 3 inches, because the plumber can increase the slope to 1/2 inch per foot to handle the additional DFU on a smaller pipe

C. 5 inches, because commercial buildings require a minimum 5inch building drain regardless of the DFU calculation

D. 6 inches, to provide a generous safety margin above the calculated 150 DFU for future building expansion potential

51. A plumber encounters a scenario where a 2inch trap arm serving a bathtub runs horizontally for 2 metres before connecting to a vent. The code maximum trap arm length for 2inch pipe is 2.4 metres (8 feet). Is this trap arm length acceptable?

A. No — the 2metre length is too long for a 2inch trap arm and must be reduced to 1.5 metres or less for compliance

B. Yes — but only if the trap arm maintains a continuous slope of at least 1/4 inch per foot throughout the entire 2metre run

C. No — the maximum trap arm length for a bathtub is shorter than the standard 2inch maximum regardless of pipe size

D. Yes — 2 metres is within the 2.4metre maximum for 2inch pipe, provided the arm has correct slope and no sags or dips

52. A plumber is installing a septic system and must determine the correct size of the disposal field. The soil percolation rate is 20 minutes per inch. The house has 3 bedrooms. The code requires a specific loading rate (litres per m^2 per day) based on the percolation rate, and a minimum field area based on the number of bedrooms and the loading rate. Why is the percolation rate the critical factor?

A. The percolation rate determines how quickly the soil can absorb and treat the effluent — slow soil needs more field area

B. The percolation rate determines the depth of the disposal trenches but has no effect on the total required field area

C. The percolation rate indicates the soil's nutrient content, which determines how effectively the field treats the effluent

D. The percolation rate measures the groundwater level, which determines the minimum separation from the trench bottom

53. A plumber discovers that a building's existing DWV system has a vent pipe that connects to the drainage system at a point below the weir of the trap it serves. This connection is below the hydraulic gradient. What problem does this create?

A. The low connection causes the vent to act as a secondary drain during peak discharge, reducing its air supply function

B. No problem — vents can connect at any elevation as long as they eventually rise above the flood level rim of the fixture

C. The low connection causes the vent to pressurize the trap rather than equalize pressure, forcing water out of the seal

D. The vent connection below the trap weir allows drainage water to flow into the vent pipe, partially or fully blocking airflow

54. A plumber installs a commercial grease interceptor (gravity type). The interceptor has a capacity of 1,500 litres and is located outdoors, buried in the ground. The access covers are at grade level. What maintenance schedule is typical for a commercial grease interceptor of this size?

A. Annual pumping coinciding with the general building maintenance schedule for all mechanical equipment and systems

B. Pumping every 1 to 3 months, or when the grease and solids accumulation reaches 25% of the total liquid depth

C. Weekly pumping is required for interceptors serving restaurants because grease accumulation is extremely rapid

D. No scheduled pumping — the interceptor is pumped only when drainage problems indicate it is full and overflowing

55. A plumber installs a 4inch PVC soil stack and must connect it to a 4inch cast iron building drain at the base. The cast iron has a nohub (hubless) end. What coupling connects the PVC to the cast iron?

A. A nohub coupling with a neoprene gasket and stainless steel shield with band clamps that accommodates both materials

B. A solventcemented PVC coupling that bonds to the PVC stack and is mechanically clamped to the cast iron drain

C. A lead and oakum caulked joint that seals the PVC spigot into a cast iron hub adapter at the base of the stack

D. A threaded adapter that screws onto the cast iron drain and provides a PVC solvent socket for the stack connection

56. A plumber encounters a building where the building drain has been installed with no cleanouts — not at the stack base, not at the direction changes, and not at the building sewer exit. The building is 15 years old and has never had a drain blockage. The homeowner argues that cleanouts are unnecessary since the drain has functioned for 15 years without problems. Is the homeowner correct?

A. Yes — if the drain has functioned for 15 years without blockage, the absence of cleanouts has no practical consequence

B. No — but cleanouts are only needed on buildings with more than 10 DFU because smaller systems rarely experience blockage

C. Yes — cleanouts are a code recommendation for new construction only and are not required on existing drain systems

D. No — cleanouts are coderequired access points for drain maintenance; their absence makes future blockage clearing difficult or impossible

57. A plumber installs a residential water supply and connects it to the municipal main through a curb stop at the property line. The service pipe is 3/4inch copper Type K. After backfilling, the plumber pressurizes the service and discovers a slow leak at the curb stop connection. The leak rate is approximately 1 drop every 5 seconds. Is this leak rate acceptable?

A. Yes — a drip rate of 1 drop every 5 seconds is within the acceptable tolerance for underground curb stop connections

B. Yes — underground connections are permitted to have minor weeping because the surrounding soil absorbs the moisture

C. No — all pressurized water supply connections must be absolutely watertight with zero leakage at any connection point

D. No — but the leak can be sealed with an exterior wrap of selffusing silicone tape over the leaking connection point

58. A plumber is troubleshooting a commercial building's water supply system. The building has a booster pump system for the upper floors. The booster pump produces a loud banging noise every time it starts. The noise comes from the discharge piping. What is the most likely cause?

A. The pump's motor bearings have failed and are producing the banging noise during the hightorque startup sequence

B. Water hammer — the sudden startup of the pump creates a pressure surge that produces a banging noise in the discharge piping

C. The pump's impeller is damaged and strikes the pump housing during each revolution at the high startup rotational speed

D. The discharge piping has loose hangers that allow the pipe to bang against the building structure during pump vibration

59. A plumber discovers that a building's hot water recirculation system has the return line connected to the hot water outlet of the water heater instead of the cold water inlet. What effect does this incorrect connection have?

A. The recirculation system functions normally because the return water enters the hot side of the tank at the correct temperature

B. The return line connection to the hot outlet creates a short loop that bypasses the distribution piping entirely

C. The incorrect connection causes the water heater to overheat because recirculated hot water reenters the hot side continuously

D. The recirculated water (at return temperature) mixes with the hottest water at the top of the tank, reducing the delivery temperature

60. A plumber installs a residential water heater with a dedicated expansion tank. The expansion tank is connected to the cold water supply line near the heater inlet. The plumber precharges the tank's air bladder to 275 kPa (40 psi) to match the building's PRV setting. After one year, the homeowner reports the T&P valve periodically drips. The plumber checks the expansion tank and finds the precharge has dropped to 140 kPa (20 psi). What caused the T&P drip?

A. The reduced precharge allows the tank to fill with water prematurely, reducing its effective expansion capacity until the T&P relieves

B. The T&P valve has a manufacturing defect that causes it to drip regardless of the expansion tank's condition or precharge

C. The expansion tank's reduced precharge has no effect on the T&P valve — the drip is caused by excessive supply pressure

D. The water heater's thermostat has drifted upward, heating the water above the T&P valve's temperature rating threshold

61. A plumber is installing a water supply for a commercial building with a dental office. The dental unit requires a water supply with backflow prevention. The dental unit uses chemicals (fluoride, cleaning agents) in its water lines. What level of backflow prevention is required?

A. An atmospheric vacuum breaker (AVB) on each dental unit's water supply connection for basic siphon protection

B. A double check valve assembly (DCVA) because dental unit chemicals are classified as a minor nonhealth hazard

C. A reduced pressure (RP/RPZ) assembly because the dental unit's chemical use creates a health hazard crossconnection

D. No backflow prevention is needed because dental units have builtin antiretraction valves that prevent backflow

62. A plumber discovers that a building's copper water supply piping has a section of greencorroded pipe where it passes through a concrete floor. The corrosion is concentrated where the pipe contacts the concrete. What caused this localized corrosion?

A. The copper pipe absorbed moisture from the concrete that created an electrolytic cell and accelerated corrosion at the contact point

B. Direct contact between copper and concrete causes corrosion because concrete is alkaline and attacks the copper surface

C. The concrete absorbed chlorides from deicing salt that migrated through the floor and concentrated at the pipe contact surface

D. The copper pipe expanded due to hot water and the friction against the concrete wore through the outer pipe wall over time

63. A plumber is sizing the hot water supply for a commercial kitchen. The kitchen has a dishwasher (10 WSFU hot), a 3compartment sink (4 WSFU hot), a prerinse spray (3 WSFU hot), and a hand sink (0.75 WSFU hot). What is the total hot water WSFU?

A. 17.75 WSFU total hot water demand, calculated by adding all four fixture values together for the kitchen branch sizing

B. 10 WSFU, calculated by using only the largest fixture value because commercial kitchens operate one fixture at a time

C. 13.5 WSFU, calculated by excluding the hand sink because it has negligible hot water demand compared to the others

D. 35.5 WSFU, calculated by applying a 2.0 safety factor to the sum of all fixture values for commercial kitchen application

64. A plumber is troubleshooting a residential water system where the homeowner reports intermittent loss of hot water during shower use. The water goes cold for 30 seconds, then returns to the set temperature. The water heater is a gasfired tankless model. What is the most likely cause?

A. The gas supply line is undersized and cannot maintain adequate gas pressure during the heater's highfire operation mode

B. The tankless heater's minimum flow rate threshold is borderline — minor flow fluctuations cause the unit to cycle off briefly

C. The gas burner's flame sensor is dirty and intermittently loses flame detection, shutting down the burner until it reestablishes

D. The "cold water sandwich" effect — recirculated hot water arrives first, then a slug of cold water in the pipe, then newly heated water

65. A plumber installs a commercial water heater with a storage tank. The heater has an ASMErated T&P relief valve. The valve is labeled "210°F / 150 psi" (99°C / 1,035 kPa). What do these two ratings mean?

A. The valve opens if the water temperature reaches 210°F regardless of pressure, or if the pressure reaches 150 psi regardless of temperature

B. The valve opens only when BOTH the temperature exceeds 210°F AND the pressure exceeds 150 psi simultaneously

C. The 210°F rating is the valve's maximum operating temperature and the 150 psi is its normal operating pressure range

D. The ratings are the maximum temperature and pressure the valve itself can withstand before the valve body fails

66. A plumber is installing a water supply for a building with a dedicated irrigation system. The irrigation system has an RP backflow preventer. The RP is installed outdoors, 450 mm above grade. During winter, the RP must be protected from freezing. What protection method is used?

A. A heated enclosure that maintains the RP above freezing temperature throughout the winter heating season

B. Draining the RP and irrigation system before the first freeze and leaving the test cocks open for the winter

C. Both methods are acceptable — the RP can either be drained or enclosed depending on whether irrigation runs yearround

D. Wrapping the RP with fibreglass insulation and plastic sheeting provides adequate freeze protection without draining

67. A plumber discovers that a building's PRV has been set to 550 kPa (80 psi). The code maximum for water pressure delivered to fixtures is 550 kPa (80 psi). Is this PRV setting acceptable?

A. Yes — 550 kPa is the code maximum and setting the PRV at this value delivers exactly the maximum permitted pressure

B. No — the PRV should be set to approximately 415 kPa (60 psi) to provide a margin below the 550 kPa code maximum

C. Yes — but only for commercial buildings; residential buildings require a maximum of 415 kPa at all fixture outlets

D. No — the PRV must be set at 50% of the code maximum (275 kPa) to provide an adequate safety margin for the system

68. A plumber is installing a water heater in a building where the cold water supply contains sediment from the municipal main. The plumber recommends installing a wholehouse sediment filter before the water heater. Where should the filter be installed relative to the other water treatment components?

A. After the water softener and before the water heater, because the softener removes the largest particles first

B. Before the PRV, because sediment can damage the PRV's internal seat and reduce its regulating effectiveness

C. After the water heater, because sediment does not affect the heater and is best captured at the point of use

D. First in the treatment sequence — before the PRV, softener, and heater — to protect all downstream components

69. A plumber discovers that a residential water heater has been installed with the T&P discharge pipe connected to the building's sanitary drainage system through a direct connection with a Ptrap. Is this installation acceptable?

A. Yes — connecting the T&P discharge to the drainage system through a trap prevents sewer gas from entering through the valve

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

C. Yes — but only if the Ptrap is a deepseal type that maintains a water seal under the hightemperature discharge conditions

D. No — but the T&P discharge can connect to the drainage system if a backwater valve is installed instead of a Ptrap

70. A plumber tests a residential water supply system at 690 kPa (100 psi) for 2 hours. The system includes a PRV set to 415 kPa. During the test, the pressure gauge reads 690 kPa throughout the 2hour test. After the test, the plumber opens a fixture and the pressure drops to 415 kPa. Is this test result normal?

A. No — the pressure should have dropped to 415 kPa during the test because the PRV regulates the pressure at all times

B. No — the sustained 690 kPa indicates the PRV has failed and is not reducing pressure to the 415 kPa set point

C. Yes — the test was applied from the supply side upstream of the PRV, so the full 690 kPa was held on the downstream side

D. Yes — but only if the test plug was placed downstream of the PRV, which isolated the PRV from the test pressure

71. A plumber installs a water supply system in a residential building with a well pump. The pressure tank is a bladder type with a 50litre drawdown capacity. The well pump's flow rate is 20 litres per minute. The pump's minimum recommended run time per cycle is 1 minute. What is the minimum flow rate that triggers a pump cycle?

A. 50 litres per minute, because the tank's drawdown volume divided by the minimum run time determines the trigger rate

B. 20 litres per minute, because the pump's maximum flow rate equals the minimum trigger rate for all pump cycle calculations

C. 10 litres per minute, because the minimum run time of 1 minute at 20 LPM produces 20 litres minus the 10 LPM demand

D. Any flow rate triggers a cycle — even 1 litre per minute draws down the tank until the pressure drops to the cutin setting

72. A plumber is installing a hot water supply system and must determine the correct pipe insulation thickness. The specification calls for insulation with a minimum Rvalue of R4. What does R4 mean?

A. The insulation resists 4 BTU per hour of heat loss per square foot of pipe surface at a specified temperature differential

B. The insulation can withstand a maximum temperature of 400°F before its thermal properties begin to degrade

C. The insulation has a thermal resistance rating of R4 per inch of thickness, requiring a specific thickness for the pipe size

D. The insulation has a total thermal resistance of R4, which measures its ability to resist heat flow regardless of thickness

73. A plumber is troubleshooting a commercial building's domestic hot water system. The recirculation pump is running, the return water temperature is 50°C, and the aquastat is set to activate the pump when the return drops below 50°C and deactivate when it reaches 55°C. The pump runs continuously. Why?

A. The aquastat is malfunctioning and sending a continuous run signal regardless of the actual return water temperature

B. The return water at 50°C is exactly at the activation setpoint — the pump activates but the heat loss prevents the return from reaching 55°C

C. The recirculation pump's impeller has worn and is not moving enough water to raise the return temperature above 50°C

D. The pump should be running continuously — aquastatcontrolled pumps are designed to operate 24 hours per day

74. A plumber installs a pointofuse (POU) electric tankless water heater to serve a single commercial hand sink. The heater requires a 30amp, 240V dedicated circuit. The existing electrical panel has no available 30amp spaces. Who determines whether the panel can accommodate the new circuit?

A. A licensed electrician who evaluates the panel's capacity, available spaces, and the building's total electrical load

B. The plumber, because the POU heater is a plumbing appliance and all aspects of its installation are within the plumbing scope

C. The building's maintenance manager, who has authority over all electrical and plumbing modifications in the building

D. The POU heater manufacturer's authorized installer, who handles both plumbing and electrical for their specific product

75. A plumber is sizing a water service for a residential building. The design flow rate is 1.2 litres per second (19 GPM). The available municipal pressure is 380 kPa. The total friction and elevation losses are estimated at 200 kPa. The minimum residual pressure required at the most remote fixture is 140 kPa. Is the municipal pressure adequate?

A. No — the calculation shows only 180 kPa residual (380 200), which exceeds the 140 kPa minimum by only 40 kPa

B. Yes — but the margin is dangerously thin and a pressure booster pump should be installed as a precautionary measure

C. Yes — the residual pressure of 180 kPa (380 200) exceeds the 140 kPa minimum with a 40 kPa margin

D. No — the 380 kPa municipal pressure is below the 415 kPa minimum required by code for all residential water services

76. A plumber installs a commercial wallmounted lavatory in a public washroom. The lavatory is mounted on a concealed carrier that is bolted to the wall structure. After installation, the plumber pushes down firmly on the front edge of the lavatory. The lavatory deflects downward approximately 5 mm. Is this acceptable?

A. Yes — 5 mm deflection under hand pressure is normal for wallmounted lavatories on concealed carriers in commercial washrooms

B. No — but only if the lavatory is a bariatricrated model that must support additional weight without any deflection whatsoever

C. Yes — wallmounted lavatories are designed to flex slightly because the carrier allows controlled deflection for impact absorption

D. No — the carrier is not properly secured; a correctly installed carrier produces zero deflection under reasonable hand pressure

77. A plumber is troubleshooting a residential gasfired water heater. The burner ignites normally, heats the water to the thermostat setpoint, and shuts off. However, within 10 minutes the burner reignites even though no hot water has been used. The tank temperature has dropped 5°C. What is the most likely cause?

A. The thermostat is functioning normally — a 5°C temperature drop from standby losses is enough to trigger the burner

B. The flue is oversized, drawing excessive standby heat from the tank through the draft hood and up the chimney

C. The thermostat's differential is set too narrow, causing frequent cycling between the setpoint and the reignition point

D. The water heater's insulation has degraded over time, increasing standby heat loss beyond the normal expected rate

78. A plumber installs a residential water softener on a well water supply. The softener's drain line connects to the building's sanitary drainage system. What type of connection is required between the softener drain and the sanitary drainage?

A. An indirect waste connection with an air gap to prevent any possibility of crosscontamination between the drain and the softener

B. A direct Ptrap connection to the nearest available sanitary drain stubout for efficient disposal of regeneration waste

C. A connection to the building's storm drainage system because softener regeneration brine cannot enter the sanitary sewer

D. A direct connection to the building sewer bypassing the septic tank because brine damages the bacterial treatment process

79. A plumber discovers that a commercial building's water cooler (drinking fountain) has a slow drip from its outlet even when no one is pressing the activation button. The drip rate is approximately 2 drops per minute. What is the most likely cause?

A. The water supply pressure to the cooler is too high and is overcoming the shutoff valve's springloaded sealing mechanism

B. The inlet water pressure is within normal range — the cooler's internal shutoff valve has a worn seat or degraded gasket

C. The cooler's internal solenoid valve has a small piece of debris preventing the valve from fully closing after each activation

D. The cooler's refrigeration unit is generating condensation that drips from the outlet nozzle rather than from the water supply

80. A plumber installs a residential bathtub with a combination tubshower valve. The valve must include a pressurebalancing or thermostatic mixing feature. Why is this feature coderequired for tubshower valves?

A. It prevents one fixture's use from affecting the water pressure at other fixtures throughout the building's supply system

B. It reduces energy consumption by limiting the amount of hot water that can flow through the shower valve during use

C. It prevents water hammer by controlling the rate of pressure change when the valve is opened or closed quickly

D. It prevents scalding by maintaining a consistent outlet temperature even when supply pressures fluctuate during use

81. A plumber is replacing a kitchen faucet and discovers that the existing faucet was installed with the hot supply on the right side and the cold supply on the left side. Code and convention require hot on the left and cold on the right. Why is this standard important?

A. It prevents scalding by ensuring the user always knows which direction to turn for hot water at every fixture in the building

B. It establishes a universal standard so that any user at any fixture instinctively knows which handle controls hot water

C. It reduces the risk of crossconnection between the hot and cold supply systems at the fixture mixing valve connection

D. It prevents damage to the faucet's mixing cartridge, which is designed for hot water input from the left port specifically

82. A plumber services a water heater and discovers that the sacrificial anode rod is almost completely consumed — only a thin wire core remains. The heater is 4 years old. What does rapid anode consumption indicate about the water?

A. The water is highly aggressive (soft, low pH, high conductivity) and is consuming the anode faster than normal

B. The anode rod was manufactured from substandard material that dissolves faster than the rated specification allows

C. The water heater's thermostat is set too high, accelerating the electrochemical reaction that consumes the anode rod

D. Normal anode consumption — a 4year service life is typical for magnesium anode rods in all water conditions

83. A plumber installs a pointofuse reverse osmosis system under a kitchen sink. The RO system produces purified water at approximately 0.2 litres per minute. The homeowner wants to connect the RO system to the refrigerator's ice maker in addition to the dedicated RO faucet. Is this connection advisable?

A. No — connecting the ice maker to the RO system would reduce the water pressure at the RO faucet below usable levels

B. Yes — but the RO system must have a storage tank with adequate capacity to serve both the faucet and the ice maker simultaneously

C. Yes — the RO system's 0.2 LPM production rate is adequate for both the faucet and the ice maker operating simultaneously

D. No — the RO system's water quality is too pure for ice making and will produce ice with an unpleasant flat taste

84. A plumber is troubleshooting a residential electric water heater that produces hot water from the upper faucets (upstairs bathroom) but lukewarm water from the lower faucets (kitchen, mainfloor bathroom). The heater is in the basement. What is the most likely cause?

A. The lower thermostat or lower heating element has failed — the upper element heats the top of the tank but the bottom remains cool

B. The lower element has failed, leaving the bottom half of the tank unheated while the upper element heats only the top portion

C. The dip tube has broken, allowing cold inlet water to mix with hot water at the top of the tank before reaching upper fixtures

D. The hot water piping to the lowerfloor fixtures is undersized, creating excessive friction that reduces the delivered temperature

85. A plumber installs a commercial prerinse spray valve at a restaurant's potwashing station. The installation includes a vacuum breaker on the spray valve's water supply connection. What is the purpose of this vacuum breaker?

A. It prevents the spray valve from delivering water above the maximum permitted temperature during prerinse operations

B. It prevents noise from the spray nozzle by introducing air into the water stream to reduce velocity and turbulence

C. It protects the water supply from contamination by preventing used water from being siphoned back through the spray head

D. It prevents backflow from the contaminated sink basin through the submerged spray nozzle during a backsiphonage event

86. A plumber discovers that a residential water heater's T&P relief valve has been replaced by the homeowner with a plug — the valve has been removed and the port sealed with a threaded cap. The homeowner says the valve was "always leaking" and the plug stopped the leak. What is the immediate risk?

A. Catastrophic failure — without the T&P valve, the water heater has no overpressure or overtemperature safety protection

B. Minor risk — the water heater's thermostat provides adequate temperature control and the plug prevents water waste

C. No immediate risk because the expansion tank absorbs all thermal expansion that would otherwise trigger the T&P valve

D. The risk is limited to water damage — the worst outcome is a tank leak at the weakest point from excessive internal pressure

87. A plumber services a water treatment system that includes an iron removal filter (birm filter). The birm filter requires a specific water chemistry to function properly. What condition must the water meet for birm to effectively remove iron?

A. The water pH must be above 5.0 and the iron concentration must be below 0.3 ppm for birm to function effectively

B. The water must have a pH of at least 6.8 and adequate dissolved oxygen for birm's catalytic iron oxidation process

C. The water must be chlorinated because birm requires free chlorine to activate its iron removal catalytic properties

D. The water must have a pH above 8.5 and a hardness below 5 gpg for the birm media to remove iron effectively

88. A plumber installs a commercial sensor faucet in a hospital patient room. The faucet has a 0.5 GPM flow rate and a 30second run time per activation. The hospital's infection control team requests that the faucet be adjusted to deliver a longer run time for thorough handwashing. What is the standard recommended handwashing duration?

A. 5 seconds, which is adequate for casual hand rinsing between routine patient contact in clinical care settings

B. 10 seconds, which matches the current healthcare standard for routine hand hygiene between patient contacts

C. 20 seconds, which is the WHO and public health recommended duration for effective handwashing with soap

D. 60 seconds, which is the surgical scrub standard that applies to all handwashing in hospital clinical environments

89. A plumber is installing a residential fire sprinkler system using CPVC piping. The CPVC pipe runs through a ceiling joist bay alongside electrical wiring. What clearance is required between the CPVC pipe and the electrical wiring?

A. A minimum of 25 mm (1 inch) separation is required between CPVC pipe and all electrical wiring in joist bays

B. Contact is permitted — but only if the electrical wiring does not generate heat that could affect the CPVC pipe material

C. A minimum of 150 mm (6 inches) separation is required to prevent electromagnetic interference with the sprinkler flow switch

D. CPVC and electrical wiring cannot occupy the same joist bay and must be separated by the joist web at minimum

90. A plumber is troubleshooting a commercial ice machine that produces cloudy ice instead of clear ice. The water supply is municipal (treated). The ice machine has an internal water filter that was replaced 2 months ago. What is the most likely cause of the cloudy ice?

A. Mineral content (dissolved solids) in the water supply that is not removed by the basic internal filter of the ice machine

B. The ice machine's compressor is failing and cannot freeze the water quickly enough to produce clear ice formation

C. The water filter was installed backward, allowing unfiltered water to bypass the filter element into the icemaking chamber

D. The municipal water supply has been recently chlorinated at a higher concentration that affects ice crystal clarity

91. A plumber installs a residential water heater with a powered anode rod. The powered anode requires a standard 120V electrical outlet within 1 metre of the water heater. The plumber installs the water connections and places the powered anode in the anode port. Who installs the electrical outlet?

A. The plumber, because the powered anode is a plumbing component and its electrical supply is part of the plumbing scope

B. The homeowner, because a standard 120V outlet is a simple household connection that does not require a licensed electrician

C. The water heater manufacturer's authorized service technician, who must commission all powered anode installations

D. A licensed electrician, because installing a new 120V electrical outlet requires an electrical permit and licensed work

92. A plumber installs a condensing boiler with an outdoor reset control. During mild weather (5°C outdoor), the boiler operates at a supply temperature of 35°C. The system has baseboard convectors rated for 75°C supply. Will the 35°C supply adequately heat the building during mild weather?

A. No — baseboard convectors cannot produce any measurable heat output at supply temperatures below 50°C

B. No — the baseboard convectors require a minimum supply of 75°C at all times regardless of outdoor conditions

C. Yes — the baseboard convectors produce reduced output at 35°C, which matches the building's reduced heat demand in mild weather

D. Yes — but only if the baseboard convectors are oversized by at least 50% to compensate for the reduced temperature

93. A plumber discovers that a hydronic heating system's pressure gauge reads 0 kPa when the system is cold and the boiler is off. The expansion tank precharge is set correctly at 103 kPa. What is the most likely cause?

A. The expansion tank's bladder has ruptured, flooding the air side with water and preventing it from maintaining system pressure

B. The system has lost all its water through a leak, and the automatic fill valve has either failed or been shut off

C. The pressure gauge has failed and reads zero regardless of the actual system pressure inside the hydronic piping

D. All three are possible — the plumber must systematically check each component to determine the actual cause

94. A steam boiler's pressuretrol is set to cut in at 0.5 psig and cut out at 2.0 psig. The differential is 1.5 psi. The boiler fires and the pressure gauge reaches 2.0 psig. The burner shuts off. As the system distributes steam, the pressure drops. At what pressure does the burner reignite?

A. 0.5 psig — the burner reignites when the pressure drops from the cutout (2.0) to the cutin setting (0.5 psig)

B. 1.0 psig — the burner reignites at the midpoint between the cutin and cutout pressures for balanced cycling

C. 2.0 psig — the burner reignites immediately because the pressuretrol cannot detect the pressure drop in the system

D. 0 psig — the burner only reignites when the system has completely depressurized to atmospheric pressure level

95. A plumber installs a hydronic system with cast iron baseboard radiators. The system has been operating for 3 years. The plumber is called because the boiler's lowwater cutoff trips repeatedly. The plumber checks the system and finds the pressure gauge at normal coldfill pressure and no visible leaks. What is the most likely cause?

A. The lowwater cutoff's float chamber has accumulated sludge that prevents the float from rising to the normal water level

B. The expansion tank has lost its air precharge, causing pressure fluctuations that trigger the lowwater cutoff

C. The automatic fill valve has failed and cannot maintain the water level as air escapes through the automatic air vents

D. Sludge accumulation in the lowwater cutoff's float chamber prevents the float from operating correctly — blowing down the LWCO restores function

96. A plumber encounters a hydronic system where the homeowner has been adding fresh water to the system weekly because the pressure drops between fillups. What damage does repeated fresh water addition cause?

A. No damage — fresh water addition is normal maintenance for all hydronic heating systems and is expected over time

B. Each addition of fresh water introduces dissolved oxygen that corrodes ferrous components throughout the system

C. Fresh water addition dilutes the glycol antifreeze concentration, reducing freeze protection below the design level

D. Fresh water addition raises the system pH above the acceptable range for the boiler's heat exchanger material limits

97. A plumber installs a onepipe steam system's radiators with supply valves. The supply valve on a onepipe steam radiator is either fully open or fully closed. Why must the valve never be left in a partially open position?

A. A partially open valve creates a pressure drop that interferes with the thermostatic air vent's ability to modulate heating

B. A partially open valve throttles the steamcondensate flow in the single pipe, creating water hammer from restricted drainage

C. A partially open valve causes condensate to pool at the valve seat, creating water hammer as incoming steam contacts the pooled water

D. A partially open valve reduces the radiator's heat output to exactly 50%, which creates an unbalanced system condition

98. A plumber discovers that a hydronic boiler's expansion tank has a precharge of 170 kPa, but the system's coldfill pressure (set by the automatic fill valve) is only 103 kPa. What problem does this mismatch create?

A. The higher precharge pushes the diaphragm to the water side, preventing water from entering the tank and eliminating expansion absorption

B. The tank overpressurizes the system during heating, forcing the relief valve to discharge at operating temperature

C. The mismatch has no effect because the expansion tank automatically adjusts its precharge to match the fill pressure

D. The tank absorbs too much water during heating, causing the system pressure to drop below the minimum operating level

99. A plumber is troubleshooting a hydronic system where all baseboard radiators on one zone heat adequately except the last radiator on the loop. This radiator is barely warm while all others are hot. The zone valve is fully open and air has been bled. What is the most likely cause?

A. The boiler's supply temperature drops by the time water reaches the last radiator on the series loop distribution piping

B. The last radiator has an internal blockage from sludge or corrosion products that restricts water flow through its passages

C. The zone circulator is undersized and cannot push water through the full loop at adequate velocity to serve all radiators

D. Insufficient flow reaches the last radiator because the water has given up too much heat to the preceding radiators on the loop

100. A plumber is installing a hydronic system with PEX tubing. The specification requires oxygenbarrier PEX. The plumber has standard PEXB tubing available (no oxygen barrier). Can the standard PEX be used if the plumber adds a corrosion inhibitor to the system water?

A. No — a corrosion inhibitor reduces but does not eliminate oxygen corrosion from continuous permeation through nonbarrier PEX

B. Yes — a corrosion inhibitor provides equivalent protection to an oxygen barrier as long as the inhibitor concentration is maintained

C. No — standard PEXB tubing is prohibited in all hydronic heating applications regardless of water treatment methods used

D. Yes — but only if the system has no ferrous components (allcopper or allplastic) that would corrode from dissolved oxygen

101. A twopipe steam system has a condensate receiver with a vent to atmosphere. The plumber notices steam escaping from the receiver's atmospheric vent. What does this indicate?

A. One or more steam traps have failed open, passing live steam into the condensate return that reaches the receiver

B. The condensate receiver's water temperature has reached boiling point from normal system heat and is producing its own steam

C. The atmospheric vent is functioning normally — a small amount of flash steam is expected from hot condensate entering the receiver

D. The receiver is overpressurized due to a blocked vent line downstream that is forcing steam back through the atmospheric opening

102. A plumber installs a condensing boiler with a neutralization kit on the condensate drain. The kit contains a container of calcium carbite (marble chips) through which the acidic condensate passes before entering the sanitary drain. What is the purpose of the neutralization kit?

A. The kit filters particulate matter from the condensate to prevent sediment from entering the building's sanitary drainage system

B. The kit cools the hot condensate to an acceptable temperature before it enters the PVC sanitary drainage piping below

C. The kit raises the pH of the acidic condensate (typically pH 3–4) to a neutral level before discharge to the drainage system

D. The kit treats the condensate with a biocide to kill bacteria that grow in the warm, acidic condensate before it enters the drain

103. A plumber is troubleshooting a radiant floor heating system where one zone has a floor surface temperature that is noticeably lower than the adjacent zones. The supply temperature to all zones is identical (35°C). The manifold flow meters show equal flow through all zones. What could cause the temperature difference?

A. The zone's thermostat is set lower than the adjacent zones and is calling for less heat, reducing the supply to that zone

B. The zone has a different floor covering (carpet instead of tile) that insulates the floor surface from the radiant heat below

C. The zone's PEX tubing was installed at a wider spacing than the adjacent zones during construction, reducing heat density

D. The zone's supply water has a lower temperature than the others due to a malfunctioning mixing valve at the manifold

104. A steam boiler's Hartford Loop is connected incorrectly — the return piping connects to the equalizer pipe above the normal water line instead of below it. What is the consequence of this incorrect connection?

A. The incorrect connection has no effect because the Hartford Loop functions regardless of where the return connects to the equalizer

B. Steam from the boiler can enter the condensate return piping, pressurizing the return and blocking condensate flow

C. The boiler's water level will be consistently higher than normal, triggering the highwater cutoff during operation

D. If the return piping develops a leak, water can drain from the boiler below the normal water line — the Hartford Loop's protection is defeated

105. A plumber installs a hydronic heating system and must select the correct glycol concentration for freeze protection. The system is in northern Alberta where outdoor temperatures can reach 40°C. What concentration provides adequate protection?

A. 50% propylene glycol by volume provides freeze protection to approximately 34°C — adequate for most conditions but marginal at 40°C

B. A 50/50 glycolwater mix provides protection to approximately 34°C; a higher concentration or burst protection to 40°C is needed

C. 30% propylene glycol provides protection to approximately 15°C — far inadequate for 40°C conditions in northern Alberta

D. A glycol concentration that protects to at least 40°C burst protection must be selected — typically 5560% propylene glycol

106. A plumber discovers that a hydronic system's zone valve has a small lever on the side that can be manually operated. A homeowner has been leaving this lever in the manualopen position because "it heats faster this way." What problem does this create?

A. The manually forced valve bypasses the thermostat, causing the zone to receive heat continuously regardless of room temperature

B. The manually open valve draws heat from other zones, reducing their heat output and creating comfort complaints

C. The zone receives heat continuously, overheating the space and wasting energy because the thermostat cannot shut off the zone

D. The manual lever damages the valve motor over time because the motor tries to close the valve against the lever's override position

107. A plumber is commissioning a new hydronic heating system. After filling, purging, and firing the boiler, the plumber must balance the system. What instrument measures the water temperature at each radiator's supply and return connections for balancing purposes?

A. A pipe clamp thermometer or infrared thermometer that measures the surface temperature of the pipe at the connection

B. An immersion thermometer (surfacemounted or insertion type) that measures the water temperature at the supply and return

C. A flow meter installed on each radiator's supply pipe that measures the gallons per minute flowing through the emitter

D. A pressure gauge on each radiator that measures the pressure drop across the emitter for indirect temperature calculation

108. A medical gas system installer completes all required tests on a new medical air piping system. The standing pressure test, crossconnection test, purity test, and flow test all pass. The thirdparty verifier issues the certification report. What is the final step before the system delivers gas to patients?

A. The hospital's pharmacy department must approve the gas quality by testing a sample from each outlet in the system

B. The fire marshal must inspect the medical gas system and issue a permit before any gas can flow to patient areas

C. The hospital's biomedical engineering department must calibrate each outlet's flow rate to match the design specification

D. The hospital's designated representative authorizes the system for clinical use and the gas source is connected to the outlets

109. A compressed air system in a manufacturing facility has experienced multiple failures of pneumatic tools at the far end of the distribution header. The tools fail because of excessive moisture in the air supply. The system has a refrigerated dryer at the compressor. What is causing moisture at the distant tools despite the dryer?

A. The header piping runs through an unconditioned space where the air temperature drops below the dryer's dewpoint, causing recondensation

B. The refrigerated dryer has failed and is no longer removing moisture from the compressed air before it enters the header

C. The pneumatic tools themselves generate moisture internally through their air motors during normal operation cycles

D. The system's air receiver tank is corroded and is adding moisture to the compressed air from standing water in the tank

110. A plumber is installing a swimming pool circulation system with a variablespeed pump. The pump has a programmable controller that can be set for different speeds at different times. The pool builder specifies that the pump must turn over the entire pool volume at least once every 8 hours. The pool volume is 60,000 litres. What is the minimum flow rate required during the filtration cycle?

A. 250 litres per minute, calculated by dividing the pool volume by 4 hours for a more aggressive turnover schedule

B. 62.5 litres per minute, calculated by dividing the pool volume by 16 hours for a slower but more energyefficient schedule

C. 125 litres per minute, calculated as 60,000 litres ÷ 8 hours ÷ 60 minutes per hour = 125 LPM minimum flow rate

D. 500 litres per minute, calculated by applying a 4× safety factor to the minimum turnover rate for the pump capacity

111. A plumber discovers that a medical gas system's oxygen alarm panel is showing a "high pressure" alarm for the oxygen supply to the surgical suite. The normal operating pressure is 350 kPa (50 psi). The alarm is set to activate at 380 kPa (55 psi). The gauge reads 390 kPa. What is the most likely cause?

A. The oxygen supply manifold's regulator has malfunctioned and is allowing the full cylinder pressure to pass downstream

B. The highpressure alarm is a false alarm caused by a defective pressure transducer on the alarm panel sensor

C. Normal fluctuation — 390 kPa is within the expected range for oxygen systems and the alarm threshold is set too sensitive

D. A second oxygen supply has been activated (such as a reserve manifold switching on) and the combined output exceeds the normal pressure

112. A plumber is installing an irrigation system with drip emitters for a landscape bed. The drip tubing operates at 140 kPa (20 psi). The building's water supply pressure is 415 kPa (60 psi). What component reduces the pressure from the supply to the drip system's operating pressure?

A. The drip emitters themselves regulate the pressure internally — no external pressure reduction is needed for drip systems

B. A flow restrictor installed at each emitter that reduces the flow rate and the corresponding pressure at each drip point

C. A check valve at the drip zone valve that reduces pressure through its internal springloaded mechanism during operation

D. A pressure regulator installed after the zone valve and before the drip tubing that reduces the pressure to 140 kPa

113. A plumber discovers that a swimming pool's DE filter has been backwashed without recharging the filter with fresh DE powder afterward. The pool has been running for 3 days without DE on the filter grids. What consequence does this have?

A. The filter grids are operating without the DE coating and are providing minimal filtration — water quality will deteriorate rapidly

B. The pool pump will overheat because the bare filter grids create excessive backpressure without the DE coating for flow regulation

C. The filter grids will become permanently clogged with pool debris that embeds in the fabric without the DE protective layer

D. No consequence — the filter functions adequately without DE for short periods because the fabric grid itself provides filtration

114. A plumber is connecting a natural gas supply to a residential outdoor BBQ through a dedicated gas line from the building's interior gas manifold. The gas line exits the building through the exterior wall and runs to the BBQ connection point. What shutoff valve is required at the BBQ end?

A. No shutoff is required at the BBQ because the interior manifold valve serves as the isolation point for the outdoor line

B. A manual gas shutoff valve within reach of the BBQ that allows the homeowner to shut off the gas supply at the appliance

C. An automatic solenoid valve that closes when the BBQ is not in use to prevent gas leakage at the outdoor connection

D. A quickdisconnect fitting that combines the connection and shutoff functions in a single device at the BBQ end point

115. A plumber is winterizing a residential swimming pool. After lowering the water level below the return inlets and skimmer, the plumber blows compressed air through the circulation piping to evacuate water. What must be done with the pool equipment (pump, filter, heater) during winterization?

A. The pump, filter, and heater drain plugs must be removed to allow all water to drain from the equipment by gravity

B. The equipment must be removed and stored indoors during the winter to prevent freezing damage to all components

C. The equipment requires no winterization because the circulating antifreeze in the piping protects all connected components

D. Only the pump requires draining — the filter and heater are designed to withstand freezing temperatures without damage

116. A medical gas system's alarm panel has three alarm conditions: normal (green), advisory (yellow), and emergency (red). The nitrogen supply shows a yellow advisory alarm. What does this typically indicate?

A. The nitrogen supply is functioning normally but has reached a lowsupply threshold indicating the reserve should be checked

B. The nitrogen supply has failed completely and the system is operating on its emergency reserve supply only

C. The nitrogen supply pressure has exceeded the maximum safe operating pressure and must be reduced immediately

D. The nitrogen system has a confirmed crossconnection with another gas system that requires immediate investigation

117. A plumber is installing a compressed air system and must determine the correct compressor size. The facility has 8 pneumatic tools, each requiring 5 CFM. If all 8 tools may operate simultaneously, what minimum compressor output is required?

A. 40 CFM minimum, calculated as 8 tools × 5 CFM per tool for the total simultaneous demand on the compressed air system

B. 20 CFM minimum, applying a 50% diversity factor because not all 8 tools will operate at peak demand simultaneously

C. 5 CFM minimum, using only the highest individual tool requirement because the compressor serves tools one at a time

D. 80 CFM minimum, applying a 2× safety factor to the simultaneous demand for compressor sizing and reserve capacity

118. A swimming pool's cartridge filter has been in service for 3 years. The homeowner cleans the filter cartridge every 2 months by spraying it with a garden hose. Despite regular cleaning, the filter pressure has been steadily increasing and the cartridge no longer returns to its original clean pressure after hosing. What is happening?

A. The garden hose spray is not powerful enough to remove all debris — a pressure washer should be used instead of a hose

B. The hose cleaning removes surface debris but not the oils, minerals, and organic films that gradually clog the filter media pores

C. Oils, body lotions, sunscreen, and minerals have gradually embedded in the filter media's pores, reducing its permeability permanently

D. The filter cartridge's pleated fabric has stretched and lost its structural shape from repeated cleaning and the weight of water

119. A plumber is installing a process piping system for a brewery. The system carries hot wort (unfermented beer) at 95°C. The specification calls for Type 304 stainless steel with triclamp (sanitary) fittings. What advantage do triclamp fittings provide for brewery process piping?

A. They allow quick disassembly for cleaning, inspection, and reconfiguration without cutting or welding the piping system

B. Triclamp fittings are stronger than welded joints and can withstand higher pressures during the brewing process

C. Triclamp fittings provide a tighter seal than welded joints because the gasket conforms to any surface irregularity

D. Triclamp fittings eliminate the need for any gasket or seal material because the metaltometal contact is selfsealing

120. A plumber discovers that a swimming pool's salt chlorine generator has a "low salt" alarm. The pool's salt level tests at 2,800 ppm. The generator requires a minimum of 3,000 ppm. What must be done?

A. Increase the generator's output setting to compensate for the low salt level until additional salt can be purchased

B. The generator will continue producing chlorine at a reduced rate — no immediate action is needed until the next salt addition

C. Bypass the salt alarm by disconnecting the sensor, because the 200 ppm deficit is within the alarm's tolerance margin

D. Add salt to the pool to raise the concentration from 2,800 ppm to at least 3,000 ppm for proper generator operation

121. A plumber is connecting a natural gas supply to a commercial rooftop air handling unit (AHU). The gas line runs from the interior meter room through a vertical riser to the roof. The riser must include a drip leg at the base before the gas enters the vertical section. Why?

A. The drip leg collects moisture and debris from the horizontal gas supply before it enters the vertical riser where it could fall back

B. The drip leg provides a test port for checking the gas supply pressure at the base of the riser during commissioning

C. The drip leg serves as a thermal expansion device for the gas piping as the vertical riser expands during operation

D. The drip leg is required only for propane installations because propane produces condensation that natural gas does not

122. A medical gas system's bulk oxygen supply consists of a cryogenic liquid oxygen tank outside the hospital. The liquid oxygen is converted to gas and delivered to the piping system at 350 kPa (50 psi). A backup supply of compressed oxygen cylinders is connected to the same manifold. What triggers the switchover from primary (bulk liquid) to backup (cylinder) supply?

A. A manual switchover by the facilities manager during scheduled maintenance of the bulk liquid oxygen supply tank

B. An automatic switchover when the liquid oxygen level drops below the minimum threshold or the supply pressure drops

C. The switchover occurs on a timed schedule — the bulk supply runs for 12 hours, then the cylinders run for 12 hours

D. The switchover is triggered by patient demand — highdemand periods use the bulk supply while lowdemand uses cylinders

123. A plumber is installing a compressed air outlet in a hospital's dental clinic. The outlet must have specific identification to distinguish it from medical gas outlets. How is the dental air outlet identified?

A. Dental air outlets use a different colour code and connector type than medical air outlets for clear identification

B. Dental air outlets use the same DISS connector as medical air because both deliver clean, dry air to patient areas

C. Dental air outlets are identified by their location only — they are identical to medical air outlets in all other respects

D. Dental air outlets use a standard industrial quickdisconnect fitting that is incompatible with all medical gas connectors

124. A swimming pool system has an automatic pool cover that is closed when the pool is not in use. Since installing the cover, the pool's chlorine demand has decreased significantly. What characteristic of the pool cover reduces chlorine demand?

A. The cover blocks wind that would otherwise cause wave action that accelerates chlorine offgassing from the water surface

B. The cover prevents debris from entering the pool, reducing the organic load that consumes chlorine during oxidation

C. The cover reduces water evaporation, and since chlorine evaporates with the water, less chlorine is lost to evaporation

D. The cover blocks UV radiation from sunlight that breaks down free chlorine through photodecomposition at the water surface

125. A plumber services a swimming pool and discovers that the pool's main drain suction line has only a single main drain with no secondary drain or safety vacuum release system (SVRS). The pool was built in 1990 before dual drain requirements were enacted. Is the single drain acceptable under current code?

A. No — existing singledrain pools must be retrofitted with either a second drain or an approved SVRS to comply with current antientrapment standards

B. Yes — pools built before the dualdrain requirement are grandfathered and do not need to comply with current standards

C. No — the pool must be closed immediately until a second drain is installed because a single drain is an imminent hazard

D. Yes — but only if the single drain has an approved antientrapment cover that meets the current ANSI/APSP16 standard

Practice Exam 13: Answer Key and Explanations

1. B — Smoke rising from behind the heat shield indicates the wood is overheating and may be charring or smouldering. The plumber must stop soldering immediately, remove the shield, inspect for ignition, and extinguish any smouldering material before it develops into a fire. Continuing to solder while wood is smoking violates every hot work safety principle.

2. D — Before introducing any ignition source (torch, lighter, spark) into a mechanical room containing gas piping, the piping must be confirmed gas-free through leak testing or atmospheric monitoring. A closed valve does not guarantee zero gas presence — valves can leak through, residual gas may remain in the piping, and fittings downstream may have developed leaks.

3. A — Polyethylene (PE) pipe is permeable to petroleum hydrocarbons — these chemicals can migrate through the pipe wall and contaminate the potable water inside. In petroleum-contaminated soil, the water service must use an impermeable material (copper or ductile iron) or the PE must be encased in a protective barrier per local requirements.

4. C — Powder-actuated tools produce impulse noise levels exceeding 140 dB per shot — well above the threshold for instantaneous hearing damage. Hearing protection is mandatory for the operator and all workers within the blast zone. Standard construction hard hats and safety glasses are also required but do not address the noise hazard.

5. B — Using the Pythagorean theorem: diagonal = $\sqrt{(400^2 + 300^2)} = \sqrt{(160{,}000 + 90{,}000)} = \sqrt{250{,}000} =$ 500 mm. This classic 3-4-5 right triangle (scaled to 300-400-500) calculates the travel distance for a rolling offset where the pipe moves both horizontally and vertically simultaneously.

6. D — All-service jacket (ASJ) is a white kraft paper and foil laminate that wraps fibreglass pipe insulation. It provides a clean, finished appearance, serves as a vapour retarder to prevent condensation on cold piping, and protects the insulation from damage. ASJ is the standard jacket for commercial plumbing pipe insulation.

7. A — Fire doors in occupied buildings must remain closed at all times to maintain fire compartmentalization. Propping open a fire door allows smoke and fire to spread between compartments, defeating the building's passive fire protection. The plumber must close the door immediately and find alternative transport routes.

8. C — Even though copper is non-combustible, a pipe penetration through a fire-rated floor creates an opening that must be sealed to maintain the fire rating. An approved firestop sealant or device listed for metallic pipe through the specific assembly type is required. The sealant fills the annular space and maintains the floor's fire resistance.

9. B — Working near identified asbestos-containing materials that have not been abated is prohibited for trades workers who are not licensed asbestos abatement professionals. Disturbing asbestos during pipe installation (drilling, cutting, moving materials) releases carcinogenic fibres. The area must be abated before any trade work begins.

10. D — Expansion = length × coefficient × temperature change = 30 m × 0.0000168/°C × (80 - 10)°C = 30 × 0.0000168 × 70 = 0.03528 m = approximately 35 mm. This thermal expansion must be accommodated by expansion loops, offsets, or mechanical expansion joints to prevent pipe stress and joint failure.

11. A — Working within 2 metres of an unprotected roof edge on a 4-storey building requires fall protection — either a personal fall arrest system (full-body harness with lanyard anchored to an approved point) or a guardrail installed at the roof edge. Falls from elevation are the leading cause of construction fatalities.

12. C — A non-metallic grommet, sleeve, or bushing prevents direct copper-to-steel contact (which would cause galvanic corrosion) and allows the copper pipe to move within the hole during thermal expansion without metal-on-metal scraping that damages the pipe surface.

13. B — "NIC" on construction drawings means "Not In Contract." The item is shown for reference or coordination purposes but is not included in this contractor's scope of work. Another contractor, the owner, or a future phase will provide and install the NIC item.

14. D — The specification states "all hot water piping" must be insulated. This includes horizontal runs, vertical risers, and any other sections of the hot water distribution system. Vertical risers in mechanical shafts lose heat through the shaft's ventilation and must be insulated to comply with the specification and energy code.

15. A — Working within a tower crane's swing radius requires direct communication with the crane operator to establish a safe work zone. The plumber and crane operator must agree on the boundaries

where the crane will not swing while workers are in the area. This coordination prevents struck-by incidents from crane loads.

16. C — $V = \pi \times r^2 \times h = \pi \times (0.6\text{ m})^2 \times 2.0\text{ m} = 3.14159 \times 0.36 \times 2.0 = 2.262\text{ m}^3$. Since 1 m^3 = 1,000 litres: 2.262 × 1,000 = 2,262 litres. Using the radius (0.6 m = half the 1.2 m diameter) is critical — using the full diameter produces a volume four times too large.

17. D — The Smart Connect indicator clip (green O-ring or tab) is designed to break or deform during the pressing operation. Its presence before pressing does not interfere with the press jaws or O-ring seal. The clip simply serves as a visual indicator — if it remains intact after the pressing cycle, the fitting was not pressed.

18. A — Standard PVC cement may not properly soften the CPVC material because CPVC has a different chemical composition than PVC. The resulting joint may appear bonded but has inadequate chemical fusion and can fail under pressure or at elevated hot water temperatures. Only CPVC-specific or universal (PVC/CPVC) cement should be used.

19. C — A long, feathery inner cone with a yellowish outer envelope is a carburizing (reducing) flame — excess acetylene produces unburned carbon that can contaminate the joint surface and interfere with filler metal flow. The flame must be adjusted to neutral (equal inner cone with no feathery tip) for proper copper brazing.

20. B — Schedule 80 and Schedule 40 PVC share the same outside diameter at each nominal size, but Schedule 80's thicker wall reduces the internal diameter. The thicker wall provides higher pressure ratings and greater structural strength for chemical waste applications. Fittings are interchangeable because the OD is identical.

21. D — The dielectric union provides superior long-term isolation because it completely interrupts both electrical continuity (through the insulating washer and sleeve) and physical metal-to-metal contact between the copper and steel. Dielectric nipples rely on a plastic liner that can crack under thermal cycling.

22. A — Compression fittings with brass ferrules are generally accepted for concealed installation in most Canadian jurisdictions when used on copper tube. The brass ferrule creates a permanent mechanical grip on the tube. However, some local codes may restrict concealed compression fittings — the plumber should verify local requirements.

23. C — A dull, grainy solder fillet indicates the fitting was overheated. The flux burned off before solder was applied, leaving the copper surface oxidized. Solder cannot wet an oxidized surface — it forms a crystallized mass rather than flowing smoothly into the capillary gap. The joint must be disassembled, recleaned, refluxed, and resoldered.

24. B — The go/no-go gauge verifies that the crimp ring is compressed within the acceptable range. Passing through the "go" side confirms the ring is not oversized (compressed enough). Not fitting into the "no-go" side confirms the ring is not undersized (not over-compressed). Both conditions met = properly crimped.

25. C — PVC and ABS are chemically different plastics that cannot be joined with standard cement for either material. The connection requires either a transition cement (green-labeled, specifically formulated for PVC-to-ABS) or a listed mechanical coupling (rubber fernco-type with band clamps) that accommodates both materials.

26. A — In heavy snowfall regions like Saskatoon, the vent terminal should extend well above the code minimum 150 mm to prevent snow accumulation from burying and blocking the opening. Local practice in snow-belt regions typically requires 300–600 mm or more above the roof surface to maintain a clear opening during winter.

27. C — A short-turn 90-degree elbow at a stack base creates an abrupt direction change that causes turbulence, debris accumulation, and potential blockages. A long-sweep 90-degree elbow or two 45-degree elbows provide a gradual transition that maintains flow velocity and prevents solids from stalling at the turn.

28. B — Three 4-inch leaders (3 × 200 m² = 600 m²) exactly match the 600 m² roof area at 75 mm/hr design rainfall intensity. Each leader must be positioned to drain approximately 200 m² of roof area, and the roof drainage must be designed to direct water to each leader's collection point.

29. D — Discharging a washing machine into a laundry tub is an accepted alternative to a dedicated standpipe, provided the tub is properly trapped, vented, and the drain can handle the flow. The discharge hose hooks over the tub rim, and the water drains through the tub's standard drain. This is a common residential installation.

30. A — The grease interceptor provides the required treatment. No additional device is typically needed between the interceptor outlet and the building sewer. Some jurisdictions may require a sampling

manhole for monitoring grease levels in the effluent, but this varies by local code and the specific restaurant's permit conditions.

31. C — Bacteria growing in the organic biofilm inside the drain pipe near the trap produce hydrogen sulfide gas. The biofilm develops on all drain pipe interior surfaces from organic matter (food waste, soap, body oils). This bacterial activity can produce sewer-like odour even when the trap seal is intact and the vent is clear.

32. A — Two 45-degree elbows with a straight section between them create a smooth offset around the boulder while maintaining the required drainage slope through the offset section. The 45-degree angles provide gradual direction changes that do not promote blockages. A cleanout at this offset location improves future maintenance access.

33. D — The code sizing table shows that a 2-inch vent at 6 metres accommodates exactly 60 DFU — matching the load. The 2-inch vent also satisfies the half-diameter minimum (half of 4 inches = 2 inches). The existing 1-1/4-inch vent (10 DFU capacity at this length) is severely undersized and must be replaced.

34. A — A removable strainer basket or sediment bucket installed in the floor drain catches food solids (vegetable trimmings, meat scraps, grains) before they enter the P-trap and downstream drainage. The basket must be emptied regularly. This prevents food waste from accumulating in the drain piping and causing blockages.

35. C — Underground DWV pipe beneath a concrete slab must have adequate concrete cover over the top of the pipe. The minimum cover (typically 50 mm / 2 inches) protects the pipe from damage during slab loading — heavy equipment, point loads from columns, and concentrated floor loads could crack an inadequately covered pipe.

36. B — 300 mm ÷ 15,000 mm (15 m) = 0.02 m/m = 2% grade. Converting: 2% grade ≈ 1/4 inch per foot, which is within the acceptable slope range for a 4-inch building sewer. The elevation difference provides adequate gravity flow for the drainage to reach the municipal connection.

37. D — Air admittance valves (AAVs) installed at each fixture or branch eliminate the need for vent pipes to penetrate the roof membrane. AAVs open to admit air when negative pressure occurs in the drain and close to prevent sewer gas escape. However, at least one conventional vent must still extend through the roof in most jurisdictions.

38. A — The shared 2-inch branch handles either the sink or dishwasher discharge individually, but when the dishwasher's pump discharge enters the branch simultaneously with residual sink drainage, the combined flow may exceed the branch's capacity momentarily. The high-volume dishwasher pump overwhelms the shared branch.

39. C — The sealed, gasketed pit cover prevents sewer gas from escaping into the basement. The vent connection on the pit provides a pathway for gas to exit through the vent stack to the roof. Together, the sealed cover and vent connection create a gas-tight system that protects the basement air quality.

40. B — Effluent leaking from a cracked distribution box saturates the soil at one concentrated point rather than being distributed across the entire disposal field. This concentrated discharge can contaminate the groundwater locally because the soil has not been engineered for the full effluent load at that single point.

41. D — A two-way cleanout fitting (or cleanout tee) provides independent access in both directions from the same location. This allows drain cleaning equipment to be directed upstream toward the fixtures or downstream toward the building sewer from a single access point at the 90-degree direction change.

42. A — The code requires at least one vent stack to extend through the roof to the open atmosphere. The 2-inch vent stack satisfies this requirement. The AAV on the 3-inch soil stack supplements the venting system without replacing the required through-roof vent. This configuration is code-compliant.

43. B — With 8 DFU and no water closets, a 2-inch pipe handles only 6 DFU (insufficient). A 2-1/2-inch pipe handles up to 12 DFU at code slope — sufficient for the 8 DFU load with capacity to spare. Since no soil pipe minimum applies (no WC connected), the 2-1/2-inch size is the minimum that accommodates the load.

44. B — The available elevation change = 2.5 m − 1.5 m = 1.0 m (1,000 mm). At 1/8 inch per foot over 20 m (65.6 ft): 65.6 × 1/8 = 8.2 inches = 208 mm of required fall. The available 1,000 mm far exceeds the 208 mm needed. The 1/8-inch slope is easily achievable with substantial elevation margin remaining.

45. D — The fresh air inlet (FAI) provides air to the building drain upstream of the running trap. The running trap creates a sealed barrier that prevents the building's drainage system from receiving air through the municipal sewer. The FAI provides the necessary air supply from the exterior to allow the drainage to "breathe."

46. A — A sanitary tee is the correct fitting for connecting a horizontal branch to a vertical stack. The tee is installed with the branch inlet sweeping in the direction of drainage flow on the vertical stack. The swept interior of the sanitary tee guides the branch discharge smoothly into the downward stack flow.

47. C — Orangeburg (bituminous fibre) pipe was manufactured from compressed wood pulp and coal tar pitch. After 50+ years underground, this material has typically deformed under soil loads, collapsed from root intrusion, softened from groundwater, and deteriorated from the slow breakdown of its organic and bituminous components.

48. B — The vent must increase by at least one pipe size (3-inch to 4-inch) as it passes through the cold attic space before exiting the roof. The larger diameter provides more internal cross-sectional area, so even with ice accumulation on the pipe walls from frost closure, adequate airflow is maintained through the opening.

49. B — With no drain blockage, clear vent, and clean trap, the bathtub's internal drain mechanism (pop-up stopper, trip-lever waste, or plunger assembly) may be partially blocking the drain opening. Hair, soap, and debris accumulate on the internal mechanism, restricting flow at the tub outlet rather than in the pipe.

50. A — A 3-inch drain at 1/4" slope handles only 42 DFU — far too small for 150 DFU. A 4-inch drain at 1/4" slope handles 216 DFU — exceeding the 150 DFU load with adequate margin. The 4-inch drain is the minimum size that meets or exceeds the capacity requirement.

51. C — For a 45-degree offset, travel = rise × 1.414. The 2-metre trap arm length is within the code maximum of 2.4 metres for 2-inch pipe. This is acceptable provided the arm maintains the correct slope with no sags, bellies, or backfall throughout the 2-metre run.

52. A — The percolation rate measures how quickly the soil absorbs water. Slow-percolating soil (high minutes per inch) absorbs effluent slowly and requires more field area to handle the daily volume. Fast-percolating soil (low minutes per inch) absorbs quickly and requires less area. The perc rate directly determines the loading rate and field size.

53. D — A vent connection below the trap weir (below the hydraulic gradient) is in the drainage zone of the pipe. During fixture discharge, drainage water flows into the vent pipe through this low connection, partially or fully blocking the air pathway. The vent must connect above the trap weir to remain above the flow line.

54. B — Commercial grease interceptors should be pumped every 1 to 3 months or when grease and solids accumulation reaches approximately 25% of the total liquid depth. The frequency depends on the restaurant's volume — high-volume kitchens may require monthly pumping while lower-volume operations may extend to quarterly.

55. A — A no-hub coupling with a neoprene gasket and stainless steel shield with band clamps is the standard method for connecting PVC to cast iron at a hubless (no-hub) end. The neoprene accommodates the different pipe materials and any slight diameter variations while creating a watertight, code-approved mechanical joint.

56. D — Cleanouts are code-required access points that enable drain cleaning equipment (cables, cameras, jetters) to enter the drainage system for maintenance. Without cleanouts, a blockage cannot be cleared without cutting into the pipe — which beneath a concrete slab means breaking the slab. Their absence makes future maintenance extremely difficult and expensive.

57. C — All pressurized water supply connections must be absolutely watertight with zero leakage. Even a slow drip (1 drop per 5 seconds) represents a continuous water loss and a potential contamination pathway. The connection must be disassembled, inspected, and remade until a zero-leak test is achieved.

58. B — The sudden startup of the booster pump creates a rapid pressure surge (water hammer) in the discharge piping. The sudden acceleration of the water column from rest to full flow velocity produces the banging noise. A slow-start drive, pressure tank, or water hammer arrestor can mitigate the surge.

59. D — Connecting the return to the hot outlet mixes the cooler return water (at return temperature) with the hottest stratified water at the top of the tank. This dilutes the hottest stored water, reducing the delivery temperature at fixtures. The return should connect to the cold inlet so return water enters the bottom for reheating.

60. A — The reduced pre-charge (from 275 to 140 kPa) allows system water to enter the tank prematurely — before thermal expansion creates the need. The tank fills partially with water at fill pressure, reducing its available expansion capacity. During heating, the remaining capacity is insufficient and the pressure rises to the T&P relief point.

61. C — Dental units use fluoride, cleaning agents, and other chemicals in their water lines. These chemicals create a health hazard (severe hazard) cross-connection with the potable supply. A reduced

pressure (RP/RPZ) assembly provides the maximum mechanical protection required for health hazard applications.

62. B — Direct contact between copper pipe and concrete causes corrosion because concrete is alkaline (pH 12–13) and attacks the copper surface. The alkalinity dissolves the protective oxide layer on the copper, exposing fresh metal to continued attack. Copper through concrete must be sleeved or wrapped to prevent contact.

63. A — Total hot WSFU = 10 + 4 + 3 + 0.75 = 17.75 WSFU. Each fixture's hot water demand is added together to determine the total hot water branch demand. This total is then converted to litres per minute using the demand curve for pipe sizing.

64. D — The "cold water sandwich" is characteristic of tankless heaters in recirculation systems. When the faucet opens, the first water is residual hot water in the pipe. Next comes a slug of cooled water that sat in the heater's heat exchanger during standby. Then newly heated water arrives. The cold slug between the two hot volumes creates the intermittent temperature drop.

65. B — The T&P valve opens if EITHER condition is met independently — temperature reaches 210°F OR pressure reaches 150 psi. It does not require both conditions simultaneously. This dual-sensing capability protects against both overtemperature (thermostat failure) and overpressure (closed system expansion) independently.

66. C — Both methods are acceptable depending on whether the irrigation system operates year-round or seasonally. In year-round climates, a heated enclosure protects the RP during winter. In seasonal climates, draining the RP and leaving test cocks open prevents trapped water from freezing and damaging the device.

67. A — The 550 kPa (80 psi) code maximum applies to the pressure delivered to fixtures. Setting the PRV at exactly 550 kPa delivers the maximum permitted pressure — this is technically code-compliant. However, many practitioners set the PRV lower (415 kPa / 60 psi) to provide margin for pressure spikes and system comfort.

68. D — The sediment filter should be first in the treatment sequence — before the PRV, softener, and heater. Sediment can damage the PRV's seat (reducing its accuracy), foul the softener's resin (reducing its capacity), and accumulate in the water heater (reducing its storage volume and insulating the element).

69. B — The T&P discharge pipe must terminate at a visible, observable location with an air gap — typically 150 mm above the floor or grade. Direct connection to the drainage system is prohibited because a drain backup could force contaminated water into the heater, and the connection prevents visual observation of valve discharge.

70. C — The test was applied from the supply side of the system. If the test plug was upstream of the PRV, or the PRV allows pressure to pass in one direction, the full 690 kPa filled the downstream piping. The PRV regulates pressure only during flow conditions — under static test conditions with no flow, the PRV may not reduce the pressure.

71. A — The pump must run for at least 1 minute per cycle. At 20 LPM, the pump delivers 20 litres per minute. The 50-litre drawdown must sustain at least 1 minute of pump run time. The trigger flow rate depends on the demand — any demand that draws the tank pressure down to the cut-in setting activates the pump.

72. D — R-value is a measure of thermal resistance — the material's ability to resist heat flow through it. R-4 means the insulation has a total thermal resistance of 4 (in imperial units: $ft^2 \cdot °F \cdot hr/BTU$). A higher R-value provides more insulation. The required thickness depends on the insulation material's R-value per inch.

73. B — The return water at 50°C is exactly at the aquastat's activation setpoint (below 50°C activates the pump). The pump runs because the return is at or below the activation point. But the heat losses in the return piping prevent the return temperature from rising to the 55°C deactivation point. The pump runs continuously because the shutoff condition is never reached.

74. A — A licensed electrician evaluates the electrical panel's total capacity, available breaker spaces, and the building's existing electrical load to determine if a new 30-amp circuit can be added. Electrical panel capacity assessment and circuit installation are outside the plumbing trade's scope.

75. C — Residual pressure = available pressure − losses = 380 − 200 = 180 kPa. This exceeds the 140 kPa minimum by 40 kPa. While the margin is modest, the system meets the code minimum requirement without a booster pump. The plumber should document the calculation for the inspection file.

76. D — A wall-mounted lavatory on a properly installed concealed carrier should produce zero deflection under reasonable hand pressure. A 5 mm deflection indicates the carrier is not adequately

secured to the building structure — the lag bolts, through-bolts, or backing may be loose or missing. The carrier must be re-secured.

77. B — A gas water heater that reignites within 10 minutes of shutting off despite no hot water use has excessive standby heat loss through the flue. An oversized flue acts as a chimney, drawing warm air from the tank continuously through the draft hood. The heat loss drops the tank temperature quickly enough to trigger the thermostat.

78. A — A water softener's drain line must connect to the sanitary drainage system through an indirect waste connection with an air gap. This prevents contaminated drain water from back-siphoning into the softener and contaminating the potable water supply. The air gap also identifies if the softener is discharging during regeneration.

79. C — A water cooler that drips from the outlet when not activated has a shutoff valve with a piece of debris preventing complete closure. Mineral deposits, scale fragments, or sediment from the supply piping lodge on the valve seat, preventing the rubber seal from contacting the seat fully. Cleaning or replacing the valve resolves the drip.

80. D — Pressure-balancing or thermostatic mixing valves prevent scalding by maintaining a consistent outlet temperature even when supply pressures fluctuate. If someone flushes a toilet (dropping cold pressure), the valve compensates to prevent the shower from delivering a sudden burst of hot water that could cause burns.

81. B — The universal standard of hot on the left and cold on the right ensures consistency at every fixture throughout every building. This predictability prevents users from accidentally turning on scalding hot water when they expect cold. It is a safety convention that protects all users, especially children and the elderly.

82. A — Rapid anode consumption (nearly gone in 4 years) indicates highly aggressive water — typically soft (low mineral content), acidic (low pH), and/or high conductivity (high dissolved solids). These conditions accelerate the electrochemical reaction that sacrifices the anode to protect the tank. More frequent anode replacement is needed.

83. B — The RO system's low production rate (0.2 LPM) fills the storage tank slowly. Both the faucet and ice maker can draw from the tank, but the tank must have adequate capacity to serve both. The ice

maker's intermittent demand plus faucet use must not exceed the tank's stored volume and the RO's recovery rate.

84. B — The lower heating element has failed, leaving the bottom half of the tank unheated. The upper element heats only the top portion. Upper-floor fixtures receive the hottest water (drawn from the top), while lower-floor fixtures receive the lukewarm mixture from the bottom. Replacing the lower element restores full-tank heating.

85. D — The vacuum breaker on a pre-rinse spray valve protects the potable supply from contamination. The spray nozzle can be submerged in contaminated water in the sink basin during use. If supply pressure drops, the submerged nozzle creates a back-siphonage path. The vacuum breaker opens to atmosphere, breaking the siphon.

86. A — Removing the T&P valve and plugging the port creates a sealed, unprotected pressure vessel. If the thermostat fails or thermal expansion exceeds the system's capacity, the water can superheat beyond 100°C under pressure with no relief path. The result can be a catastrophic tank rupture — a potentially fatal explosion.

87. B — Birm is a catalytic iron removal media that requires a minimum pH of 6.8 and adequate dissolved oxygen in the water to function. The birm catalyzes the oxidation of dissolved (ferrous) iron to particulate (ferric) iron, which is then captured in the filter bed. Without sufficient pH and dissolved oxygen, the catalytic process fails.

88. C — The WHO and public health authorities recommend a minimum 20-second handwashing duration with soap for effective hand hygiene. The faucet's 30-second run time should be maintained or slightly extended to provide adequate time for the full 20-second wash plus rinsing.

89. B — CPVC pipe and electrical wiring can share a joist bay provided the wiring does not generate heat that could damage the CPVC. Standard residential wiring (Romex/NMD) at normal amperage does not produce significant heat. Direct contact is permitted as long as the wiring is not a heat-producing source (such as a heat cable).

90. A — Cloudy ice in a commercial ice machine despite a functional water filter typically indicates dissolved mineral content (total dissolved solids / TDS) that the basic internal filter cannot remove. Minerals trapped in the ice crystal structure scatter light, producing cloudiness. A more advanced filtration system (carbon block or RO) may be needed.

91. D — Installing a new 120V electrical outlet requires an electrical permit and licensed electrician. The outlet installation — running wire from the panel, installing the receptacle box, and making connections — is electrical work outside the plumbing trade's scope. The plumber installs the water connections and places the anode; the electrician provides power.

92. C — Baseboard convectors produce heat output proportional to the supply water temperature. At 35°C supply during mild weather, the convectors produce reduced output — but the building's heat demand is also reduced in mild weather. The outdoor reset control matches the reduced boiler output to the reduced building demand.

93. B — A zero-pressure reading when the system should be at fill pressure (103 kPa) has multiple possible causes: the system lost water through a leak, the fill valve failed or was shut off, or the pressure gauge failed. The plumber must systematically check each component — gauge, fill valve, and system for leaks — to identify the actual cause.

94. A — The pressuretrol's cut-in setting is 0.5 psig. The burner fires until the pressure reaches 2.0 psig (cut-out), then shuts off. As steam is distributed and condenses, the pressure drops. The burner reignites when the pressure falls to 0.5 psig (cut-in). The 1.5 psi differential prevents rapid cycling.

95. D — Sludge (iron oxide, scale, sediment) accumulates in the low-water cutoff's float chamber over time, preventing the float from rising to indicate adequate water level. The boiler has water, but the sludged float cannot sense it. Blowing down the LWCO (opening the drain valve briefly) flushes the sludge and restores float function.

96. B — Each addition of fresh water introduces dissolved oxygen into the hydronic system. Dissolved oxygen is the primary driver of corrosion in ferrous (iron and steel) components. A properly filled system consumes its initial oxygen and remains stable. Repeated fresh water additions continuously reintroduce oxygen, accelerating rust and scale formation.

97. C — In a one-pipe steam system, the supply valve must be fully open or fully closed. A partially open valve creates a restriction where incoming steam contacts pooled condensate trying to drain back through the same pipe. This collision between steam and condensate produces violent water hammer that can damage piping and fittings.

98. A — When the expansion tank's pre-charge (170 kPa) exceeds the system's fill pressure (103 kPa), the higher air pressure pushes the diaphragm fully against the water inlet. No water can enter the tank because the air charge overpowers the system pressure. The tank provides zero expansion absorption.

99. D — In a series loop system, each radiator removes heat from the water sequentially. By the time the water reaches the last radiator, it has already given up significant heat to all preceding units. The last radiator receives the coolest supply water and produces the least heat output. This is a fundamental characteristic of series loop piping.

100. A — A corrosion inhibitor reduces but does not eliminate oxygen corrosion from continuous permeation through non-barrier PEX. Oxygen continuously enters the system through the PEX wall, overwhelming the inhibitor's capacity over time. Only oxygen-barrier PEX (with an EVOH or aluminum layer) prevents oxygen permeation.

101. A — Steam escaping from the condensate receiver's atmospheric vent indicates that live steam is reaching the receiver — which means one or more steam traps have failed in the open position. Failed-open traps pass live steam through to the condensate return, wasting energy and potentially damaging the receiver and return piping.

102. C — The neutralization kit raises the pH of the condensing boiler's acidic condensate (typically pH 3–4 from carbonic acid) to a neutral level (pH 6–9) before it enters the building's sanitary drainage system. The calcium carbonate media (marble chips) chemically neutralizes the acid through a buffering reaction.

103. B — If the supply temperature and flow rates are identical across all zones, a floor covering difference is the most likely cause. Carpet acts as an insulator between the heated slab and the room, reducing the surface temperature the occupant feels. Tile and hard surfaces conduct heat efficiently; carpet does not.

104. D — The Hartford Loop's purpose is to prevent the boiler from draining below the normal water line if the return piping develops a leak. The return connects below the waterline so that the steam pressure in the equalizer holds the water level at the loop connection point. Connecting above the waterline defeats this protection.

105. D — At -40°C, the glycol concentration must provide burst protection (not just freeze protection) to at least -40°C. A 50% propylene glycol mix provides freeze protection to approximately -34°C. For -

40°C burst protection, a higher concentration (typically 55–60%) is needed. The manufacturer's freeze protection chart determines the exact concentration.

106. A — The manual lever on a zone valve overrides the thermostat by holding the valve open regardless of the room temperature. The room overheats because the thermostat cannot close the valve, and the zone receives heat continuously. Energy is wasted heating a space that has already reached or exceeded the desired temperature.

107. B — A pipe clamp thermometer (strap-on type) or infrared thermometer measures the pipe surface temperature at the supply and return connections of each radiator. The difference between these two temperatures (ΔT) indicates the heat delivered by that emitter. Balancing adjusts each zone's flow to achieve the design ΔT.

108. D — After the third-party verifier's certification report is issued confirming all tests pass, the hospital's designated representative (typically the facilities director or clinical engineering manager) formally authorizes the system for clinical use. The gas source manifold is then connected and gas flows to patient outlets.

109. A — The refrigerated dryer at the compressor removes moisture to its rated dewpoint. However, if the header runs through an unconditioned space (outdoor wall, unheated attic, cold warehouse bay) where the air temperature drops below the dryer's dewpoint, the moisture condenses out of the air again at the cold point — re-introducing water into the line downstream.

110. C — Minimum flow rate = pool volume ÷ turnover time = 60,000 litres ÷ 480 minutes (8 hours × 60) = 125 LPM. The variable-speed pump must deliver at least 125 litres per minute during the filtration cycle to achieve the required single turnover every 8 hours.

111. B — A high-pressure alarm typically indicates the supply manifold regulator has malfunctioned — either the primary regulator has failed open or the line regulator downstream is not functioning. The full cylinder or bulk supply pressure passes through to the piping system, exceeding the normal 350 kPa operating pressure.

112. D — A pressure regulator installed after the zone valve and before the drip tubing reduces the 415 kPa supply to the drip system's 140 kPa operating pressure. Drip emitters are designed for low pressure — excessive pressure causes emitters to blow off the tubing or deliver water at rates far above their design specification.

113. A — Without DE on the filter grids, the bare fabric grid provides minimal filtration — it can capture only large debris but not the fine particles that DE normally traps. Pool water clarity deteriorates rapidly as fine particles pass through the uncoated grids. Fresh DE must be added immediately.

114. B — A manual gas shutoff valve within reach of the BBQ allows the homeowner to turn off the gas supply at the appliance for safety. This provides local isolation for the outdoor appliance without requiring a trip to the interior manifold. The valve is typically a quarter-turn ball valve for easy operation.

115. A — All pool equipment drain plugs (pump, filter, heater, chlorinator) must be removed to allow water to drain completely from the equipment by gravity. Trapped water in any component will freeze, expand, and crack the housing, heat exchanger, volute, or filter tank. Drain plugs should be stored in the pump basket for safekeeping.

116. A — A yellow advisory alarm on the nitrogen supply typically indicates a low-supply condition — the primary supply is approaching depletion and the reserve or secondary supply should be checked and prepared. It is a proactive warning, not an emergency. The system continues to deliver gas from the remaining supply.

117. A — Total CFM = 8 tools × 5 CFM = 40 CFM minimum compressor output. If the specification states all 8 tools may operate simultaneously, no diversity factor is applied — the compressor must deliver the full simultaneous demand. Additional capacity for future expansion and system losses should also be considered.

118. C — Regular hose cleaning removes surface debris but not the oils (body oils, sunscreen, lotions), minerals (calcium, iron), and organic films that gradually embed in the filter media's microscopic pores. These contaminants reduce the cartridge's permeability over time. Periodic chemical soaking (filter cleaner solution) dissolves these embedded contaminants.

119. B — Tri-clamp fittings allow quick disassembly without cutting, welding, or threading. The clamp releases with a simple hand tool, and the joint separates for cleaning, inspection, or reconfiguration. This is essential in brewery operations where regular cleaning-in-place (CIP) and system modifications are part of normal operations.

120. D — The salt level (2,800 ppm) is below the generator's minimum requirement (3,000 ppm). Salt must be added to raise the concentration to at least 3,000 ppm for the generator to produce chlorine at its

rated efficiency. The required amount of salt is calculated based on the pool volume and the 200 ppm deficit.

121. A — The drip leg at the base of the vertical riser collects moisture and debris from the horizontal gas supply before it enters the vertical section. Without the drip leg, moisture and particulates would travel up the riser and potentially reach the rooftop equipment's gas valve, causing malfunction or unsafe operation.

122. C — The switchover from primary bulk liquid oxygen to backup cylinder supply is automatic. A switchover manifold monitors the primary supply pressure and automatically activates the backup cylinders when the liquid oxygen level drops below the minimum threshold or the primary pressure falls below the set point.

123. B — Dental air outlets use the same DISS connector and colour coding as medical air outlets because both deliver clean, dry, oil-free air for patient contact. The dental air system meets the same quality standards as medical air. The outlets are identified by their location (dental clinic) and labeling.

124. D — Sunlight's ultraviolet radiation breaks down free chlorine in pool water through photodecomposition — UV light converts hypochlorous acid into inactive compounds. The pool cover blocks UV radiation, dramatically reducing this chlorine loss mechanism. Covered pools maintain chlorine levels much longer than uncovered pools.

125. A — Current anti-entrapment standards (Virginia Graeme Baker Act, ANSI/APSP-7) require existing single-drain pools to be retrofitted with either a second drain or an approved safety vacuum release system (SVRS) that detects entrapment and shuts off the pump. Grandfathering does not apply to this life-safety requirement.