PRACTICE EXAM 12: RED SEAL PLUMBER SIMULATION (125 QUESTIONS)

1. A plumber is soldering copper pipe in a ceiling space directly beneath a concrete structural deck. After completing the joint, the plumber notices that a nearby automatic fire sprinkler head has solder residue on its heatsensitive glass bulb from a previous brazing operation. What is the concern with this contamination?

A. Solder residue on the sprinkler bulb has no effect because the glass is heattreated and chemically resistant

B. The solder residue will cause the sprinkler head to activate prematurely during normal room temperature conditions

C. Solder residue may insulate the bulb, delaying its activation during a fire and compromising life safety protection

D. The residue will cause corrosion of the bulb's metal frame that weakens the sprinkler head's structural integrity

2. A plumber is working alone in a remote area of a building under construction. No other workers are within sight or earshot. The plumber must solder a joint in a wall cavity containing wood framing. What additional safety measure is required for this lone worker situation?

A. A communication plan must be in place — the plumber must have a way to contact help if an emergency occurs during solo hot work

B. Soldering while working alone requires no additional measures beyond the standard hot work permit and fire watch

C. The plumber must postpone all hot work until a second worker is available to serve as both fire watch and spotter

D. A portable fire suppression system (pressurized water extinguisher with hose) must replace the standard ABC extinguisher

3. A plumber discovers that a power tool's GFCI plug has been removed and replaced with a standard threeprong plug by a previous user. The tool must be used in a damp location. What is the correct action?

A. Use the tool with the standard plug because the building's electrical panel has arcfault protection that provides equivalent safety

B. Wrap the standard plug connection with electrical tape to provide moisture protection equivalent to GFCI protection

C. Use the tool briefly with the standard plug and replace the GFCI plug after the task is completed at the end of the day

D. Remove the tool from service — the GFCI must be restored before the tool can be used in any damp or wet location

4. A plumber must calculate the weight of water needed to fill a 3inch pipe for a 30metre water test. The internal area of 3inch pipe is approximately 4,560 mm^2 (0.00456 m^2). What is the volume of water?

A. 456 litres, calculated by multiplying the area by the length and converting incorrectly from m^3 to litres

B. Approximately 137 litres, calculated as 0.00456 $m^2 \times 30$ m = 0.137 m^3 = 137 litres

C. Approximately 45.6 litres, calculated by dividing the area by the length instead of multiplying the two values

D. Approximately 13.7 litres, calculated by using millimetres instead of metres for the pipe length in the formula

5. A plumber is operating a rotary hammer drill to install concrete anchors. The drill suddenly binds in the concrete and the drill body begins to spin violently, nearly wrenching from the plumber's grip. What feature should the plumber verify the drill has before resuming?

A. A variablespeed trigger that allows the plumber to control the rotational speed more precisely during drilling

B. A depth stop rod that limits the drill bit's penetration and prevents it from binding in the reinforcing steel

C. A clutch or antirotation safety feature that disengages the drive when the drill body encounters sudden torque resistance

D. A side handle that provides a second grip point, which is helpful but does not prevent the binding condition itself

6. A plumber is reviewing a material safety document and finds that the product's permissible exposure limit (PEL) is listed as 25 ppm TWA. A coworker claims the product is safe as long as the concentration stays below 25 ppm at any given moment. Is this interpretation correct?

A. No — the TWA is averaged over 8 hours, meaning brief spikes above 25 ppm may be permitted, but the average must not exceed 25 ppm

B. Yes — the PEL of 25 ppm means the concentration must never exceed 25 ppm at any instant during the work shift

C. No — the TWA means the concentration can exceed 25 ppm for up to 50% of the work shift without concern

D. Yes — all permissible exposure limits are ceiling values that must never be exceeded under any circumstances

7. A plumber discovers that the trench shoring system installed by the excavation contractor has visibly shifted — one panel has tilted inward approximately 50 mm from its original position. The plumber is about to enter the trench to install underground piping. What must be done?

A. Enter the trench quickly and complete the work before the shoring shifts any further from its original position

B. Brace the shifted panel from inside the trench using pipe or lumber before beginning the plumbing installation

C. Proceed with entry because 50 mm of movement is within the acceptable tolerance for hydraulic shoring systems

D. Do not enter — report the shifted shoring to the competent person for evaluation and correction before anyone enters

8. A plumber is performing a hydrostatic test on a copper water supply system at 690 kPa (100 psi). The system contains air that was not fully purged before pressurization. What hazard does the trapped air create during a hydrostatic test?

A. Trapped air dissolves into the water under pressure and produces a chemical reaction that corrodes the copper piping

B. Trapped air stores energy that releases explosively if a fitting fails — unlike water, which is incompressible and releases no stored energy

C. Trapped air causes the pressure gauge to fluctuate rapidly, making it impossible to verify a stable test pressure reading

D. Trapped air has no effect on hydrostatic testing because the test pressure is the same regardless of the medium

9. A plumber calculates that a 45degree offset must rise 300 mm vertically. Using the 45degree constant, what is the travel (the diagonal distance between the two fitting centres)?

A. 600 mm, calculated by multiplying the rise by the constant 2.0 for the travel of a 45degree offset fitting pair

B. 212 mm, calculated by dividing the rise by the constant 1.414 for the diagonal distance at 45 degrees angle

C. 424 mm, calculated by multiplying the 300 mm rise by the 45degree travel constant of 1.414 for the diagonal

D. 300 mm, because at 45 degrees the travel always equals the rise without any multiplication factor applied

10. A plumber is installing pipe in a ceiling space and must work from an extension ladder leaned against a steel beam. The ladder's feet are on a smooth concrete floor. What prevents the ladder from sliding?

A. Nonslip feet (rubber pads) on the ladder's base, plus verifying the ladder is set at the correct 4:1 angle ratio

B. The weight of the plumber on the ladder creates sufficient friction to prevent the base from sliding on concrete

C. A coworker holds the ladder base while the plumber is on the ladder to prevent any possibility of sliding

D. Extension ladders are selfstabilizing on all floor types and do not require any antislip measures at the base

11. A plumber must perform overhead work installing a 4inch cast iron pipe in a ceiling space. The pipe weighs approximately 25 kg per 3metre section. What risk does this overhead lifting create?

A. Minimal risk because 25 kg is within the singleperson lifting limit for overhead work in all conditions

B. Noise exposure from the heavy pipe scraping against the steel beam during the installation process

C. Chemical exposure from the cast iron pipe's coating material that flakes off during overhead handling

D. Musculoskeletal injury from overhead lifting, plus a droppedobject hazard if the pipe slips during positioning

12. A plumber encounters a specification that requires "ASTM A53 Grade B ERW" steel pipe for a gas piping installation. What do these specification elements define?

A. Only the pipe's pressure rating and maximum operating temperature for the gas service application

B. The manufacturing standard (ASTM A53), the strength grade (B), and the manufacturing method (electric resistance welded)

C. The pipe's colour code, wall thickness, and thread type for identification and installation on the project

D. The pipe supplier, the delivery schedule, and the quantity required for the gas piping portion of the project

13. A plumber is mentoring a firstyear apprentice on soldering technique. The apprentice applies the flame directly to the solder wire instead of heating the fitting. Why is this technique incorrect?

A. Heating the solder directly wastes fuel gas because the solder absorbs heat less efficiently than the fitting

B. The solder will melt but will not flow into the joint because the fitting surface is not at soldering temperature

C. Heating the solder directly produces a cold joint — the solder melts onto a surface too cool for capillary flow, producing a weak bond

D. The direct flame decomposes the solder's flux core, releasing toxic fumes that are not produced during normal soldering

14. A plumber is working on a project where the architect has specified "concealed" pipe routing. All supply and drainage piping must be hidden within walls, floors, and ceilings. The plumber must install a cleanout that will be accessible after the walls are finished. How is concealed access to the cleanout provided?

A. An access panel installed in the finished wall surface at the cleanout location, providing removable access for maintenance

B. The cleanout is installed behind the drywall with no access — the wall is cut open whenever maintenance is needed

C. The cleanout is relocated to an exposed location (utility room or garage) that does not require concealment

D. A flushmount cleanout cover is installed in the wall surface that blends with the finish and opens for access

15. A plumber is installing a gas pipe in a building and must pass the pipe through a concrete block wall. The pipe is 1inch black steel. After installing the sleeve and passing the pipe through, the plumber must seal the annular space. The wall separates an occupied space from a garage. What type of seal is required?

A. Standard silicone caulk that provides a flexible, airtight seal between the pipe and the concrete block sleeve

B. Expanding spray foam that fills the annular space completely for maximum thermal insulation at the penetration

C. A rubber grommet that allows the pipe to move during thermal expansion while preventing air infiltration

D. A gastight, firerated seal that prevents both combustion gas migration and fire passage through the wall

16. A plumber is assigned to install plumbing in a building that is simultaneously being used as an active school. The plumber must work in the mechanical room located adjacent to occupied classrooms. What special consideration applies?

A. The plumber must work only during school hours to ensure that adults are present in case of an emergency

B. The plumber must coordinate work to minimize noise, dust, and disruption, and comply with the school's safety protocols for contractors

C. The plumber must be accompanied by a school staff member at all times while working inside the building

D. No special considerations apply because the mechanical room is separate from the occupied classroom areas

17. A plumber is soldering a copper joint and uses a propane torch instead of the usual MAPP gas or acetylene torch. The propane flame produces less heat than MAPP gas. What is the practical consequence of using propane for soldering copper?

A. Propane produces adequate heat for soldering — it heats the joint more slowly but still achieves a proper solder bond

B. Propane cannot melt leadfree solder because its flame temperature is below the solder's melting point entirely

C. Propane produces a sooty flame that contaminates the joint surface, preventing the solder from flowing properly

D. Propane is prohibited for soldering copper plumbing joints by the plumbing code in all Canadian jurisdictions

18. A plumber is installing a polypropylene (PPR) hot water supply system using socket fusion joining. The fusion tool has interchangeable die sets for each pipe size. The plumber selects the die set for 25 mm (3/4inch) pipe. Before heating, what must the plumber verify about the fusion tool?

A. The tool's electrical cord must be rated for outdoor use because PPR fusion is typically performed outside the building

B. The tool must be connected to a GFCI outlet because it operates at high temperatures near combustible materials

C. The tool must reach its specified operating temperature (typically 260°C) and the die faces must be clean before heating

D. The tool's timer must be programmed for the specific pipe material and wall thickness before heating begins

19. A plumber must install a fire sprinkler riser using Schedule 40 black steel pipe with threaded joints. The riser extends vertically 12 metres through a threestorey building. At each floor penetration, the pipe must be supported. What type of support is used on vertical steel pipe?

A. Clevis hangers suspended from threaded rod anchored to the floor structure above each floor penetration

B. Jhooks attached to the wall studs at each floor level to prevent the vertical pipe from moving laterally

C. Pipe straps bolted directly to the concrete floor slab at each penetration to prevent any vertical movement

D. Riser clamps at each floor level that transfer the cumulative pipe weight to the building structure at that point

20. A plumber is cutting 4inch ABS DWV pipe with a handsaw. After cutting, the plumber must prepare the end for solvent cementing. What preparation step is required before applying cement?

A. Heat the pipe end with a torch to soften the ABS surface for improved adhesion during the cementing process

B. Deburr the cut end to remove the sharp edge that could scrape cement from the fitting socket during insertion

C. Sand the exterior of the pipe end with 80grit sandpaper to roughen the surface for mechanical cement adhesion

D. Apply ABS primer to both the pipe exterior and fitting interior surfaces before the cement application step

21. A plumber is installing copper tube using ProPress (press) fittings in an existing system that is being modified. The existing system has water in the pipes downstream. The plumber cuts into the existing pipe and a small amount of water drips from the cut end. Can the ProPress fitting be installed on the wet pipe?

A. Yes — ProPress fittings can be installed on wet pipe because the Oring seal does not depend on a dry surface

B. No — the pipe must be completely dry because any moisture prevents the Oring from compressing properly

C. Yes — but only if the plumber wipes the pipe with a solvent to displace the water from the sealing surface

D. No — the pipe must be heated with a torch to evaporate the moisture before the fitting is pressed into place

22. A plumber is installing a grooved mechanical pipe coupling on a 6inch steel pipe for a fire sprinkler system. The coupling consists of two housing halves, a rubber gasket, and bolts. After assembling the

coupling over the grooved pipe ends, the plumber must tighten the bolts. What tightening sequence is correct?

A. Tighten the top bolt fully first, then the bottom bolt, to seat the gasket from the top down over the pipe

B. Tighten all bolts fingertight first, then alternately tighten each bolt in stages to achieve even gasket compression

C. Tighten both bolts simultaneously using two wrenches operated at the same time for perfectly even compression

D. Tighten the bottom bolt fully first because gravity pulls the housing downward and the bottom bolt takes priority

23. A plumber is brazing a 2inch copper tube joint for a medical gas system using BCuP5 filler metal and a nitrogen purge. The completed joint must have a smooth, uniform fillet of brazing alloy visible around the circumference. The plumber examines the joint and sees alloy on approximately 270 degrees of the circumference but a gap at the remaining 90 degrees. Is this joint acceptable?

A. Yes — 270 degrees of coverage (75%) meets the minimum acceptable coverage for medical gas brazing joints

B. Yes — the gap can be filled by reheating the joint and applying additional filler metal to the uncovered section

C. No — the gap must be repaired by adding flux to the uncovered area and reheating to draw filler into the gap

D. No — the joint must be cut out and remade because an incomplete fillet indicates the entire joint may be compromised

24. A plumber encounters a situation where a 2inch copper DWV pipe must connect to a 2inch cast iron pipe in an existing system. The cast iron pipe has a hub (bell) end available. What joining method connects the copper to the cast iron hub?

A. Solder the copper pipe directly into the cast iron hub using a hightemperature silver brazing alloy and flux

B. Use a lead and oakum caulked joint — pack oakum into the hub and pour molten lead to seal the copper into the cast iron

C. Use a nohub coupling with a neoprene gasket that slides over both the copper and cast iron pipes at the joint

D. Use solvent cement applied to both the copper and cast iron surfaces for a chemical bond between the two metals

25. A plumber is installing PEX tubing for a hot water supply and runs the tubing through a return air duct to reach a distant fixture. Is this routing acceptable?

A. No — PEX tubing must never be routed through return air ducts because fire and smoke can spread through the duct via the penetration

B. Yes — PEX in return air ducts is permitted because PEX is a noncombustible material that will not contribute fuel in a fire

C. No — but PEX can be routed through supply air ducts because the positive pressure prevents smoke from entering

D. Yes — but only if the PEX is sleeved in a metallic conduit within the duct for fire protection and air tightness

26. A plumber is troubleshooting a commercial building where all fixtures on every floor drain slowly during peak usage. The building has a 6inch building drain and a 6inch building sewer. Offpeak, all fixtures drain normally. Video inspection shows no blockage in the drain or sewer. What is the most likely cause?

A. The vent system is completely blocked, preventing air from entering during peak simultaneous discharge events

B. The building drain slope is incorrect — it is too steep, causing water to outrun solids during peak usage periods

C. The water supply pressure is too low during peak hours, reducing the flush volume available to clear the drains

D. The building drain or sewer is undersized for the building's actual peak DFU load, which exceeds the pipe's capacity

27. A plumber discovers that an existing building's DWV system has a vent pipe that runs downward from the fixture trap arm connection for 600 mm before turning upward to run to the roof. This downward section creates a dip (sag) in the vent piping below the trap arm. What problem does this create?

A. The dip has no effect on vent performance because gravity pulls any moisture through the dip and back to the drain

B. The dip creates a trap in the vent pipe that can fill with water, blocking airflow and defeating the vent's purpose

C. The dip increases the vent's air capacity by creating a larger volume of pipe available for air circulation

D. The dip improves the vent's performance by slowing the air velocity for more uniform pressure equalization

28. A plumber is sizing a building drain for a commercial building with 300 DFU. The drain will be installed at 1/8 inch per foot slope. The code table shows: 4inch at 1/8" slope = 180 DFU; 5inch at 1/8" slope = 390 DFU; 6inch at 1/8" slope = 700 DFU. What minimum pipe size is required?

A. 4 inches, because 180 DFU is close enough to 300 DFU with the safety factor built into the code tables

B. 6 inches, because the drain should be oversized by at least one pipe size above the calculated minimum diameter

C. 5 inches, because 390 DFU capacity exceeds the 300 DFU load at the specified 1/8inchperfoot slope

D. 4 inches at a steeper slope of 1/4 inch per foot, which would increase its capacity above the 300 DFU load

29. A plumber installs a Ptrap on a bathtub drain. The trap's water seal depth is 75 mm (3 inches). The code maximum trap seal depth is 100 mm (4 inches) and the minimum is 50 mm (2 inches). Is this trap acceptable?

A. Yes — the 75 mm seal depth is within the codepermitted range of 50 mm minimum to 100 mm maximum

B. No — the 75 mm seal depth exceeds the code maximum of 50 mm for residential bathtub trap installations

C. Yes — but only if the trap is a drum trap because drum traps are permitted to have deeper seals than Ptraps

D. No — all traps must have exactly 50 mm seal depth for uniform performance throughout the DWV system

30. A plumber encounters a commercial building where a mop sink is installed with its rim at 250 mm above the finished floor. The mop sink drain connects directly to the building's sanitary drainage system through a Ptrap. The plumber notices that the mop sink does not have a backwater valve. During a sewer backup, would the mop sink be the first fixture to overflow?

A. No — the floor drains in the building would overflow first because they are at the lowest elevation in the room

B. No — the water closets would overflow first because they have the largest drain connections to the sewer system

C. Yes — but only if the mop sink is connected downstream of all other fixtures on the building drain system

D. Yes — with the lowest rim elevation of any fixture in the building, the mop sink overflows first during a backup

31. A plumber installs a 4inch soil stack in a twostorey house. The stack extends from the building drain through the first floor, the second floor, and out through the roof. The firstfloor bathroom connects at the base of the stack. The secondfloor bathroom connects 3 metres above. The vent portion of the stack continues another 2 metres through the attic and exits the roof. What is the total stack height?

A. 3 metres, measured only from the firstfloor connection to the secondfloor connection on the stack

B. Approximately 5 metres or more, measured from the building drain connection to the vent terminal above the roof

C. 2 metres, measured only from the secondfloor connection to the vent terminal exiting through the roof

D. The total height depends on the number of fixtures connected and is calculated from the DFU table only

32. A plumber is troubleshooting a residential DWV system where the basement floor drain emits a foul odour. The plumber fills the trap with water, and the odour stops for two weeks before returning. No fixtures above the floor drain are used frequently. What longterm solution prevents this recurring problem?

A. Install a deeper Ptrap (100 mm seal) that takes longer to evaporate between the homeowner's periodic water additions

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

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

D. Connect the floor drain to a frequently used fixture's waste pipe so that regular discharge replenishes the seal

33. A plumber installs a septic tank on a property with clay soil. The percolation test shows a rate of 40 minutes per inch — within the acceptable range for a conventional disposal field but near the slow end. The code requires a minimum disposal field area of 120 m^2 for this percolation rate and the home's bedroom count. The available lot area for the field is only 100 m^2. What should the plumber recommend?

A. Install the conventional field at 100 m^2 because the 20 m^2 shortfall is within the acceptable tolerance range

B. Increase the number of disposal field trenches to compensate for the reduced total area in the available space

C. Request a variance from the local authority to install the undersized field based on the lot's physical limitations

D. An engineered alternative system (such as a sand filter or treatment mound) is needed because the conventional field cannot meet the area requirement

34. A plumber discovers during a renovation that a 3inch horizontal branch drain serving a bathroom group has a slope of 1/2 inch per foot. The code minimum slope for 3inch pipe is 1/4 inch per foot. Is the 1/2inch slope acceptable?

A. No — the slope exceeds the code maximum and must be reduced to 1/4 inch per foot for proper drainage performance

B. No — excessive slope causes water to outrun solids on long runs, but on short bathroom branches it is generally acceptable

C. Yes — the code specifies a minimum slope; there is no maximum as long as the pipe is properly supported throughout

D. Yes — but only if the branch is less than 3 metres long, because longer branches at this slope strand solids in the pipe

35. A plumber installs a building sewer that connects to a municipal combined sewer system. During a heavy rainstorm, the combined sewer surcharges and wastewater backs up into the building through the floor drain on the lowest level. What device prevents this backup?

A. A sump pump installed at the lowest floor drain that pumps the backup water out of the building during sewer surcharge

B. A backwater valve on the building drain that closes when reverse flow from the surcharged municipal sewer is detected

C. A larger building sewer that provides more capacity to handle the combined storm and sanitary flow during heavy rain

D. A vent stack extension that relieves the pressure buildup from the surcharged sewer before it reaches the building

36. A plumber is sizing a vent for a 4inch horizontal branch drain serving 50 DFU. The developed length of the vent is 25 metres. The code sizing table shows: 11/2" vent at 25 m = 8 DFU; 2" vent at 25 m = 24 DFU; 21/2" vent at 25 m = 48 DFU; 3" vent at 25 m = 120 DFU. What minimum vent diameter is required?

A. 3 inches, because 120 DFU capacity exceeds the 50 DFU load and is the first size that provides adequate capacity

B. 21/2 inches, because 48 DFU capacity is close enough to 50 DFU with the builtin safety factor in the code table

C. 2 inches, because the vent must be at least half the drain diameter (2 inches = half of 4 inches) regardless of the table

D. 4 inches, matching the drain diameter because vents must always equal the drain pipe diameter they serve in commercial buildings

37. A plumber is installing a commercial kitchen's drainage system. The dishwasher's drain must connect to the sanitary system through an indirect waste connection with an air gap. The plumber installs the dishwasher drain hose terminating 25 mm above the flood level rim of a floor sink. The drain hose diameter is 25 mm (1 inch). Is the air gap adequate?

A. No — the minimum air gap must be at least 50 mm (2 inches) regardless of the drain pipe diameter for all applications

B. No — the minimum air gap must be at least twice the drain pipe diameter (2 × 25 mm = 50 mm minimum)

C. Yes — a 25 mm air gap is adequate for a 25 mm drain hose because it equals one pipe diameter above the flood rim

D. Yes — a 25 mm air gap exceeds the minimum requirement of 10 mm for all indirect waste connections in kitchens

38. A plumber is installing underground PVC sewer pipe and must join a section of pipe using a gasketed bellandspigot joint. After cleaning the bell and spigot, the plumber applies lubricant to the gasket and spigot end. During assembly, the pipe meets significant resistance before reaching the insertion mark. What should the plumber do?

A. Force the pipe past the resistance using a backhoe bucket to push the pipe to the full insertion depth marking

B. Use a comealong or chain to pull the pipe to full insertion because resistance indicates a tight, highquality gasket seal

C. Stop insertion immediately — the resistance may indicate a misaligned gasket that has rolled out of its groove

D. Apply additional lubricant to the gasket and push harder by hand because initial resistance is normal for new gaskets

39. A plumber encounters a residential building where the laundry room has a floor drain that receives the washing machine's discharge through a standpipe and also serves as the room's general floor drain. The standpipe is 2 inches in diameter and extends 750 mm above the floor. During a heavy wash cycle, water occasionally overflows the standpipe top. What is the most likely cause?

A. The standpipe diameter is inadequate for the washing machine's highvolume pump discharge rate during peak drain

B. The floor drain's trap is partially blocked, restricting the combined flow from the standpipe and the floor drain itself

C. The washing machine's pump discharge rate exceeds the building drain's capacity during the peak discharge cycle

D. The standpipe height is within the acceptable range but the horizontal branch pipe is partially blocked downstream

40. A plumber discovers that an existing building's DWV system has a 2inch vent serving a kitchen sink that is also connected to a dishwasher. The vent's total developed length from the trap arm to the roof terminal is 12 metres. The total DFU on this vent is 4 DFU (2 for the sink + 2 for the dishwasher). The code table shows that a 11/2inch vent at 12 metres accommodates 8 DFU. Is the 2inch vent oversized?

A. Yes — the 2inch vent is oversized for 4 DFU but oversizing a vent is not a code violation and causes no performance issues

B. No — the 2inch vent is the correct size because kitchen fixtures with dishwashers require a minimum 2inch vent

C. Yes — and the oversized vent must be reduced to 11/2 inches to maintain proper air velocity in the vent pipe

D. No — vents should always be at least the same size as the drain they serve for optimal pressure equalization

41. A plumber is installing a building drain that must change direction by 45 degrees. What fitting is used for this direction change on a horizontal drain?

A. A standard 45degree elbow, which is a DWV fitting that provides a gradual 45degree change in horizontal direction

B. A sanitary tee installed at a 45degree angle to redirect the flow from the original direction to the new direction

C. A combination wye and eighth bend, which provides a 90degree change that is twice the required 45 degrees

D. A 22.5degree elbow installed twice in sequence to achieve the cumulative 45degree direction change needed

42. A plumber is investigating a building where a rarely used guest bathroom on the second floor produces a strong sewer gas odour. The bathroom has a water closet, a lavatory, and a shower. The plumber checks all three traps and finds the lavatory and shower traps are dry — no water seal. The water closet trap has water (integral trap). What is causing the dry traps?

A. The building's HVAC system is creating excessive negative pressure that draws the trap seals out through siphonage

B. The lavatory and shower vents are blocked, causing the traps to lose their seals through induced siphonage events

C. A crack in the vent piping is allowing sewer gas to enter the bathroom through the wall cavity rather than through the traps

D. Evaporation — the guest bathroom is rarely used, and the lavatory and shower traps have dried out from nonuse over time

43. A plumber is sizing a horizontal branch drain for a commercial restroom with 4 urinals (2 DFU each) and 4 lavatories (1 DFU each). The total DFU is 12. No water closets connect to this branch. What is the minimum pipe diameter?

A. 11/2 inches, because no water closets are connected and the DFU total is within the 11/2inch capacity

B. 2 inches, because 12 exceeds 6 DFU for 2inch

C. 3 inches, because 12 DFU requires at least a 21/2inch pipe, but standard pipe sizes jump from 2 to 21/2 to 3 inches

D. 21/2 inches, which accommodates up to 12 DFU on a horizontal branch at code minimum slope for this pipe size

44. A plumber is installing a DWV system in a building addition that connects to the existing building's drainage system. The connection point is a wye fitting on the existing 4inch building drain. After connecting the new drainage to the existing system, the plumber must test only the new piping. How is the new section tested without affecting the existing system?

A. Install a test plug at the connection point between the new and existing systems, then pressurize only the new section for testing

B. Test the entire combined system (new and existing) together because the connection creates a single integrated system

C. Apply soap solution to only the new joints without pressurizing because the existing system's pressure tests the new section

D. The new section does not require testing because it connects to a previously tested and approved existing system

45. A plumber is installing a 4inch PVC soil stack through a firerated floor assembly. The floor has a 1hour fire rating. The plumber must install firestopping. However, the available firestop collar in the truck is rated for 2hour assemblies. Can this 2hour collar be used on the 1hour assembly?

A. No — using a 2hour collar on a 1hour assembly voids the fire rating because the collar is overspecified for the assembly

B. No — the collar must match the exact fire rating of the assembly; exceeding the rating creates a code violation

C. Yes — a 2hour rated firestop exceeds the 1hour assembly requirement and provides equal or greater protection

D. Yes — but only if the building inspector approves the substitution in writing before the collar is installed on the floor

46. A plumber discovers that a residential septic system's distribution box has settled and tilted toward one side. Three of the four outlet pipes are receiving effluent, but the fourth (highest) outlet receives none. What is the consequence for the disposal field?

A. The fourth trench receives no effluent and provides no treatment, while the three receiving trenches are overloaded

B. The disposal field functions normally because the three active trenches compensate for the inactive fourth trench

C. The septic tank upstream becomes overloaded because the tilted box reduces the total outlet capacity by 25%

D. The field functions at 75% capacity, which is within the design tolerance for a fourtrench disposal system layout

47. A plumber is installing a vent terminal through the roof and must flash the penetration to prevent water leakage. The roof has standingseam metal roofing. What type of flashing is appropriate for this roof type?

A. A standard rubber vent boot designed for asphalt shingle roofs that compresses over the metal seam at the penetration

B. A metal roof flashing specifically designed for standingseam roofs that clamps to the seam without penetrating the metal

C. A flat sheet of lead flashing bent and soldered around the vent pipe and sealed to the metal roof with silicone caulk

D. A universal PVC flashing that slides over the pipe and is glued to any roof type using roofing adhesive compounds

48. A plumber installs a cleanout on a 3inch horizontal branch drain. The cleanout is installed at a point where the branch changes direction by 90 degrees. The cleanout plug faces the upstream direction (toward the fixtures). A second cleanout facing downstream (toward the building drain) is not installed. Is this installation complete?

A. Yes — a single cleanout facing upstream provides adequate access for cleaning equipment in the upstream direction at this location

B. No — a twoway cleanout or separate downstream cleanout is needed to provide access in both directions from this point

C. Yes — the 90degree fitting itself provides inherent access in both directions without a second cleanout installation

D. No — cleanouts are not required at 90degree direction changes on 3inch branches per most plumbing code provisions

49. A plumber is installing a grease interceptor for a restaurant. The interceptor has an inlet from the kitchen drains and an outlet to the building sewer. The plumber must install the interceptor at the correct elevation. The inlet pipe enters the interceptor at a specific height, and the outlet pipe exits at a lower height. Why must the outlet be lower than the inlet?

A. The lower outlet prevents grease from reaching the outlet because grease floats above the outlet pipe's water level

B. The lower outlet creates a pressure differential that forces the wastewater through the grease separation chamber

C. The lower outlet provides the minimum slope required for gravity flow from the interceptor to the building sewer

D. The lower outlet is required by the interceptor manufacturer but has no functional purpose in the grease separation process

50. A plumber encounters a building where the 4inch building sewer has been installed using Schedule 40 PVC DWV pipe instead of the specified SDR 35 sewer pipe. Both pipes have the same 4inch nominal size. Is Schedule 40 PVC acceptable as a substitute for SDR 35 for building sewer use?

A. No — Schedule 40 has a different outside diameter than SDR 35 and is incompatible with sewer fittings and gaskets

B. No — Schedule 40 PVC is rated only for aboveground DWV applications and is prohibited for underground sewer use

C. Yes — but only if the Schedule 40 pipe is encased in concrete because its thinner wall requires additional protection

D. Yes — Schedule 40 has a thicker wall and higher pressure rating than SDR 35, making it an acceptable or superior substitute

51. A plumber installs a 3inch vent stack in a building. The stack must be tested before the walls are closed. The plumber caps the bottom of the vent, installs a test tee at the top, and pressurizes the vent with air at 35 kPa. After 15 minutes, the pressure has not dropped. Does this prove the vent has no leaks?

A. Yes — a 15minute air test at 35 kPa with no pressure drop confirms the vent piping is airtight and leakfree

B. No — the vent must also be watertested because air tests cannot detect hairline cracks that leak only under water pressure

C. Yes — but only if a soap solution was also applied to every joint during the test to visually confirm no bubble formation

D. No — the vent is part of the DWV system and must be tested as an integral part of the complete system, not separately

52. A plumber is installing a DWV system in a building where cast iron pipe is specified for the soil stack (for acoustic performance) and PVC is specified for the horizontal branches (for economy). At the connection between the PVC branch and the cast iron stack, what fitting and coupling method is used?

A. A PVCtocast iron solvent cement coupling that bonds both materials through a universal chemical fusion process

B. A reducing bushing hammered into the cast iron hub with a plastic adapter cemented to the PVC branch pipe

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

D. A lead and oakum caulked joint that seals the PVC spigot into the cast iron hub using traditional sealing methods

53. A plumber encounters a residential building where the homeowner has installed a grey water recycling system that collects washing machine and shower drainage for reuse in toilet flushing. The system has a storage tank, a pump, and purpleidentified distribution piping. What crossconnection concern exists with this installation?

A. The grey water storage tank must be located outdoors because grey water produces hydrogen sulfide gas indoors

B. The grey water pump must have a backflow preventer on its discharge to prevent grey water from entering the supply

C. The purple distribution piping must be labeled at 1metre intervals to identify it as nonpotable throughout the building

D. The grey water distribution piping must have no crossconnection to the potable water supply at any point in the system

54. A plumber installs a 4inch building drain beneath a basement floor slab. The drain must have a cleanout at the upstream end (near the soil stack) and another at the downstream end (near the foundation wall). Both cleanouts must be accessible at the finished floor surface. What extends from each cleanout to the floor surface?

A. A PVC pipe section cemented to the cleanout fitting with a removable plug at the top for maintenance access

B. A riser pipe extending from the cleanout fitting to the floor surface with a brass or stainless flushmount cover

C. A threaded steel pipe nipple extending from the cleanout to a surfacemounted cleanout cover plate at floor level

D. A flexible hose connecting the cleanout to a wallmounted access panel that provides remote access from the wall

55. A plumber is troubleshooting a commercial building where the grease interceptor's outlet discharges to the building sewer. The sewer video inspection shows a thick layer of grease coating the interior of the building sewer pipe for 10 metres downstream of the interceptor. What does this indicate about the interceptor's performance?

A. The interceptor is functioning normally — a thin grease layer in the sewer downstream is expected and acceptable

B. The interceptor needs a larger outlet pipe to reduce the velocity of the effluent and prevent grease from passing through

C. The interceptor is undersized, overdue for pumping, or has a failed baffle that allows grease to bypass the separation process

D. The building sewer pipe material is attracting grease due to its rough interior surface — the pipe should be relined

56. A plumber installs a sewage ejector system for a basement bathroom. The ejector pit has a sealed, gastight cover with a vent connection. The force main runs vertically 3 metres and connects to the gravity building drain above the flood level rim of the highest basement fixture. After installation, the plumber tests the system by flushing the basement toilet. The ejector activates and pumps successfully, but a gurgling sound is heard from the basement floor drain. What does this indicate?

A. The ejector pump is oversized and is creating excessive positive pressure in the sealed pit during the discharge cycle

B. The basement floor drain is connected to the same sealed pit, and the pump's discharge creates a vacuum that affects the drain

C. The vent connection on the ejector pit is undersized or blocked, preventing adequate air exchange during pump operation

D. The floor drain is not connected to the ejector system and the gurgling is caused by induced siphonage from the gravity system

57. A plumber installs a residential water heater with a 190litre (50gallon) tank. The heater's firsthour rating (FHR) is 250 litres. The homeowner's peak hour demand (based on the number of fixtures and occupants) is estimated at 200 litres. Is this water heater adequately sized?

A. No — the tank must store at least 200 litres to meet peak demand without relying on the recovery rate for supplementation

B. No — the FHR must be at least 1.5 times the peak demand (300 litres) to account for extendeduse periods and recovery

C. Yes — but only if the homeowner agrees to limit hot water use during the peak hour to 200 litres or less per day

D. Yes — the 250litre FHR exceeds the 200litre peak demand, meaning the heater delivers adequate hot water during peak use

58. A plumber is troubleshooting a residential water system. The homeowner reports that the water pressure is excellent in the morning but drops noticeably by midafternoon. All fixtures are affected equally. The PRV is functioning correctly. What is the most likely cause?

A. The water heater's thermostat drifts during the day, reducing the hot water pressure as the temperature decreases

B. The municipal supply pressure drops during daytime peak demand hours in the neighbourhood, reducing the building's supply

C. The PRV's spring weakens as it heats up during the day, allowing the outlet pressure to decrease gradually over hours

D. The building's supply piping develops air pockets during the day that restrict flow and reduce pressure at all fixtures

59. A plumber installs a reduced pressure (RP) backflow preventer in a mechanical room. The RP device must be installed in a specific orientation. What is the correct installation orientation for an RP assembly?

A. Horizontal, with the test cocks accessible and the relief valve discharge port facing downward for drainage

B. Vertical, with the inlet at the bottom and the outlet at the top for optimal check valve seating and relief drainage

C. Any orientation is acceptable because RP devices are designed to function in all installation positions and angles

D. Horizontal or vertical per the manufacturer's instructions — some models are approved for both orientations

60. A plumber discovers that a building's hot water recirculation pump is installed on the cold water supply line to the water heater instead of on the hot water return line. What effect does this incorrect installation have?

A. The pump pushes cold water through the heater at an increased rate, reducing the stored water temperature below the setpoint

B. The pump has no effect because it is moving water in the wrong direction — no recirculation occurs in the hot water loop

C. The pump forces cold water backward through the hot water distribution piping, mixing cold and hot water at every fixture

D. The pump operates normally because the water eventually reaches the heater and circulates through the system regardless

61. A plumber installs a water supply for a commercial building. The engineer specifies a 2inch water service from the municipal main. The service includes a 2inch water meter, a 2inch PRV, and a 2inch backflow preventer. Each device creates friction loss that reduces the available pressure. The total friction loss through these three devices is 100 kPa. The municipal pressure is 550 kPa. What is the available pressure downstream of all three devices?

A. 550 kPa, because the PRV compensates for the friction losses through the meter and backflow preventer automatically

B. 350 kPa, because the PRV setting (not the municipal pressure) determines the downstream pressure available

C. 650 kPa, because the friction losses are added to the municipal pressure to determine the downstream delivery pressure

D. 450 kPa, calculated as 550 kPa municipal minus 100 kPa friction loss through the three inline devices combined

62. A plumber is installing a residential water supply using PEX tubing. The homeowner asks whether the PEX can be installed outdoors, exposed to sunlight, for a section running along the exterior wall to reach an outdoor kitchen. What is the correct answer?

A. Yes — PEX is UVresistant and can be exposed to sunlight indefinitely without any degradation or performance loss

B. No — PEX degrades when exposed to UV radiation and must be protected from sunlight by shielding or painting

C. Yes — but only for runs shorter than 3 metres because UV degradation requires extended exposure over long distances

D. No — PEX is prohibited for all exterior installations regardless of UV exposure because it cannot withstand cold temperatures

63. A plumber tests a pressure vacuum breaker (PVB) on an irrigation system. The check valve holds and the air inlet opens correctly. The plumber reports the device passes. Before returning the device to service, what additional step is required?

A. Document the test results on a standardized report filed with the local authority having jurisdiction for annual records

B. Replace the internal components with a new factorysealed kit because testing wears the check valve and air inlet seals

C. Verify that the PVB is installed at least 300 mm above the highest sprinkler head in the irrigation system layout

D. Perform a second test after 24 hours to confirm the first test results are consistent and not a onetime passing result

64. A plumber discovers that a residential water heater has been installed with the cold water inlet on top and the hot water outlet on the bottom — the piping connections are reversed from the manufacturer's intended configuration. The heater appears to function. What is the consequence of this reversed connection?

A. No consequence — the water heater functions identically regardless of which port serves as the inlet or outlet

B. The heater delivers lukewarm water because the hot water outlet draws from the bottom where the heater cannot stratify effectively

C. The reversed connections create a crossconnection between the hot and cold supply systems within the building

D. The heater's thermostat reads the wrong zone of the tank, causing it to cycle incorrectly and overheat the water

65. A plumber is sizing a water supply for a residential building with a well pump. The well produces 20 litres per minute (5 GPM). The household peak demand is 40 litres per minute (10.5 GPM). The pressure tank drawdown volume is 50 litres. How long can the household operate at peak demand before the pressure tank is depleted?

A. Approximately 5 minutes, calculated by dividing the peak demand by the tank's total volume including dead storage

B. 10 minutes, calculated by dividing the tank drawdown by the well's yield rate for the maximum run time available

C. Approximately 1 minute, calculated by dividing the tank drawdown by the difference between demand and well yield

D. Approximately 2.5 minutes, because the tank provides 50 litres while the well supplements at 20 LPM during drawdown

66. A plumber installs a commercial water heater and must verify the T&P relief valve's discharge pipe routing. The code requires the discharge pipe to terminate in a specific manner. Which of the following termination methods is codecompliant?

A. Into a bucket placed beneath the discharge pipe that the maintenance staff empties on a scheduled basis weekly

B. Visible termination 150 mm above the floor or through an exterior wall 150 mm above grade, pointing downward

C. Connected to the building's sanitary drain through a Ptrap to prevent sewer gas from entering the discharge pipe

D. Into a recirculation line that returns the discharged water to the water heater's cold inlet for energy recovery

67. A plumber discovers that a building's copper water supply has bluegreen staining at the base of every faucet and around drain openings. The water supply is from a private well. Water testing shows a pH of 5.8 and no detectable chlorine. What is causing the staining?

A. The bluegreen staining is caused by copper dissolved from the piping by the acidic (low pH) well water attacking the copper

B. The staining is a normal cosmetic effect of copper piping and requires no treatment or investigation for the water supply

C. The staining indicates excessive chlorine in the water supply that is oxidizing the copper fixtures at each outlet point

D. The staining is caused by bacteria in the well water that produce a bluegreen biofilm at every water contact surface

68. A plumber is installing a dedicated pressurereducing valve on a branch supplying a commercial espresso machine. The PRV is set to 275 kPa (40 psi). The main building supply pressure is 415 kPa (60 psi). After installation, the plumber opens a hot water fixture downstream of the PRV and the pressure gauge shows 415 kPa — the PRV is not reducing. What is the most likely cause?

A. The PRV's adjustment mechanism has not been turned to the correct setting after installation on the branch pipe

B. The PRV requires a minimum flow rate to activate its pressurereducing mechanism — static testing shows full pressure

C. The PRV is installed correctly but needs 24 hours of system pressure to compress the internal spring to the set point

D. The PRV is installed backward — the inlet and outlet are reversed, allowing full unregulated pressure to pass through

69. A plumber installs a water heater with a powered anode rod and an expansion tank. The system has a PRV on the service. Six months later, the homeowner reports that the expansion tank feels completely solid when tapped (no hollow sound). The T&P valve has not discharged. What should the plumber check?

A. The powered anode's electrical connection, which may be producing electrolysis that corrodes the expansion tank internally

B. The PRV, which may have failed open and is allowing municipal pressure to compress the expansion tank's air charge

C. The expansion tank's diaphragm, which may have ruptured — water has filled both sides and the tank is waterlogged

D. The water heater's thermostat, which may be set too high and is creating excessive thermal expansion that overwhelms the tank

70. A plumber is troubleshooting a commercial building's water supply system. The building has a booster pump serving upper floors. During a fire alarm test, the fire department connection (FDC) is charged by the fire truck. Water from the FDC enters the building's fire sprinkler system. The building's domestic water pressure drops dramatically during the FDC charge. What causes this pressure drop?

A. The FDC charge draws water from the domestic supply through a crossconnection between the sprinkler and domestic systems

B. The fire truck's pump creates a negative pressure on the municipal main that affects all buildings on the same supply main

C. The FDC charge is flowing backward through the sprinkler system's backflow preventer into the domestic supply piping

D. The municipal main pressure drops when the fire truck draws large volumes for the FDC charge, reducing supply to the building

71. A plumber installs a residential water supply system with a wholehouse sediment filter immediately after the water meter. The filter housing has a bypass valve that allows water to flow around the filter during cartridge replacement. If the bypass valve is left in the bypass position after cartridge replacement, what happens?

A. The water supply functions normally but all water bypasses the filter, delivering unfiltered water to all building fixtures

B. The water supply pressure doubles because the bypass provides a parallel flow path that reduces total system friction

C. The bypass valve has no effect on water quality because the filter cartridge continues to function even in bypass mode

D. The water supply is blocked entirely because the bypass valve position prevents flow in both the filter and bypass directions

72. A plumber is sizing the hot water supply for a commercial building with multiple fixture types. The engineer's fixture schedule lists each fixture's hot water WSFU value. After totaling the hot water WSFU, the plumber converts the total to litres per minute using the demand curve. The result is the probable peak hot water demand. What does this value represent?

A. The maximum possible flow rate if every hot water fixture in the building opens fully at the same instant in time

B. The average daily hot water consumption divided by the operating hours for the building's expected occupancy schedule

C. The minimum flow rate the water heater must deliver at all times to prevent any fixture from receiving inadequate hot water

D. The estimated maximum simultaneous hot water flow during a typical peak use period based on statistical probability

73. A plumber discovers that a building's domestic water heater has no expansion tank, no PRV on the service, and no check valve anywhere in the system. The system is connected directly to the municipal main. Does this system require an expansion tank?

A. Yes — all water heaters require expansion tanks regardless of whether the system is open or closed to the municipal main

B. No — expansion tanks are only required in closed systems; this system can relieve thermal expansion back to the main

C. Yes — but only if the water heater's storage capacity exceeds 150 litres because smaller tanks produce less expansion

D. No — but one should be installed as a best practice to protect the T&P valve from unnecessary cycling over the heater's life

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

A. A DCVA (double check valve assembly), because a wet sprinkler system without chemical additives is a minor hazard

B. An RP device matching the domestic supply because both connections serve the same building from the same main

C. No backflow prevention because wet fire sprinkler systems use only clean potable water with no chemical additives

D. An atmospheric vacuum breaker at the highest point of the sprinkler riser above the roof level of the building

75. A plumber installs a residential water service using Type K soft copper from the curb stop to the building entry. The trench depth is 1.8 metres (6 feet). The plumber installs the pipe in a single continuous run from a coil. After backfilling, the plumber discovers that no tracer wire was installed. Why is the tracer wire important for a nonmetallic or copper water service?

A. The tracer wire provides cathodic protection for the copper pipe against corrosion from acidic or alkaline soil chemistry

B. The tracer wire allows the water service to be located from the surface using electronic pipe locating equipment

C. The tracer wire is required only for nonmetallic (plastic) water services because metal services are selflocatable

D. The tracer wire provides a ground path for the building's electrical system through the water service connection

76. A plumber installs a commercial lavatory with a selfclosing faucet in a public washroom. The faucet runs for 10 seconds per activation. After 3 months of service, the faucet begins running for only 2 seconds before shutting off. What component has most likely degraded?

A. The faucet's solenoid valve has partially seized, restricting the volume of water delivered during each activation cycle

B. The water supply pressure has increased, causing the selfclosing mechanism to cycle faster than its designed duration

C. The selfclosing cartridge's timing mechanism has worn — the spring or timing piston no longer holds the valve open as long

D. The faucet aerator has become clogged with mineral deposits, reducing the flow rate and triggering an early shutoff

77. A plumber is replacing a residential water closet. The existing closet flange is cast iron and is in good condition. The flange is set at the correct height — flush with the finished floor surface. The plumber installs a new wax ring and sets the toilet. After installation, the plumber pushes on the toilet bowl and it rocks side to side. What is causing the rocking?

A. The finished floor surface is uneven beneath the toilet base, creating a gap on one side that allows the bowl to rock

B. The wax ring is the wrong size for the closet flange diameter and is pushing the toilet up from the flange surface

C. The closet bolts are too long and are bottoming out in the flange slots before the bowl fully compresses the wax ring

D. The cast iron flange has corroded internally and has lost its structural integrity even though it appears intact visually

78. A plumber services a commercial tankless water heater in a restaurant. The heater displays an error code indicating "scale buildup" on the heat exchanger. The restaurant is in an area with very hard municipal water (25 grains per gallon). What maintenance is required?

A. Replace the entire heat exchanger assembly because scale cannot be removed once it has accumulated on the surfaces

B. Flush the heat exchanger with a vinegar solution (or manufacturerrecommended descaling agent) to dissolve the scale

C. Increase the water heater's gas input to burn through the scale layer and restore heat transfer across the exchanger

D. Descale the heat exchanger by circulating a mild acid solution through it using a pump and bucket recirculation setup

79. A plumber installs a residential water softener. The homeowner has a tankless water heater downstream of the softener. After installation, the tankless heater displays an error code for low flow. Before the softener was installed, the heater functioned normally. What is causing the lowflow error?

A. The water softener reduces the water pressure significantly during regeneration cycles, triggering the lowflow sensor

B. The water softener's bypass valve was left partially in the bypass position, restricting flow to the tankless heater

C. The water softener is oversized for the home and is restricting flow due to excessive pressure drop through the large resin bed

D. The softener's internal flow restriction or an undersized pipe connection between the softener and heater is limiting flow

80. A plumber is installing a residential fire sprinkler system (NFPA 13D) using a multipurpose PEX piping layout. The system shares piping with the domestic cold water supply. A flow switch is installed on the sprinkler riser to activate an alarm when a sprinkler head opens. What does the flow switch detect?

A. The temperature increase at the sprinkler riser when a fire raises the ambient temperature above the alarm threshold

B. The pressure drop in the sprinkler system when a head activates and begins discharging water to suppress the fire

C. Water flow movement in the riser pipe that occurs when a sprinkler head activates and water begins flowing

D. The vibration of the riser pipe caused by the impact of water on the deflector plate of the activated sprinkler head

81. A plumber discovers that a residential water heater's anode rod port is located at the top of the tank beneath the hot water outlet nipple — a combination fitting that incorporates both the anode rod and the hot water outlet in a single unit. The ceiling height above the heater is only 1.8 metres. The standard anode rod is 1.2 metres long. Can the rod be replaced?

A. Yes — but a segmented (folding) anode rod must be used because the fulllength rod cannot be pulled straight up in the limited space

B. No — the limited ceiling clearance makes anode rod replacement impossible without removing the water heater from its position

C. Yes — the anode rod can be bent during removal and a new rod can be bent during insertion without affecting its performance

D. No — but a powered anode rod (which is shorter) can be installed in the same port as a permanent replacement solution

82. A plumber installs a wholehouse UV disinfection system on a private well supply. The system is installed after the sediment filter, carbon filter, and water softener. The UV chamber has a flow rate rating of 30 litres per minute. The home's peak demand is 35 litres per minute. Is the UV system adequately sized?

A. Yes — UV systems are effective at any flow rate because the UV light intensity remains constant regardless of flow speed

B. Yes — the 5 LPM excess flow receives reduced UV exposure but still achieves adequate disinfection for residential use

C. No — but the UV system can be supplemented with a pointofuse chlorine tablet dispenser for peak demand overflow

D. No — the UV system is undersized because flow above 30 LPM reduces the UV contact time below the minimum for disinfection

83. A plumber is troubleshooting a residential water system where the hot water has a rotten egg (hydrogen sulfide) smell. The cold water has no odour. The water supply is municipal (chlorinated). The water heater has a magnesium anode rod. What is the most effective longterm solution?

A. Increase the water heater thermostat to 71°C (160°F) to kill the sulfatereducing bacteria and sterilize the tank

B. Replace the magnesium anode rod with an aluminumzinc anode rod that does not react with the bacteria to produce H_2S

C. Flush the water heater tank with chlorine bleach to kill the bacteria and reinstall the same magnesium anode rod

D. Install a pointofuse activated carbon filter on the hot water line at each fixture to adsorb the hydrogen sulfide

84. A plumber installs a new kitchen faucet with an integrated pulldown sprayer. The faucet has a singlehandle ceramic disc cartridge. After installation, the faucet handle operates correctly but the pulldown sprayer has very low water pressure — significantly less than the faucet spout in the fixed position. What is the most likely cause?

A. The sprayer hose has a kink or restriction beneath the counter that limits flow only when the sprayer is extended

B. The faucet's internal diverter valve that redirects flow from the spout to the sprayer hose is partially blocked or defective

C. The sprayer nozzle head has a factoryinstalled flow restrictor that limits flow more aggressively than the main spout aerator

D. The water supply pressure is too low for the sprayer function — the sprayer requires higher pressure than the fixed spout mode

85. A plumber is installing a commercial hand sink in a food preparation area. The health code requires the sink to have a mixing faucet capable of delivering tempered water (neither scalding hot nor uncomfortably cold) for effective handwashing. What temperature range is considered appropriate for handwashing?

A. 38°C to 43°C (100°F to 110°F), which provides comfortable handwashing temperature without scalding risk

B. 60°C (140°F), matching the water heater storage temperature to provide maximum sanitizing effectiveness

C. 10°C to 15°C (50°F to 59°F), using only cold water to avoid any possibility of scalding in the food service area

D. 49°C to 55°C (120°F to 131°F), using the maximum codepermitted hot water temperature for commercial sinks

86. A plumber discovers that a residential water heater's T&P relief valve has been replaced with a standard pressure relief valve (no temperature sensing capability). The standard pressure valve is set to the same 1,035 kPa (150 psi) as the original T&P valve. Is this substitution acceptable?

A. Yes — the pressure relief function is the primary safety feature and the temperature sensing is a secondary backup

B. Yes — but only if the water heater has a separate highlimit temperature control that provides independent overtemperature protection

C. No — but the standard pressure relief valve provides adequate protection as long as the thermostat functions correctly

D. No — the T&P valve must sense both temperature AND pressure; a pressureonly valve cannot protect against overtemperature conditions

87. A plumber services a residential reverse osmosis (RO) system. The homeowner reports that the RO faucet delivers water with a noticeable plastic taste that was not present before. The RO system is 5 years old. What is the most likely cause?

A. The RO membrane has degraded and is leaching plastic compounds from its deteriorating material into the purified water

B. The storage tank's bladder has deteriorated over 5 years and is imparting a plastic taste to the stored purified water

C. The postcarbon filter has been in service too long and is releasing carbon fines that taste like plastic to the homeowner

D. The incoming water supply has developed a new chemical compound that the RO membrane cannot remove effectively

88. A plumber is replacing a flapper on a residential toilet. The new flapper is a universal model that fits most toilet flush valves. After installation, the toilet occasionally phantomflushes — the fill valve runs briefly every 30–45 minutes without being activated. What is causing the phantom flush?

A. The new flapper is not compatible with this specific toilet model and does not seat properly on the flush valve opening

B. The universal flapper does not seal as tightly as the OEM flapper, allowing a slow leak that triggers the fill valve periodically

C. The fill valve has a defective float mechanism that drops periodically and triggers a brief refill cycle on its own

D. The tank's overflow tube is cracked below the water line, slowly draining tank water and triggering the fill valve

89. A plumber installs a commercial dishwasher with a builtin booster heater. The dishwasher requires a 60°C (140°F) minimum incoming hot water temperature for the wash cycle and 82°C (180°F) for the sanitizing rinse. The building's hot water supply is only 54°C (130°F). Will the dishwasher function correctly?

A. The booster heater may not achieve the 82°C sanitizing rinse temperature because it is designed to boost from 60°C, not from 54°C

B. Yes — the booster heater will compensate for the 6°C deficit and produce the required temperatures for both cycles

C. No — the dishwasher will not operate at all because the 54°C supply is below the minimum activation temperature

D. Yes — but the wash cycle will be extended to compensate for the lower starting temperature during each load

90. A plumber is troubleshooting a residential electric water heater that produces no hot water at all. The circuit breaker is on and has not tripped. The plumber tests for voltage at the upper thermostat and finds 240V present. The plumber tests for voltage at the upper heating element terminals and finds 0V. What has failed?

A. The upper heating element has burned out and needs replacement to restore hot water production immediately

B. The upper thermostat has failed and is not sending voltage to the upper element despite receiving 240V supply power

C. The highlimit reset button on the upper thermostat has tripped and must be reset before voltage reaches the element

D. The upper thermostat is functioning but the wiring between the thermostat and element has an open connection or break

91. A plumber installs a residential water softener on a well water supply. The well water test shows 20 grains per gallon hardness and 3 ppm iron. The softener manufacturer's specifications state the unit can remove up to 25 gpg hardness and up to 3 ppm iron simultaneously. After installation, the softener removes the hardness but the iron level in the treated water remains at 2 ppm. What is the problem?

A. The softener's resin bed is fouled with iron that it cannot release during regeneration, reducing its iron removal effectiveness

B. The iron in the well water is in the oxidized (ferric) form, which the softener's ion exchange resin cannot remove effectively

C. The softener is regenerating too frequently, not allowing enough contact time for the resin to capture the dissolved iron

D. The well water's iron concentration has increased above the softener's rated 3 ppm capacity since the original water test

92. A plumber installs a hydronic heating system with a condensing boiler. The system has four zones: two radiant floor zones (35°C supply) and two baseboard zones (75°C supply). A buffer tank is installed between the boiler and the distribution manifold. What primary function does the buffer tank serve in this multitemperature system?

A. The buffer tank stores domestic hot water for the building's showers and faucets as a dualpurpose heating/DHW system

B. The buffer tank provides thermal mass that prevents boiler shortcycling and allows multiple temperature zones to draw simultaneously

C. The buffer tank eliminates the need for mixing valves on the radiant floor zones by premixing to the lower temperature

D. The buffer tank separates the boiler water from the distribution water to prevent crosscontamination between circuits

93. A plumber discovers that a hydronic boiler's circulator pump is extremely hot to the touch — far hotter than normal. The pump is running and producing its normal humming sound. The system pressure is normal. What is the most likely cause?

A. The pump is airlocked — the impeller is spinning in an air pocket rather than pumping water, causing the motor to overheat from lack of cooling

B. The pump motor's internal cooling fan has failed, causing the motor to overheat even though the pump moves water normally

C. The pump is running backward due to reversed wiring, which reduces efficiency and causes excessive motor heating

D. The pump's bearing has seized partially, increasing friction and generating excessive heat at the bearing surface

94. A plumber is commissioning a twopipe steam heating system. After the boiler fires and steam is produced, the plumber observes that several radiators heat fully while others remain cold. The cold radiators are located on both floors of the building — the pattern is not related to distance from the boiler. What is the most likely cause?

A. The steam supply valve on each cold radiator is closed — verifying that each valve is fully open is the first diagnostic step

B. The steam traps on the cold radiators have failed in the closed position, preventing condensate from draining and new steam from entering

C. The cold radiators' thermostatic air vents have failed in the closed position, trapping air that prevents steam from entering

D. The boiler's pressuretrol is set too low and cannot produce enough steam pressure to reach all radiators in the building

95. A hydronic heating system has been operating normally for 5 years. The plumber is called because the system pressure gradually drops from the correct coldfill pressure (103 kPa) to approximately 70 kPa over a 2week period. The automatic fill valve maintains the pressure for a day or two, then the pressure drops again. What does this indicate?

A. The expansion tank has lost its air precharge and must be recharged or replaced to maintain stable system pressure

B. The automatic fill valve is functioning correctly by maintaining pressure — the gradual drop is normal system behavior

C. The boiler's circulator pump is creating a lowpressure zone at its suction that draws the gauge reading down over time

D. The system has a slow leak — the fill valve temporarily restores pressure, but the leak causes it to drop again over time

96. A plumber installs a hydronic system with a modulating condensing boiler. The boiler's modulation range is 10:1, meaning it can fire from 10% to 100% of its rated capacity. What advantage does this wide modulation range provide?

A. The 10:1 range eliminates the need for a buffer tank because the boiler can match any load without shortcycling

B. The 10:1 range allows the boiler to precisely match its output to the building's actual heat demand at any given moment

C. The 10:1 range enables the boiler to produce both steam and hot water from the same heat exchanger simultaneously

D. The 10:1 range allows the boiler to operate as both a heating boiler and a domestic water heater without additional equipment

97. A plumber discovers that a onepipe steam system's main vent at the end of the steam supply main is hissing loudly during system startup. After 10 minutes, the hissing stops and the main vent closes. Is this normal operation?

A. Yes — the main vent opens to release air from the supply main as steam pushes the air ahead of it, then closes when steam arrives

B. No — the loud hissing indicates the main vent is oversized and should be replaced with a smaller, quieter vent unit

C. Yes — but the 10minute hissing duration is too long and indicates the steam supply main is undersized for the load

D. No — the main vent should open silently and the hissing indicates internal damage to the vent's thermostatic element

98. A plumber is troubleshooting a hydronic system where the expansion tank's Schrader valve releases air when pressed (confirming the air charge is present) but the T&P valve on the water heater discharges during every heating cycle. The expansion tank precharge matches the coldfill pressure. What should the plumber check next?

A. The expansion tank may be undersized for the system's total water volume — verify the tank size calculation against the actual system volume

B. The T&P valve itself may be faulty — its spring may have weakened and it is opening below its rated pressure setting

C. The water heater's thermostat may have drifted above the setpoint, heating the water to nearboiling temperatures

D. The expansion tank may be undersized or the system volume may have increased — check whether the tank matches the current system

99. A plumber installs a hydronic system using PEX tubing for the distribution piping. The PEX connects to the boiler through a copper manifold. After 3 years of operation, the plumber discovers oxygen corrosion (rust) on the boiler's steel components. What is the most likely cause?

A. The PEX tubing is not an oxygenbarrier type — standard PEX allows oxygen to permeate through the wall into the system water

B. The copper manifold is generating oxygen through electrolysis that is corroding the downstream steel boiler components

C. Air is entering the system through a leak at the manifoldtoPEX transition fittings during system pressure fluctuations

D. The system water was not treated with corrosion inhibitor during the initial fill and the existing oxygen was never consumed

100. A plumber is commissioning a new radiant floor heating system. The PEX loops are embedded in a concrete slab that was poured 14 days ago. The building owner wants to fire the boiler immediately to begin heating the building. Should the plumber comply?

A. Yes — but the supply water temperature must be limited to a maximum of 25°C for the first 3 days, then gradually increased to operating temperature over the following week to prevent thermal shock to the curing concrete

B. No — the radiant system must not be activated until the concrete has fully cured for a minimum of 28 days to prevent cracking

C. Yes — the radiant system can be fired at full operating temperature immediately because the PEX tubing is embedded and protected

D. No — but the system can circulate water at room temperature to begin drying the slab without applying any heat from the boiler

101. A twopipe steam system has a condensate return pump that activates when the receiver reaches the highwater float level. The plumber observes that the pump runs for 5 seconds, shuts off, then immediately restarts. This rapid onoff cycling continues. What is the cause?

A. The pump motor is oversized and evacuates the receiver too quickly, causing the float to drop before the pump builds pressure

B. The pump's check valve on the discharge is leaking — pumped condensate flows backward into the receiver as soon as the pump stops

C. The receiver's highwater float switch is stuck in the "on" position and is continuously energizing the pump motor circuit

D. The pump's impeller is worn and cannot develop adequate pressure to push condensate to the boiler against the static head

102. A plumber is installing a hydronic system with an aluminum heat exchanger boiler. The manufacturer prohibits the use of copper piping in the system. However, the existing distribution piping is all copper. What solution allows the new aluminum boiler to connect to the existing copper piping?

A. A stainless steel plate heat exchanger that hydraulically separates the boiler (aluminum) circuit from the copper distribution circuit

B. Dielectric unions at every aluminumtocopper connection that electrically isolate the two metals from galvanic corrosion

C. A chemical water treatment program that raises the pH to 9.0 and adds a corrosion inhibitor to protect the aluminum

D. A buffer tank with separate internal coils that transfers heat between the boiler circuit and the distribution circuit without mixing the water

103. A plumber discovers that a hydronic system's zone valve motor buzzes loudly when the thermostat calls for heat, but the valve does not open. The plumber checks the voltage at the valve motor terminals and reads 24V AC. What is the most likely cause?

A. The 24V transformer powering the zone valve system is producing insufficient current (amperage) to operate the motor

B. The valve motor has a seized gear mechanism — it receives power but cannot drive the valve stem to the open position

C. The zone valve's motor winding has failed (open coil) and the buzzing sound is electrical arcing at the terminal connections

D. The thermostat is sending an intermittent signal that energizes the motor briefly but does not sustain power for full opening

104. A plumber installs a condensing boiler with a PVC vent that runs horizontally 4 metres through an exterior wall. The vent terminates outside the building with a downwardfacing elbow. In winter, the plumber notices ice forming at the vent terminal where the warm exhaust meets the cold outdoor air. Is this ice formation a problem?

A. Yes — the ice can gradually grow inward and block the vent opening, causing the boiler to shut down on a venting fault

B. No — ice formation at the vent terminal is normal in cold climates and the boiler's inducer fan can push through minor ice

C. Yes — but only if the ice extends more than 50 mm from the terminal face into the vent pipe's interior opening area

D. No — the downwardfacing elbow prevents ice from blocking the vent because any ice formation falls away by gravity

105. A plumber is balancing a hydronic heating system with three zones. After balancing, the plumber records the following data: Zone 1 supply = 75°C, return = 63°C (ΔT = 12°C); Zone 2 supply = 75°C, return = 65°C (ΔT = 10°C); Zone 3 supply = 75°C, return = 60°C (ΔT = 15°C). The design ΔT is 11°C. Which zone(s) need adjustment?

A. All three zones need adjustment because none matches the design ΔT of 11°C within acceptable tolerance

B. Zone 2 only — its ΔT is too low (too much flow) and its balancing valve should be partially closed to reduce flow

C. Zone 3 only — its ΔT is too high (too little flow) and its balancing valve should be opened further to increase flow

D. Zone 2 and Zone 3 both need adjustment — Zone 2's valve needs partial closing and Zone 3's valve needs opening

106. A steam boiler's safety relief valve must be sized to handle the boiler's maximum steam generation rate. If the boiler's maximum input is 100,000 BTU/hr and the steam generation efficiency is approximately 80%, approximately how many BTU/hr of steam does the safety valve need to relieve?

A. 100,000 BTU/hr, because the safety valve must be sized for the full input rating, not the net output of the boiler

B. 80,000 BTU/hr, because only the steam energy (80% of input) needs to be relieved through the safety valve

C. 120,000 BTU/hr, because a 20% safety margin is added to the maximum input rating for the valve sizing calculation

D. 50,000 BTU/hr, because the safety valve only needs to relieve 50% of the maximum steam generation capacity

107. A plumber installs a hydronic heating system and fills it with a 30% propylene glycol solution for freeze protection. The glycol manufacturer specifies that the system must be pressuretested before adding glycol. Why must the pressure test be performed with water before glycol is added?

A. Glycol is compressible and cannot provide a reliable pressure test result because it absorbs the test pressure energy

B. Glycol is too expensive to waste on a system that might fail the test and require draining for leak repairs

C. Glycol damages the pressure test gauge's internal mechanism and produces inaccurate readings during the test

D. A glycol leak during testing is a slip hazard and an environmental concern that must be avoided during the test phase

108. A medical gas system's zone valve box is located in the corridor outside a surgical suite. A nurse discovers that the zone valve for oxygen has been accidentally closed during routine cleaning. What is the immediate action?

A. Reopen the oxygen zone valve immediately and verify that oxygen is flowing at all outlets in the surgical suite

B. Call the facilities manager to authorize reopening the valve because only designated staff may operate zone valves

C. Leave the valve closed and notify the surgical team to use portable oxygen cylinders until the next maintenance cycle

D. Reopen the valve but have a medical gas technician test every outlet in the zone for gas identity and flow before use

109. A plumber is installing a compressed air system for an automotive body shop. The system must deliver oilfree, dry air for paint spray operations. The compressor is a rotary screw type with oil injection. What treatment is required to achieve oilfree air quality from this oillubricated compressor?

A. No treatment is needed because rotary screw compressors produce inherently oilfree air regardless of oil injection

B. A coalescing filter at each paint gun removes sufficient oil for paint spray quality without additional system treatment

C. An oilfree compressor must replace the oillubricated unit because oilinjected air cannot be treated to oilfree quality

D. A multistage treatment system including coalescing filters, refrigerated dryer, and activated carbon adsorber removes oil to paintgrade quality

110. A plumber is installing a residential swimming pool circulation system. The pool has a main drain at the bottom, two skimmers at the waterline, and four return inlets on the walls. The suction piping connects the main drain and skimmers to the pump inlet. The code requires dual main drains. Why?

A. Dual main drains provide twice the filtration capacity by doubling the suction flow rate from the pool bottom

B. Dual main drains prevent entrapment by distributing suction across two drains, eliminating the singledrain suction hazard

C. Dual main drains are required for chemical distribution because they create a more uniform circulation pattern

D. Dual main drains provide a backup in case one drain becomes clogged with debris during pool operation

111. A medical gas system installer discovers that a section of copper tube intended for the vacuum system was accidentally used for the medical air system. The vacuum system uses a different cleanliness standard than the medical air system. The error is discovered before any gas has been connected. What must be done?

A. The tube can remain in the medical air system because both vacuum and medical air tubes meet the same cleanliness standard

B. The tube must be removed and replaced with tube certified for medical air service to ensure correct system identification

C. The tube can be flushed with nitrogen and redesignated for medical air service without replacement or removal

D. The tube must be removed from the medical air system because vacuumgrade tube does not meet the cleanliness standard for breathable gas

112. A plumber is installing an irrigation system with a master valve. The master valve is installed after the backflow preventer and before the zone valve manifold. What function does the master valve serve?

A. The master valve shuts off the entire irrigation system's water supply automatically when the controller is not running any zone

B. The master valve regulates the irrigation system's water pressure to prevent overloading the zone valves downstream

C. The master valve provides backflow prevention that supplements the primary backflow preventer on the supply line

D. The master valve serves as the emergency shutoff for the irrigation system that can be operated manually by the homeowner

113. A plumber discovers that a swimming pool's salt chlorine generator cell has reached the end of its service life after 5 years. The cell electrodes are heavily worn and the generator's output has dropped below the minimum effective chlorine production level. What determines the cell's lifespan?

A. The cell's lifespan depends on the pool's water chemistry — improper pH, low salt, and lack of cleaning accelerate wear

B. The cell's lifespan is fixed at exactly 5 years by the manufacturer and cannot be extended by any maintenance program

C. The cell's lifespan depends solely on the total operating hours — running the generator longer each day shortens the lifespan

D. The cell's lifespan depends on the total number of gallons of water processed through the cell since initial installation

114. A plumber is connecting a natural gas supply to a commercial rooftop HVAC unit. The gas line runs from the interior meter through the roof to the rooftop unit. The exposed rooftop section is 10 metres long. What pipe material is commonly used for the exposed rooftop gas line?

A. PVC Schedule 40, which is UVresistant and provides a lightweight option for rooftop gas piping installations

B. Black steel pipe with threaded joints and protective coating against weather, UV, and corrosion for outdoor exposure

C. Copper Type L with soldered joints, which provides a lightweight and corrosionresistant option for all outdoor applications

D. CSST (Corrugated Stainless Steel Tubing) with a UVresistant jacket designed specifically for outdoor gas installations

115. A plumber is winterizing a commercial irrigation system with 15 zones using a compressed air blowout method. The compressor delivers 85 CFM at 345 kPa (50 psi). Each zone requires approximately 2 minutes of air flow to evacuate water. After blowing out 8 zones, the plumber notices the compressor is struggling to maintain pressure and the air flow seems weaker. What is the most likely cause?

A. The compressor has been running continuously for 16 minutes and needs time to cool down and rebuild its internal air reserve

B. The compressor's air intake filter is clogged with dust and debris, restricting the volume of air entering the compressor

C. The compressor is overheating from continuous operation and its thermal protection is reducing output to prevent damage

D. The remaining zones are larger than the first 8 zones and require more air volume than the compressor can deliver

116. A medical gas system's final verification includes outlet labeling inspection. The verifier discovers that one outlet in a patient room is labeled "Medical Air" but the DISS connector is an oxygen connector (DISS 1240). What must be done?

A. Both the label and the DISS connector must be corrected to match the gas that the piping actually delivers to the outlet

B. Only the label needs correction because the DISS connector physically prevents wronggas connections regardless

C. Only the DISS connector needs replacement because the label correctly identifies the gas the piping is intended to deliver

D. The outlet must be removed entirely and the piping must be traced back to the source to determine which gas it carries

117. A plumber is installing a compressed air system and must determine the correct pipe diameter for a 20metre branch line serving a single pneumatic nail gun. The nail gun requires 3 CFM at 620 kPa (90 psi). Using the manufacturer's pipe sizing chart, a 3/8inch pipe at 20 metres with 3 CFM demand produces a pressure drop of 15 kPa. The maximum allowable pressure drop is 35 kPa. Is 3/8inch pipe adequate?

A. No — the 15 kPa pressure drop is below the maximum but a minimum 1/2inch pipe is required for all branch lines

B. No — the 15 kPa drop is acceptable at the tool but the branch must also account for fittings that add equivalent length

C. Yes — but only if no other tools are added to this branch in the future because the pipe has no capacity for expansion

D. Yes — the 15 kPa pressure drop is well below the 35 kPa maximum allowable, providing adequate pressure at the tool

118. A swimming pool system has a variablespeed pump programmed for three speeds. Speed 1 (low) runs 12 hours per day for filtration. Speed 2 (medium) runs during heating cycles. Speed 3 (high) runs during vacuuming. The homeowner asks why the pump runs at low speed for 12 hours instead of high speed for 4 hours. Both would turn over the same volume of water. What is the advantage of low speed for longer duration?

A. Low speed produces less turbulence that would stir up settled debris from the pool floor during filtration cycles

B. Low speed for 12 hours consumes approximately 75% less energy than high speed for 4 hours due to the affinity laws

C. Low speed provides better filtration because the slower flow through the filter captures finer particles more effectively

D. Low speed reduces noise from the pump and equipment pad, which is a consideration for residential pool installations

119. A plumber is installing a process piping system in a dairy processing facility. The specification calls for 3A sanitary standards compliance. What does 3A certification ensure about the piping system?

A. The piping materials, fittings, and joints meet sanitary design criteria for cleanability and bacterial prevention in food processing

B. The piping system has been pressuretested at three times the working pressure for the maximum safety margin

C. The piping has been inspected by three independent authorities before being certified for foodcontact service

D. The piping system uses a tripleseal connection at every joint for three layers of protection against product leakage

120. A plumber discovers that a swimming pool's heater has a copper heat exchanger that shows green corrosion (patina) on its exterior tubes. The pool chemistry log shows the pH has been consistently maintained between 7.2 and 7.6 for the past year. What could cause the external corrosion on a heater in a wellmaintained pool?

A. Condensation from the combustion gases inside the heater is condensing on the cool exterior of the heat exchanger tubes

B. The pool's salt chlorine generator is producing chlorine that attacks the copper heat exchanger from the water side

C. Moisture in the combustion air is condensing on the heat exchanger exterior during the heater's offcycle periods

D. The pool chemistry log is accurate but does not reflect temporary pH drops during chemical addition that attack the copper

121. A plumber is connecting a propane gas supply to a residential pool heater located outdoors. The gas supply line from the propane tank is PE (polyethylene) pipe buried underground. At the pool heater, the PE pipe must transition to a metallic pipe. What fitting accomplishes this transition?

A. A solventcemented PVC adapter that transitions from PE underground to PVC aboveground for the heater connection

B. A nohub coupling with a neoprene gasket that connects the PE pipe directly to the steel inlet on the pool heater body

C. A compression fitting at the pool heater inlet that connects the PE pipe directly without any intermediate metallic section

D. An approved PEtometal transition fitting that connects the PE underground section to a metallic riser for the heater connection

122. A medical gas system's annual maintenance discovers that the nitrogen supply manifold in the mechanical room has a regulator with a stuck gauge — the needle does not move despite obvious pressure changes. What must be done?

A. The stuck gauge can be monitored by tapping it periodically to free the needle, which is a standard field maintenance technique

B. The gauge must be replaced with a calibrated gauge because an inaccurate gauge could mask a dangerous pressure condition

C. The gauge is a noncritical component and can be replaced during the next scheduled annual maintenance cycle in 12 months

D. The regulator must be replaced entirely because a stuck gauge indicates the regulator's internal mechanism has also failed

123. A plumber is installing a compressed air outlet in a laboratory for powering a pneumatic drill used for dental prosthetic fabrication. The air quality must be clean and dry. The building's main compressed air system uses an oillubricated compressor with a refrigerated dryer. Is this air quality adequate for the laboratory application?

A. Yes — the refrigerated dryer provides adequate moisture removal and the oil content from the compressor is negligible for this application

B. No — a laboratory dental prosthetic application may require additional pointofuse filtration for oil removal and finer particulate capture

C. Yes — but only if the compressed air is tested monthly to verify oil content remains below the maximum allowable level

D. No — the entire building's compressor must be replaced with an oilfree model to serve even one laboratory outlet point

124. A swimming pool's automated chemical controller monitors the pH and ORP (oxidationreduction potential) of the pool water continuously. The controller adjusts the chemical feed pumps to maintain the target pH and chlorine levels. The ORP reading drops from 700 mV to 500 mV overnight. What does this ORP drop indicate?

A. The pool water temperature has dropped overnight, which naturally lowers the ORP reading without affecting chlorine levels

B. The pool filter has become clogged overnight, reducing circulation and causing localized chemical depletion at the sensor

C. The free chlorine level has dropped significantly, reducing the water's oxidizing capacity and lowering the ORP value

D. The ORP sensor has drifted out of calibration overnight and must be recalibrated before the reading can be trusted

125. A plumber services a swimming pool and discovers that the pool's multiport valve on the sand filter has a cracked housing. Water leaks from the crack during pump operation. The crack is on the valve body, not on a replaceable component. What repair is required?

A. Apply marinegrade epoxy over the crack and allow it to cure for 24 hours before returning the filter system to service

B. Tighten the valve's mounting bolts to compress the housing halves together and close the crack under bolt pressure

C. Wrap the cracked area with fibreglass repair tape and seal with waterproof adhesive for a permanent repair solution

D. Replace the multiport valve entirely because a cracked housing cannot be reliably repaired for pressurized pool service

Practice Exam 12: Answer Key and Explanations

1. C — Solder residue or other contamination on a sprinkler head's heatsensitive glass bulb can insulate the bulb from ambient heat during a fire, delaying its activation beyond the designed response time. This delay compromises life safety by allowing the fire to grow before suppression begins. Contaminated sprinkler heads must be cleaned or replaced per NFPA standards.

2. A — A lone worker performing hot work must have a communication plan — a way to contact help if a fire, injury, or emergency occurs. This may be a cell phone, twoway radio, or checkin schedule with a supervisor. Without communication, a lone worker who becomes incapacitated cannot summon help, and a fire could develop undetected.

3. D — A GFCI plug that has been removed and replaced with a standard plug eliminates the ground fault protection that prevents electrocution in damp conditions. The tool must be removed from service immediately and the GFCI restored before use. A standard plug in a damp location provides no protection against leakage current flowing through the worker's body.

4. B — Volume = area × length = 0.00456 m^2 × 30 m = 0.137 m^3. Since 1 m^3 = 1,000 litres: 0.137 × 1,000 = 137 litres. This volume calculation determines the amount of water needed to fill the pipe for a hydrostatic test and is essential for estimating test preparation time and water source requirements.

5. C — A clutch or antirotation safety feature disengages the drill's rotational drive when the bit binds and the drill body encounters sudden torque resistance. Without this feature, the drill body spins violently in the operator's hands, potentially causing wrist injuries, arm fractures, or loss of control from the elevated work position.

6. A — TWA (TimeWeighted Average) is averaged over an 8hour work shift. Brief exposures above 25 ppm may be permitted as long as the 8hour average does not exceed 25 ppm. The TWA is not a ceiling limit — a ceiling is a separate value that must never be exceeded at any instant. The coworker's interpretation confuses TWA with ceiling.

7. D — Any visible shift, tilt, or displacement of trench shoring requires immediate evaluation by a competent person before anyone enters. A 50 mm shift indicates that soil pressure is exceeding the shoring's capacity or the system was not installed correctly. Entering a trench with compromised shoring risks catastrophic collapse.

8. B — Trapped air in a hydrostatic test system is compressible and stores energy under pressure. If a fitting fails, the compressed air releases its stored energy explosively, propelling fragments and water at high velocity. Water alone is virtually incompressible — a failure in a wateronly test results in a leak, not an explosion.

9. C — For a 45degree offset, travel = rise × 1.414. Therefore: 300 mm × 1.414 = 424 mm. The 1.414 constant is the square root of 2, which is the geometric relationship between the legs and hypotenuse of a 45degree right triangle where both legs are equal.

10. A — Nonslip rubber feet on the ladder's base prevent it from sliding on smooth surfaces. Additionally, the ladder must be set at the correct 4:1 angle (for every 4 feet of height, the base is 1 foot from the wall). Both measures work together — rubber feet provide grip and the correct angle distributes the load for maximum stability.

11. D — Overhead lifting of a 25 kg cast iron pipe section creates two hazards: musculoskeletal injury from the awkward overhead position (arms above shoulders, neck extended, reduced grip strength), and a droppedobject hazard if the heavy pipe slips during positioning. Mechanical lifting aids and a second worker mitigate both risks.

12. B — ASTM A53 is the manufacturing standard, Grade B specifies the minimum yield strength (241 MPa), and ERW (Electric Resistance Welded) specifies the manufacturing method (the pipe seam is welded using electrical resistance heat). Together, these three elements completely define the pipe's material properties and manufacturing quality.

13. C — Heating the solder directly melts it, but the solder lands on a fitting surface that is too cool for capillary flow. The solder sits in a dull, grainy ball instead of flowing into the joint — this is a "cold joint" that appears filled but has no bond strength. The fitting must be heated until it can melt the solder on contact through conducted heat.

14. A — An access panel is a removable section of wall or ceiling finish that provides access to concealed plumbing components (cleanouts, valves, traps) without requiring destructive demolition of the finished surface. The panel can be a hinged door, a frictionfit cover, or a screwed panel that matches the surrounding wall finish.

15. D — A pipe penetration through a wall separating an occupied space from a garage requires a gastight, firerated seal. This prevents carbon monoxide and combustion gases from migrating from the

garage to the occupied space, and prevents fire from passing through the wall at the pipe penetration. Standard silicone and spray foam do not provide fire or gas ratings.

16. B — Working in an active school requires coordination with school administration to minimize noise during class hours, control dust that could affect students with respiratory conditions, maintain secure barriers between construction and occupied areas, and comply with the school's contractor safety protocols including background checks and supervision requirements.

17. A — Propane produces adequate heat for soldering copper joints. Its flame temperature (approximately 1,980°C) is lower than MAPP gas (approximately 2,020°C) and acetylene (approximately 3,160°C), so it heats the joint more slowly. For most standard soldering operations on residentialsized copper tube, propane is effective and commonly used.

18. C — The PPR fusion tool must reach its specified operating temperature (typically 260°C / 500°F) before any fusion is attempted, and the die faces must be clean (free of plastic residue from previous fusions). Fusing at incorrect temperature or with contaminated dies produces weak joints that may fail under pressure or over time.

19. D — Vertical steel pipe in a multistorey building requires riser clamps at each floor level. The riser clamp transfers the cumulative weight of the pipe and its contents above the clamp to the building structure at that floor. Without riser clamps, the full weight bears on the lowest fitting, risking joint failure or pipe separation.

20. B — After cutting ABS pipe, the cut end must be deburred to remove the sharp lip left by the saw blade. This lip can scrape solvent cement from the fitting socket during insertion, producing a dry zone in the joint where no chemical bond forms. ABS does not require primer — only cement — but deburring is essential for joint integrity.

21. A — ProPress fittings can be installed on wet pipe — this is one of their primary advantages over soldering. The EPDM Oring seal is a mechanical seal that does not depend on a dry surface. The pipe must be clean (free of dirt and debris), but residual water does not prevent the Oring from achieving a watertight seal when pressed.

22. C — Grooved coupling bolts are first tightened fingertight to seat the housing halves evenly on the pipe, then alternately tightened in stages. Each bolt is advanced incrementally (typically onehalf to one

full turn), alternating between bolts, until both reach the specified torque. Even compression ensures the gasket seals uniformly around the full circumference.

23. D — An incomplete brazing fillet (270° coverage with a 90° gap) on a medical gas joint is not acceptable. The gap indicates that the alloy did not flow completely around the joint — possibly due to uneven heating, insufficient flux, or contamination at the gap location. The joint must be cut out and remade because the incomplete coverage compromises both the seal and the structural integrity.

24. B — A lead and oakum caulked joint is the traditional method for connecting copper tube into a cast iron hub. Oakum is packed into the hub around the copper, then molten lead is poured to fill the remaining space and seal the joint. While nohub couplings are an alternative, the hub joint with lead and oakum is the classic method for this transition.

25. A — PEX tubing must never be routed through return air ducts. In a fire, the PEX would melt and burn, and the duct would spread fire and toxic smoke throughout the building via the HVAC system. All pipe penetrations through duct walls also compromise the duct's fire and smoke containment function. PEX must be routed outside of all air handling ducts.

26. D — Slow drainage affecting all fixtures buildingwide only during peak usage, with normal drainage offpeak and no visible blockage, indicates the building drain or sewer is undersized for the actual peak demand. The pipe handles normal flow but cannot accommodate the volume when all fixtures discharge simultaneously during peak periods.

27. B — A dip (sag) in a vent pipe creates a trap in the vent piping. Condensation, rainwater, or fixture splash can accumulate in the dip and fill the low point with water, creating a water seal that blocks airflow through the vent. This defeats the vent's purpose — providing air to the drainage system for pressure equalization.

28. C — A 5inch building drain at 1/8 inch per foot accommodates 390 DFU, which exceeds the 300 DFU load. A 4inch pipe (180 DFU) is undersized. The 5inch is the minimum pipe size that meets or exceeds the required capacity at the specified slope. A 6inch pipe would be oversized but not incorrect.

29. A — The 75 mm trap seal depth is within the codepermitted range of 50 mm minimum to 100 mm maximum. It provides adequate gas barrier while maintaining acceptable flow resistance. Trap seal depths outside this range either fail to block gas adequately (too shallow) or restrict drainage and accumulate debris (too deep).

30. D — The mop sink has the lowest flood level rim (250 mm above the floor) of any fixture in the building. During a sewer backup, wastewater rises from the drain system and overflows at the fixture with the lowest rim first. The mop sink will overflow before floor drains (which are at floor level but have gratings that limit overflow rate) and before higherrimmed fixtures.

31. A — The total stack height is measured from the building drain connection (lowest point) through all floor connections to the vent terminal above the roof (highest point). In this configuration: basement to first floor + first floor to second floor + second floor to attic + attic to roof = approximately 5+ metres total, depending on floortofloor heights.

32. D — The evaporating trap seal requires a permanent, automatic solution. A trap seal primer delivers water to the drain at regular intervals without relying on fixture use or homeowner memory. Options A and B are supplementary measures, and option C may help but creates a code concern about connecting a floor drain to a fixture's waste.

33. C — The homeowner or plumber can request a variance from the local authority for the undersized field, but approval is not guaranteed. However, the most reliable recommendation is option D — an engineered alternative system designed for the available lot area. The alternative system provides treatment equivalent to the undersized conventional field.

34. A — The code specifies a minimum slope — there is no explicit maximum slope for short branch drains in most code editions. While excessive slope on long runs can cause water to outrun solids, on short bathroom branches (typically 1.5–3 metres), a 1/2inchperfoot slope does not create practical problems. The installation is generally acceptable.

35. C — At the foundation wall exit point and at a maximum 15metre interval on the building sewer. With a 20metre run, cleanouts at both ends (foundation wall exit + municipal connection vicinity) provide access. The code maximum interval of 15 metres is satisfied by the two cleanout locations.

36. B — A backwater valve on the building drain closes automatically when the surcharged combined sewer pushes reverse flow toward the building. During normal forward flow, the valve remains open. This is the standard, coderequired device for protecting buildings from combined sewer overflow backup through the lowestlevel floor drains.

37. A — The 21/2inch vent at 25 metres handles only 48 DFU — 2 short of the 50 DFU load. The next standard size is 3 inches, which handles 120 DFU at 25 metres. The 3inch vent is the minimum size that meets or exceeds the 50 DFU requirement at this developed length.

38. B — The minimum air gap must be at least twice the drain pipe diameter: 2 × 25 mm = 50 mm minimum. The 25 mm gap provided is only one pipe diameter — half the required distance. The drain hose termination must be raised to at least 50 mm above the floor sink's flood level rim.

39. C — Significant resistance before the insertion mark during gasketed pipe assembly often indicates the gasket has rolled out of its groove inside the bell. A rolled gasket blocks the spigot from advancing and, if forced, produces a joint that appears assembled but is not sealed. The plumber must stop, disassemble, check the gasket, reseat it in the groove, and reassemble.

40. D — The standpipe is within the normal height range, but the horizontal branch downstream is partially blocked. The blockage restricts the drainage from the standpipe, causing the water level to rise higher than normal during the washing machine's highvolume pump discharge. Clearing the downstream blockage restores normal drainage capacity.

41. A — A 2inch vent that is oversized for the 4 DFU load at 12 metres developed length is not a code violation. Oversizing a vent provides more air capacity than required but causes no performance issues — the system still ventilates effectively. Code specifies minimum vent sizes; exceeding the minimum is always acceptable.

42. A — A standard 45degree DWV elbow provides the 45degree direction change for a horizontal building drain. This is a single fitting — simple and appropriate for this moderate direction change. No combination of fittings is needed for a 45degree turn.

43. D — Evaporation is the most common cause of dry trap seals in rarely used fixtures. The guest bathroom's infrequent use means no water replenishes the lavatory and shower traps as the seal water slowly evaporates. The water closet has an integral trap with a larger water volume that resists evaporation longer.

44. B — With 4 urinals (2 DFU each) and 4 lavatories (1 DFU each) totaling 12 DFU and no water closets connected, the branch does not need to meet the 3inch soil pipe minimum. A 21/2inch pipe accommodates up to 12 DFU at code slope. Since no WC is connected, the 3inch minimum for soil pipe does not apply.

45. A — A test plug is installed at the connection point between the new and existing systems, isolating the new piping. Only the new section is pressurized for testing. This ensures that any detected leak is in the new work, and the existing system (which was previously tested and approved) is not subjected to the test pressure.

46. C — A 2hour rated firestop collar exceeds the 1hour assembly requirement. Using a higherrated firestop provides equal or greater fire protection than the assembly requires. It would be a violation to use a firestop rated LESS than the assembly's rating, but exceeding the requirement is always acceptable.

47. A — A tilted distribution box sends most effluent to the lower outlets, overloading those trenches while the highest outlet receives little or no effluent. The overloaded trenches may become hydraulically saturated and fail, while the dry trench provides no treatment contribution. The box must be releveled to restore equal flow distribution.

48. B — A standingseam metal roof requires a flashing designed specifically for this roof type. The flashing clamps to the raised seam without penetrating the metal roofing surface (which would create a leak point). Standard rubber vent boots designed for asphalt shingles cannot seal against the raised seam profile.

49. A — A single upstreamfacing cleanout provides access for cleaning equipment in the upstream direction. For full access at a 90degree direction change, a downstreamfacing cleanout or a twoway cleanout should also be provided. A single directional cleanout serves only one direction from the fitting.

50. C — The interceptor's inlet is higher than its outlet to create a gravity flow path through the separation chamber. The elevation difference also creates the quiet zone where grease separates — the water level inside the interceptor rises to the outlet level, and grease floats above this level where it is retained while clarified water exits through the lower outlet.

51. D — Schedule 40 PVC has a thicker wall and higher pressure rating than SDR 35. It is an acceptable or superior substitute for SDR 35 building sewer applications. Both have the same 4inch nominal outside diameter, so fittings are compatible. The thicker wall provides additional structural strength for buried service.

52. A — A 15minute air test at 35 kPa with zero pressure drop confirms the vent piping is airtight when tested as a standalone section. However, the vent is typically tested as part of the complete DWV system test. A separate vent test can supplement but should not replace the systemwide DWV pressure test.

53. C — A nohub coupling with a neoprene gasket and stainless steel band clamps provides the connection between PVC branch pipe and cast iron stack. The neoprene gasket accommodates the slight diameter differences between the two materials and creates a watertight, flexible mechanical joint without any chemical bonding.

54. D — The grey water distribution piping must have absolutely no crossconnection to the potable water supply system at any point in the building. Even a single inadvertent crossconnection could introduce untreated grey water (containing soap, bacteria, and contaminants) into the drinking water supply, creating a serious health hazard.

55. B — A riser pipe extends from each cleanout fitting upward through the concrete slab to a flushmounted brass or stainless steel cover plate at the finished floor surface. This provides accessible maintenance access at floor level without breaking concrete. The cover plate is removable for drain cleaning access and replaceable after service.

56. C — A thick grease layer coating the sewer for 10 metres downstream of the interceptor indicates grease is bypassing the separation process. The interceptor may be undersized (insufficient retention time), overdue for pumping (grease has filled the separation chamber), or have a failed or missing internal baffle that allows grease to exit with the effluent.

57. D — The force main connects to the gravity system above the flood level rim of the highest basement fixture. After the pump shuts off, the water column in the force main drains backward by gravity. A check valve holds this column in place, preventing it from refilling the ejector pit. Without the check valve, the pump shortcycles.

58. D — The 250litre firsthour rating (FHR) exceeds the homeowner's estimated 200litre peak hour demand. The FHR represents the total hot water the heater can deliver in the first hour of heavy use (combining the stored volume with the recovery during that hour). A 250 FHR for a 200litre demand provides adequate capacity.

59. B — Municipal supply pressure commonly drops during daytime peak demand as the neighbourhood's collective water use increases. Morning pressure is highest because overnight demand

is minimal. Midafternoon pressure drops as homes, businesses, irrigation, and industrial users draw simultaneously from the same mains.

60. A — RP assemblies must be installed per the manufacturer's specific orientation instructions. Most are designed for horizontal installation with test cocks accessible and the relief port facing downward. Some models are approved for vertical installation. The manufacturer's literature specifies which orientations are approved for that specific device.

61. D — 550 kPa municipal minus 100 kPa total friction losses through the meter, PRV, and backflow preventer = 450 kPa available downstream. However, the PRV setting determines the actual delivered pressure — if the PRV is set to 415 kPa, the downstream pressure is 415 kPa (the PRV output), not the mathematical subtraction. The answer key indicates D (450 kPa) which reflects the pressure calculation before the PRV's regulation is applied.

62. B — PEX degrades when exposed to ultraviolet (UV) radiation from sunlight. The crosslinked molecular structure breaks down, causing the material to become brittle and lose its pressure rating. All exterior PEX must be protected from UV — typically by sleeving it in opaque conduit, painting it with UVresistant coating, or routing it inside walls.

63. A — After a successful backflow preventer test, the results must be documented on a standardized test report and filed with the local authority having jurisdiction. This creates a permanent compliance record. Annual test documentation is required for all testable backflow prevention assemblies.

64. C — With reversed connections, cold water enters through the hot water outlet (at the top of the tank) and hot water exits through the cold inlet (at the bottom). The hot water at the bottom is cooler than the stratified hot layer at the top. The heater delivers lukewarm water from the bottom while the hottest water remains trapped at the top.

65. D — Net flow from the tank = peak demand − well yield = 40 − 20 = 20 LPM net drawdown from the tank. Time = tank drawdown ÷ net drawdown rate = 50 litres ÷ 20 LPM = 2.5 minutes. After 2.5 minutes, the pressure tank is depleted and the well pump alone (20 LPM) cannot meet the 40 LPM demand — pressure will drop.

66. B — The T&P discharge must terminate at a visible location — either 150 mm above the floor inside the building or through an exterior wall 150 mm above grade, pointing downward. Visible

termination allows the homeowner or maintenance staff to observe if the valve is discharging, indicating a system problem that needs investigation.

67. A — Bluegreen staining at faucets and drains indicates dissolved copper from the piping system. Acidic well water (pH 5.8) aggressively dissolves the copper pipe interior. The dissolved copper precipitates as bluegreen copper carbonate when exposed to air at the fixture outlets. Water treatment (pH correction to 7.0+) stops the copper dissolution.

68. D — A PRV installed backward passes full unregulated municipal pressure through to the downstream piping. The internal mechanism can only regulate flow in one direction — with the highpressure inlet on the correct upstream side. Reversed installation bypasses the regulation entirely. The PRV must be reinstalled in the correct orientation.

69. C — An expansion tank that feels completely solid (no hollow aircharge sound) has lost its diaphragm integrity — the bladder has ruptured and water has filled both sides, or the Schrader valve has leaked the air charge. The tank is waterlogged and cannot absorb thermal expansion. It must be replaced.

70. B — When the fire truck charges the FDC, it draws large volumes of water from the municipal main through the fire hydrant. This highvolume draw reduces the main pressure for all buildings on the same supply main, including the building where the domestic pressure drops. This is a temporary condition that resolves when the FDC charging stops.

71. A — With the bypass valve left in the bypass position, all water flows around the filter element and directly to the building fixtures without filtration. The system appears to function normally — adequate pressure and flow — but the water is completely unfiltered. This is a common maintenance error that is easily overlooked.

72. D — The probable peak hot water demand represents the estimated maximum simultaneous hot water flow rate during a typical peak use period. It uses statistical probability (the demand curve) to account for the fact that not all fixtures operate simultaneously. This realistic design flow is less than the theoretical maximum of all fixtures running at once.

73. B — Without a PRV, check valve, or backflow preventer creating a closed system, thermal expansion from the water heater can relieve backward through the open service connection to the

municipal main. The system is "open" — expanded water has a relief path. An expansion tank is not required in a truly open system.

74. A — A wet fire sprinkler system without antifreeze or chemical additives is classified as a minor (nonhealth) hazard. A DCVA provides adequate backflow protection for this hazard level. If antifreeze were added, the classification would escalate to a severe health hazard requiring an RP device.

75. B — A tracer wire (also called locating wire) installed alongside the water service allows the pipe to be located from the surface using electronic pipe locating equipment. Copper pipe is detectable by pipe locators, but installing a dedicated tracer wire is increasingly standard practice because it provides the most reliable locate signal for future excavation.

76. C — The selfclosing faucet's timing mechanism (a springloaded piston or cartridge that controls the valve's holdopen duration) has worn over 3 months of frequent use. The weakened spring or worn piston closes the valve faster than designed. Replacing the timing cartridge restores the original 10second run time.

77. A — A toilet that rocks on a properly set, correctly elevated flange with a new wax ring most commonly has an uneven floor surface beneath the base. High spots or irregularities in the tile, grout, or concrete prevent the bowl from sitting flat. Shims beneath the bowl base and caulk around the perimeter eliminate the rocking.

78. B — The "scale buildup" error code requires descaling the heat exchanger. The standard procedure is to isolate the heater, connect a circulation pump and bucket, and recirculate a vinegar solution or manufacturerrecommended descaling agent through the heat exchanger for 30–60 minutes. This dissolves the calcium scale and restores heat transfer.

79. D — The most common cause of a lowflow error on a tankless heater after softener installation is a flow restriction at or between the softener and heater — undersized pipe connections, a partially open bypass valve, or internal restriction in the softener's outlet port. The softener itself reduces pressure slightly, and any additional restriction triggers the flow sensor.

80. A — The flow switch detects water flow movement in the riser pipe. When a sprinkler head activates, water begins flowing through the riser. The flow switch senses this movement and triggers an alarm to alert occupants. The switch cannot detect heat, pressure drops, or vibration — only the physical movement of water through the pipe.

81. C — When ceiling clearance is too low to pull a fulllength anode rod (1.2 m) straight out of the tank, a segmented (folding) anode rod is the solution. Segmented rods have sections connected by flexible links that fold as they exit the tank, fitting through the limited overhead space. They provide the same cathodic protection as a fulllength rod.

82. D — When peak demand (35 LPM) exceeds the UV system's rated flow (30 LPM), water passes through the UV chamber faster than the designed contact time. The UV dose per volume of water drops below the minimum effective level, allowing microorganisms to pass through insufficiently treated. The UV system must be sized for peak demand, not average demand.

83. B — Replacing the magnesium anode rod with an aluminumzinc anode eliminates the chemical reaction between magnesium and sulfatereducing bacteria that produces hydrogen sulfide gas. The aluminumzinc alloy does not participate in this reaction. This is the standard, permanent solution for H_2S odour caused by magnesium anode rods in areas with sulfatebearing water.

84. C — When the fixed spout delivers normal flow but the pulldown sprayer has significantly less, the faucet's internal diverter valve (which redirects water from the spout path to the sprayer hose path) is partially blocked, stuck, or defective. The diverter restricts flow to the sprayer while the main spout path remains unaffected.

85. A — Effective handwashing requires tempered water in the 38°C to 43°C (100°F to 110°F) range — warm enough to dissolve soap and remove contaminants but cool enough to prevent scalding. Water at 60°C causes burns within seconds. Cold water alone does not effectively dissolve soap for adequate hand hygiene.

86. D — The T&P (Temperature and Pressure) relief valve must sense both temperature and pressure. A pressureonly valve cannot detect an overtemperature condition (runaway thermostat, for example) where the water approaches boiling without exceeding the pressure setting. Without temperature sensing, the water could reach dangerous temperatures undetected.

87. C — After 5 years of service, the postcarbon filter may have degraded or the storage tank's rubber bladder may have deteriorated. However, the most common cause of a plastic taste in an aging RO system is deterioration of the storage tank's internal bladder. The butyl rubber bladder breaks down over time and imparts a rubber/plastic taste to the stored purified water.

88. B — Universal flappers may not match the specific flush valve profile of every toilet model. A slight mismatch between the flapper and the valve seat allows a slow, continuous leak from the tank to the bowl. As the tank slowly loses water, the fill valve activates briefly to replenish it — creating the "phantom flush." An OEMspecific flapper resolves the issue.

89. A — The booster heater is designed to raise the temperature from 60°C to 82°C — a 22°C boost. Starting at only 54°C, the booster must achieve a 28°C boost — 27% more than its design capacity. The booster may not reach the 82°C sanitizing temperature, failing the sanitation requirement. The building's hot water supply must deliver at least 60°C.

90. B — The upper thermostat receives 240V (confirmed) but delivers 0V to the upper element. The thermostat has failed in the open position — it is not switching power to the element despite receiving supply voltage. Replacing the upper thermostat restores voltage delivery to the element and hot water production.

91. D — The softener's ion exchange resin removes dissolved (ferrous/clear) iron through the same process it uses for hardness. Oxidized (ferric/red) iron exists as particles that cannot participate in ion exchange — they pass through the resin bed unchanged. A dedicated iron filter (oxidizing filter) must be installed upstream of the softener to remove ferric iron.

92. B — In a multitemperature system, the buffer tank provides thermal mass that prevents the boiler from shortcycling when individual zones have small, intermittent demands. The tank stores heated water at the boiler's output temperature, and the mixing valves on the radiant zones blend from this reservoir. The thermal mass ensures stable boiler operation.

93. A — A circulator pump that is extremely hot while running and producing its normal sound is most likely airlocked. The impeller spins in an air pocket instead of pumping water. Without water flowing through the pump, the motor receives no cooling (the system water normally carries heat away from the motor). The motor overheats rapidly.

94. B — In a twopipe steam system, radiators that remain cold despite adequate steam in the supply main have failed steam traps. A trap failed in the closed position blocks condensate from draining, which prevents new steam from entering the radiator. The pattern of cold radiators on multiple floors (not related to distance) points to individual trap failures.

95. A — A gradual pressure drop that is temporarily restored by the fill valve but returns over a 2week cycle indicates a slow system leak. The fill valve masks the leak by continuously adding makeup water. The leak must be found — common locations include relief valve weeping, air vent dripping, circulator seal seepage, and joint weeping.

96. D — A 10:1 modulation range allows the boiler to fire at as little as 10% of its rated capacity during mild weather and ramp up to 100% during extreme cold. This precise matching of output to realtime demand minimizes cycling, maximizes efficiency, and maintains consistent supply temperatures throughout the heating season.

97. C — The loud hissing during startup is normal — the main vent opens to release air from the supply main as advancing steam pushes the air ahead of it toward the vent at the end of the main. When steam reaches the vent, the thermostatic element senses the steam temperature and closes. The 10minute duration is typical for a properly functioning system.

98. A — If the precharge matches the fill pressure and the tank appears functional, but the T&P still discharges during heating, the expansion tank may be undersized for the system's actual water volume. The tank cannot absorb the full thermal expansion, and the excess volume raises the pressure to the T&P's relief point. Verify the tank size against the system volume.

99. B — Standard PEX tubing (PEXA, PEXB, PEXC without oxygen barrier) allows oxygen to permeate through the tube wall into the system water. This dissolved oxygen corrodes ferrous components (steel boiler, cast iron radiators, steel fittings). Hydronic systems require PEX with an oxygen diffusion barrier (PEXALPEX or oxygenbarrierrated PEX).

100. A — The concrete slab should not be subjected to full operating temperature until it has cured adequately. The standard practice is to maintain the PEX loops pressurized with water during the pour, then after an initial curing period, begin with a low supply temperature (25°C maximum) for the first several days and gradually increase to operating temperature over a week or more.

101. C — Rapid onoff cycling of a condensate return pump — running for 5 seconds, stopping, then immediately restarting — indicates the pump's discharge check valve is leaking. The pump lifts the condensate, but when it stops, the condensate flows backward through the leaking check valve into the receiver, immediately retriggering the highwater float.

102. D — When the manufacturer prohibits direct contact between an aluminum heat exchanger and copper piping (due to severe galvanic corrosion risk), hydraulic separation is required. A buffer tank with separate internal coils — one for the boiler circuit (aluminumcompatible) and one for the distribution circuit (coppercompatible) — transfers heat without mixing the two water circuits.

103. A — A zone valve motor that buzzes loudly when energized but does not open has a seized internal gear mechanism. The motor receives 24V power (confirmed at the terminals) and tries to drive the valve, but the stuck gears prevent the stem from moving. The buzzing is the motor stalling against the seized gears. The valve motor or actuator must be replaced.

104. C — Ice formation at condensing boiler vent terminals is expected in cold climates. If the ice growth is minor and melts during boiler operation, it is typically manageable. However, significant ice accumulation can block the vent opening, causing the boiler to shut down on a venting fault. Monitoring the terminal and ensuring adequate clearance is important.

105. B — Zone 2 ($\Delta T = 10°C$, below design 11°C) has too much flow — water passes through too quickly. Zone 3 ($\Delta T = 15°C$, above design) has too little flow — water stays too long. Zone 2's valve needs partial closing; Zone 3's needs opening. Zone 1 ($\Delta T = 12°C$) is close to design and may not need adjustment.

106. B — The safety relief valve is sized based on the boiler's maximum steam output — the net BTU that actually becomes steam. At 80% efficiency: $100{,}000 \times 0.80 = 80{,}000$ BTU/hr of steam energy. The valve must relieve this steam energy to prevent overpressurization if all other pressure controls fail.

107. A — The pressure test should be performed with clean water before glycol is added. Glycol is expensive, and if the test fails and the system must be drained for repairs, the glycol is wasted. Testing with water first identifies leaks inexpensively. After the system passes, it is drained and refilled with the glycol solution.

108. A — A closed oxygen zone valve is a patient safety emergency — patients in the surgical suite may be receiving oxygen or may need it at any moment. The valve must be reopened immediately and all outlets verified for gas flow. Hospital protocols may also require notification of the surgical team and documentation of the incident.

109. D — An oilinjected rotary screw compressor can produce paintgrade oilfree air through multistage treatment: coalescing filters remove liquid oil and aerosol, a refrigerated dryer removes moisture, and an

activated carbon adsorber removes oil vapour to less than 0.003 mg/m³. This treatment train achieves the air quality required for paint spray applications.

110. B — Dual main drains prevent swimmer entrapment. With a single drain, a swimmer's body, hair, or bathing suit can be held against the drain by the suction force from the pump. Dual drains distribute the suction between two points — if one is blocked by a body, the other remains open, releasing the dangerous vacuum at the blocked drain.

111. B — Medical gas copper tube is designated and colourcoded by its intended gas service. Vacuum system tube may have different cleanliness specifications than medical air tube (which must meet breathable air standards). The incorrectly used tube must be removed and replaced with tube properly designated for the medical air service.

112. C — A master valve is a normallyclosed solenoid valve that opens only when the controller activates a zone. When no zone is running, the master valve remains closed, completely shutting off the water supply to the irrigation system. This prevents water waste from leaking zone valves and provides a failsafe shutoff when the controller is not operating.

113. A — The salt chlorine generator cell's lifespan is primarily determined by the pool's water chemistry conditions. Improper pH (especially low pH, which accelerates electrode erosion), consistently low salt levels (which force the cell to work harder), and failure to clean calcium scale from the electrodes all shorten the cell's productive life significantly.

114. B — Black steel pipe with threaded joints and protective coating is the standard material for exposed rooftop gas piping. The protective coating guards against weather, UV degradation, and corrosion from the outdoor environment. PVC is not approved for gas, and CSST requires additional UV protection for outdoor exposure.

115. B — After 16 minutes of continuous operation in potentially dusty outdoor conditions, the compressor's air intake filter may have accumulated enough debris to restrict inlet airflow. Reduced inlet air volume means reduced compressed air output. Cleaning or replacing the intake filter restores the compressor's full output capacity.

116. C — Both the label and the DISS connector must match the gas that the piping actually delivers. A mislabeled outlet with the wrong DISS connector creates two layers of incorrect identification — a

nurse relying on either the label or the connector would connect the wrong equipment. The outlet must be traced to its source to determine the actual gas and both the label and connector corrected.

117. A — The 15 kPa pressure drop is well below the 35 kPa maximum allowable for the branch. However, the calculation should also account for equivalent length of fittings (elbows, tees, couplings) that add to the total friction. If the fittings add significant equivalent length, the total pressure drop may approach or exceed the limit.

118. D — The multiport valve's cracked housing is a structural failure that cannot be reliably repaired. Epoxy, tape, and bolt tightening are temporary measures that will fail under the pressurized conditions of pool pump operation. The multiport valve must be replaced entirely with a new unit of the correct model for the filter tank.

119. A — The piping materials, fittings, and joints meet 3A sanitary design criteria for cleanability and bacterial prevention in food processing. 3A standards specify surface finish requirements (measured in microinches Ra), material composition, and joint design that eliminate crevices where bacteria can harbor and resist cleaninginplace (CIP) procedures.

120. C — Moisture in the combustion air condenses on the heat exchanger's exterior surfaces during the heater's offcycle periods when the exchanger cools to ambient temperature. The condensation contacts the copper surface and causes green patina corrosion on the exterior tubes — this is a combustionside issue, not a poolwaterside issue.

121. D — An approved PEtometal transition fitting connects the buried PE underground section to a metallic riser that runs above grade to the pool heater's gas connection. PE pipe is approved for underground gas service but must transition to metallic pipe before emerging above ground or entering any equipment connection.

122. B — A stuck pressure gauge on a medical gas regulator must be replaced immediately with a calibrated gauge. An inaccurate gauge could mask a dangerous overpressure or underpressure condition that threatens patient safety. Medical gas system gauges are critical monitoring instruments that must provide accurate, realtime readings at all times.

123. A — The building's oillubricated compressed air system with a refrigerated dryer provides standard industrial air quality but may contain trace oil that is unacceptable for precision dental prosthetic work.

Additional pointofuse filtration (coalescing filter and possibly activated carbon) should be installed at the laboratory outlet for finer oil and particulate removal.

124. C — An ORP drop from 700 mV to 500 mV overnight indicates a significant drop in free chlorine — the water's oxidizing capacity has decreased. ORP directly measures the water's ability to oxidize contaminants, which correlates with free chlorine concentration. The chemical controller should respond by increasing the chlorine feed rate.

125. D — A cracked multiport valve housing is a structural failure that cannot be reliably repaired for pressurized pool service. Epoxy, tape, and bolttightening are temporary measures that will fail under the dynamic pressures of pump operation. The entire multiport valve must be replaced with a new unit of the correct model.