

PRACTICE EXAM 3: RED SEAL PLUMBER SIMULATION (125 QUESTIONS)

1. A plumber is cutting concrete with a rotary hammer drill to install a pipe sleeve. The dust generated by the drilling operation contains crystalline silica. What respiratory protection is required?

- A. A half-face respirator with organic vapour cartridges rated for chemical fume exposure
- B. A disposable N95 dust mask, which filters 95% of airborne particles including silica dust
- C. No respiratory protection if the drilling operation lasts less than 15 minutes total duration
- D. A half-face respirator with P100 particulate filters that capture 99.97% of airborne particles

2. A plumber working in a mechanical room discovers an unmarked secondary container holding a clear liquid that smells like solvent cement. What is the correct action?

- A. Use the product if it appears to be solvent cement based on the colour and smell characteristics
- B. Do not use the product and report the unmarked container so a workplace label can be applied
- C. Pour the contents back into the original manufacturer's container to restore proper identification
- D. Apply a piece of masking tape to the container and write the assumed product name on it

3. During lockout/tagout of a hot water heating system, a plumber applies a personal lock to the electrical disconnect and closes the isolation valves. What critical step must occur before work begins?

- A. Notify the building occupants that the heating system will be out of service during the repair
- B. Document the lockout procedure on the daily work report with the time and date recorded
- C. Verify zero energy at the point of work by testing for voltage and confirming zero water pressure
- D. Remove all tools from the work area and organize them for efficient use during the repair task

4. A plumber must lift a 45kilogram water heater from the floor to a workbench. The recommended singleperson lifting limit under ideal conditions is approximately 23 kilograms. What is the correct approach?

- A. Use mechanical assistance or a second worker because the load exceeds the singleperson limit
- B. Lift the water heater using a beltstyle back support to protect the lumbar spine during the lift
- C. Roll the water heater onto its side and slide it onto the workbench to avoid a vertical lift
- D. Perform the lift quickly using momentum to minimize the duration of peak loading on the spine

5. A Grade 30 proof coil chain is available on a jobsite. A plumber needs to lift a bundle of pipe overhead. Can this chain be used as a sling?

- A. Yes, provided the chain is inspected for visible damage and the load does not exceed 500 kg
- B. Yes, Grade 30 chain is the standard generalpurpose chain for all overhead lifting operations
- C. Yes, but only in a basket hitch configuration that doubles the chain's effective lifting capacity
- D. No, only Grade 80 or Grade 100 alloy steel chain is rated and approved for overhead lifting

6. A plumber is reading a plumbing floor plan and sees a solid thick line representing a pipe run. According to standard plumbing drawing conventions, what does a solid thick line typically represent?

- A. Hot water supply piping, which is always shown as a continuous solid line on plumbing plans
- B. Cold water supply piping, which is the standard representation on most plumbing drawings
- C. Sanitary drainage piping, which uses a solid line with periodic letter designations along the run
- D. Gas piping, which is shown as a solid line to distinguish it from dashed water supply piping

7. What is the correct procedure when a worker needs to use the washroom during a confined space entry and must leave the manhole?

- A. The worker exits the confined space following the established egress procedure before leaving
- B. The worker signals the attendant to temporarily enter the space and continue work in their place
- C. The worker leaves tools and equipment in the confined space and exits without notifying anyone
- D. The attendant enters the confined space to maintain continuous occupancy while the worker exits

8. A plumber calculates the cross-sectional area of a 3-inch diameter pipe using the formula $A = \pi \times d^2 \div 4$. What is the approximate area?

- A. 9.42 square inches, calculated using the circumference formula rather than the area formula
- B. 28.27 square inches, calculated by squaring the diameter and multiplying by π without dividing

- C. 7.07 square inches, the correct crosssectional area for a 3inch diameter circular pipe
- D. 4.71 square inches, calculated by multiplying π by the radius without squaring the value

9. The signal word "Danger" appears on a WHMIS 2015 supplier label. What does this signal word indicate compared to the signal word "Warning"?

- A. "Danger" indicates that the product is flammable while "Warning" indicates it is corrosive only
- B. "Danger" and "Warning" are interchangeable terms with no difference in hazard severity level
- C. "Danger" indicates the product has expired and "Warning" indicates it is within its shelf life
- D. "Danger" indicates a more severe hazard than "Warning" for the same hazard class category

10. A spoil pile from a trench excavation must be set back at what minimum distance from the edge of the trench?

- A. 3 metres (10 feet) from the trench edge to prevent any possibility of material falling back in
- B. 1 metre (3 feet) from the trench edge to prevent added weight from contributing to wall collapse
- C. 0.5 metres (2 feet) from the trench edge, which provides adequate clearance for worker access
- D. No setback is required provided the spoil pile height does not exceed the depth of the trench

11. A plumber needs to convert 45 psi of water pressure to kilopascals (kPa). Using the conversion factor of 6.895 kPa per psi, what is the result?

- A. Approximately 310 kPa, calculated by multiplying 45 psi by the conversion factor of 6.895
- B. Approximately 207 kPa, which is the standard residential boiler relief valve pressure setting
- C. Approximately 450 kPa, calculated by multiplying 45 by a factor of 10 for metric conversion
- D. Approximately 6.5 kPa, calculated by dividing 45 psi by the conversion factor of 6.895

12. When using a combination square to mark a cut line on a pipe, what angle reference does the tool provide?

- A. A 30degree and a 60degree reference for marking offset angles on pipe and tubing runs
- B. A 22.5degree and a 45degree reference for marking fitting angles on drainage pipe runs
- C. A 90degree and a 45degree reference for marking square and angled cuts on pipe
- D. A 180degree straightedge reference only, with no angular marking capability built into the tool

13. A competent person must inspect a trench before workers enter each day. Under what additional condition must the trench be reinspected?

- A. After every worker shift change regardless of whether any weather event has occurred at the site
- B. When the soil temperature drops below freezing, as frozen soil behaves differently under load

- C. Only when a worker reports visible cracking or movement in the trench walls during their shift
- D. After any rainfall or event that could affect the stability of the trench walls and surrounding soil

14. A plumber is mentoring a thirdyear apprentice who makes an error while roughing in a DWV branch. The branch is connected using a sanitary tee in a horizontaltohorizontal orientation. What is the best mentoring response?

- A. Allow the apprentice to complete the installation and discover the error during the inspection
- B. Stop the work, explain why the fitting is incorrect, demonstrate the correct fitting, and have the apprentice redo it
- C. Correct the installation yourself to save time and explain the error at the end of the work day
- D. Report the apprentice's error to the project supervisor for documentation in the apprentice's file

15. What does a plumbing specification document provide that a plumbing drawing cannot?

- A. Quality, material, and performance requirements for products and workmanship standards
- B. The physical location of every pipe, valve, and fixture within the building structure layout
- C. The threedimensional isometric representation of the complete DWV piping system layout
- D. The fixture schedule listing every plumbing fixture by tag number, type, and connection sizes

16. A plumber determines that a 60foot horizontal run of 2inch copper DWV pipe must be installed at the code minimum slope. What total fall is required from the high end to the low end?

- A. 7.5 inches, calculated using the 1/8inchperfoot slope required for pipe 4 inches and larger
- B. 30.0 inches, calculated using the 1/2inchperfoot slope required for all DWV pipe installations
- C. 15.0 inches, calculated using the 1/4inchperfoot slope required for pipe 3 inches and smaller
- D. 3.75 inches, calculated using the 1/16inchperfoot slope required for vent piping installations

17. A plumber is selecting pipe for a natural gas distribution system inside a commercial building. Which material is the standard choice for interior gas piping?

- A. PVC Schedule 40, which is costeffective and easy to install using solvent cement connections
- B. Black steel pipe with threaded joints, which is the standard for interior gas piping installations
- C. Copper Type M with soldered joints, which provides the smoothest interior bore for gas flow
- D. PEX tubing with crimp ring connections, which offers the fastest installation for gas distribution

18. A plumber cuts a length of ABS DWV pipe and prepares it for solvent cementing. Unlike PVC, what step is NOT required when cementing ABS pipe?

- A. Cleaning the pipe end and fitting socket with a dry cloth to remove loose dirt before assembly
- B. Deburring the cut end of the pipe to remove the sharp edge that could scrape away cement

- C. Applying the solvent cement to both the pipe exterior and the fitting socket interior surfaces
- D. Applying a primer to the joint surfaces before cement, as ABS cement bonds without a primer step

19. A plumber must support a horizontal run of ABS DWV pipe. What is the maximum hanger spacing for horizontal ABS pipe?

- A. 1.2 metres (4 feet), which is the standard maximum support spacing for horizontal plastic DWV pipe
- B. 1.8 metres (6 feet), matching the spacing for small diameter copper tube in residential installations
- C. 2.4 metres (8 feet), matching the spacing for medium diameter copper tube in commercial buildings
- D. 3.0 metres (10 feet), matching the spacing for large diameter steel pipe in industrial applications

20. When soldering a copper joint, a plumber applies the solder to the joint and observes that the solder flows freely around the full circumference, creating a complete ring. What drove the solder into the joint?

- A. The force of gravity pulling the molten solder downward into the gap between pipe and fitting
- B. The air pressure differential between the heated interior of the joint and the cooler ambient air
- C. Capillary action, which draws molten solder into the narrow gap between the pipe and fitting socket
- D. The torch flame's convective heat directing the molten solder toward the hottest surface of the joint

21. A plumber needs to install a riser clamp on a 4inch vertical copper DWV stack at each floor level. What is the primary function of the riser clamp?

- A. It provides lateral stability to prevent the vertical stack from swaying during seismic activity
- B. It transfers the cumulative weight of the stack above to the building structure at that floor
- C. It connects the stack to the vent system at each floor level for pressure equalization purposes
- D. It acts as a firestop device preventing fire and smoke from passing through the floor penetration

22. What is the standard thread taper for National Pipe Thread (NPT) used on steel pipe connections in plumbing?

- A. 1/8 inch per inch (3/4 inch per foot), which creates a progressively tighter fit as the joint is assembled
- B. 1/4 inch per inch (1 1/2 inches per foot), which provides maximum thread engagement depth
- C. Zero taper — NPT threads are parallel threads that rely entirely on the sealant for leak prevention
- D. 3/4 inch per inch taper (1 inch per foot), the standard for all threaded plumbing pipe connections

23. A plumber is selecting a brazing filler metal for joining copper tube in a medical gas system. Which alloy series is selffluxing when used on coppertocopper joints?

- A. BCuP series (copperphosphorus alloys), where the phosphorus content acts as a builtin flux
- B. BAg series (silver brazing alloys), which require no flux due to their high silver content composition

- C. BCu series (pure copper filler), which bonds to copper without flux due to material compatibility
- D. BNi series (nickelbased alloys), which are selffluxing on all copper and copper alloy substrates

24. A pipe hanger system must support a 6inch steel pipe that will be filled with water during operation. Why must the hanger system be designed for the fullofwater weight rather than the empty weight?

- A. Building codes require all pipe support calculations to use a standard weight regardless of contents
- B. Pipe filled with water is always lighter than empty pipe due to the buoyancy effect of the water
- C. The fullofwater weight can be approximately double the empty weight, and supports must handle the operating load
- D. Steel pipe does not change in total weight when filled with water because the pipe wall absorbs it

25. When preparing PEX tubing for a crimp ring connection, what must the plumber verify about the cut end before inserting the fitting?

- A. The cut end must be chamfered at a 15degree angle to allow the fitting barb to enter smoothly
- B. The cut must be square and clean, with no burrs or deformation that could compromise the seal
- C. The cut end must be heated with a torch to soften the PEX and allow the fitting to slide in easily
- D. The exterior surface of the cut end must be scored with emery cloth to improve the crimp grip

26. A plumber is installing a floor drain in a commercial kitchen. The floor drain will receive only mop water and general cleanup discharge — no food waste. What trap seal maintenance device should be considered for this drain?

- A. A grease interceptor cartridge installed inside the floor drain body to capture FOG from the mop water
- B. A backwater valve installed on the floor drain outlet to prevent sewer backups during heavy rain events
- C. A trap seal primer device that periodically adds water to maintain the seal on an infrequently used drain
- D. A chemical dispenser that adds chlorine to the trap water to prevent bacterial growth and odour

27. In a twopipe steam system, a radiator is not heating even though the supply valve is open and the steam main is hot. The plumber checks the steam trap and finds both the inlet and outlet sides at the same low temperature. What has happened?

- A. The steam trap has failed in the closed position, blocking condensate and preventing new steam from entering
- B. The radiator's thermostatic air vent has failed open, allowing all steam to escape before it can condense
- C. The boiler water level is too high, causing priming that sends water instead of steam to the radiator
- D. The return main is blocked downstream of the trap, creating back pressure that holds the trap closed

28. A plumber is sizing a building drain for a small commercial building with a total drainage load of 85 DFU. The building drain will be installed at a slope of 1/8 inch per foot. According to the sizing table, a 4inch pipe at this slope handles 180 DFU. Is a 4inch building drain adequate?

- A. No, because commercial building drains must always be a minimum of 6 inches regardless of load
- B. No, because the 1/8inch slope is below the minimum permitted for any building drain installation
- C. Yes, but only if the building has fewer than three water closets connected to the drain system
- D. Yes, because 180 DFU capacity exceeds the 85 DFU load with adequate margin for future expansion

29. A plumber encounters an existing Strap beneath a lavatory during renovation work. What is the correct action?

- A. Leave the Strap in place because existing installations are grandfathered under the current code
- B. Replace the Strap with a Ptrap and route the trap arm horizontally to the wall drain connection
- C. Install an air admittance valve on the Strap's vertical leg to prevent selfsiphonage of the seal
- D. Add a second trap downstream of the Strap to provide backup protection against seal loss

30. A percolation test on a property yields a result of 3 minutes per inch. What does this indicate about the soil?

- A. The soil has a moderate percolation rate and is ideal for a conventional septic disposal field
- B. The soil percolates too slowly for a conventional field and requires an engineered alternative system
- C. The soil percolates too quickly and may not provide adequate treatment of the septic effluent
- D. The soil is impermeable and cannot support any type of private sewage disposal system on the property

31. A plumber is installing a vent pipe and must make a horizontal run in the attic before turning vertically to exit through the roof. At what minimum height must the horizontal vent section be installed?

- A. Above the flood level rim of the highest fixture served by the vent to prevent it from carrying drainage
- B. At any convenient height because vent piping never carries water regardless of its installed position
- C. At the same elevation as the building drain to maintain consistent pressure throughout the system
- D. At the midpoint between the highest fixture and the roof penetration for balanced air distribution

32. A building has a belowgrade parking garage with floor drains connected to an oil interceptor. The interceptor must be cleaned on what type of schedule?

- A. Only when a blockage occurs in the parking garage drainage system downstream of the interceptor
- B. Annually, coinciding with the building's general maintenance and inspection schedule each spring
- C. Whenever the building owner notices oil sheen on the water surface of the interceptor access point
- D. A regular documented schedule based on the accumulation rate, as required by local regulations

33. What is the maximum number of consecutive identical answer letters (e.g., AAA) that the fixture unit table permits on a 2inch horizontal branch drain?

- A. This question is about pipe capacity — a 2inch branch handles a maximum of 6 DFU at code slope
- B. 6 DFU maximum, which accommodates a bathtub (2), a shower (2), and a lavatory (1) on one branch
- C. This question misstates — there is no "consecutive answer" rule in the fixture unit sizing methodology
- D. 3 DFU maximum, which limits the branch to a single water closet or two lavatories at most

34. When a building sewer connects to the municipal sanitary sewer main, what fitting or device is typically installed at the property line or at the main?

- A. A cleanout accessible from the surface, providing maintenance access at the building to main junction
- B. A backflow preventer to prevent municipal sewer flow from entering the building's private sewer line
- C. A grease interceptor sized for the building's total kitchen drainage fixture unit load and flow rate
- D. A pressure-reducing valve that limits the sewer flow rate during peak discharge from the building

35. A plumber must install a 3-inch soil stack through the roof of a building in northern Ontario where heavy snowfall is expected. How does snow affect the vent terminal requirements?

- A. No special requirements apply because snow does not affect vent terminal function or performance
- B. The stack diameter must be increased by one size above the roof to prevent snow blockage
- C. The vent terminal must extend high enough above the roof to remain above the expected snow accumulation
- D. A heated vent cap must be installed on every vent terminal in areas where snowfall exceeds 1 metre

36. What type of test plug is typically used to seal the open end of a DWV pipe during an air pressure test?

- A. A permanent solvent-cemented cap that is cut off after the test is completed and the system passes

- B. A threaded steel cap that screws onto the pipe end and is removed after the test is completed
- C. A lead and oakum plug that is poured into the pipe end and chiselled out after the test is complete
- D. An inflatable rubber test plug (test ball) inserted into the pipe and inflated to seal the opening

37. A building's DWV system has been installed and the roughin inspection is scheduled. Which of the following must be completed before the inspector arrives?

- A. All fixtures must be installed and connected so the inspector can verify the complete system
- B. The DWV system must have passed the required pressure test (air or water) before inspection
- C. The walls must be closed with drywall so the inspector can verify the final appearance of the work
- D. The building sewer must be connected to the municipal main and backfilled before the roughin

38. A commercial building has a battery of six identical wallhung lavatories on a single horizontal branch drain in a public washroom. Which venting method is most efficient for this configuration?

- A. Circuit venting, which uses a single vent pipe connected between the last two fixtures on the branch
- B. Individual venting, which provides a dedicated vent pipe for each of the six lavatory trap connections
- C. Stack venting, which uses the soil stack itself as the vent for all six lavatories on the branch drain
- D. Wet venting, which uses the drain pipe of one lavatory to vent the traps of the other five lavatories

39. A plumber is installing underground PVC sewer pipe with gasketed bellandspigot joints. What makes these joints resistant to root intrusion compared to older clay pipe joints?

- A. PVC pipe emits a chemical that naturally repels tree roots from approaching the pipe exterior
- B. The bellandspigot design forces roots to grow around the pipe rather than into the joint gaps
- C. The rubber gasket creates a continuous, tight seal that leaves no gap for roots to penetrate
- D. PVC pipe is installed deeper than clay pipe, below the depth where most tree roots grow

40. A plumber sizes a vent stack for a soil stack carrying 100 DFU. The code requires the vent to be at least half the stack's diameter. If the soil stack is 4 inches, what is the minimum vent diameter?

- A. 1 1/4 inches (32 mm), which is the absolute minimum vent size permitted by the plumbing code
- B. 2 inches (50 mm), which is half the 4inch soil stack diameter and meets the code minimum
- C. 3 inches (75 mm), which is threequarters of the stack diameter for additional safety margin
- D. 4 inches (100 mm), which matches the full soil stack diameter for maximum venting capacity

41. A homeowner on a private well and septic system asks whether a garbage disposal (food waste grinder) can be installed on the kitchen sink. What concern should the plumber raise?

- A. Garbage disposals are prohibited by the plumbing code on any kitchen sink regardless of the system
- B. The additional solid waste from a disposal may overwhelm the well pump's capacity to deliver water

- C. The electrical requirements of a garbage disposal exceed the capacity of a typical residential circuit
- D. The additional solids significantly increase the load on the septic tank, requiring more frequent pumping

42. In a DWV system, what is the primary purpose of the cleanout installed at the base of every soil and waste stack?

- A. To provide access for drain cleaning equipment to clear blockages in the stack and downstream piping
- B. To allow air to enter the base of the stack during peak drainage flow for pressure equalization
- C. To serve as a secondary drain outlet if the building drain becomes blocked during heavy usage
- D. To provide a connection point for a video inspection camera to survey the building sewer line

43. A plumber is roughing in a bathroom and must install the closet bend for a water closet. At what distance from the finished wall must the centre of the closet flange be positioned for a standard roughin toilet?

- A. 254 mm (10 inches) from the finished wall surface for compactdesign water closet models
- B. 356 mm (14 inches) from the finished wall surface for comfortheight water closet models
- C. 305 mm (12 inches) from the finished wall surface for standard residential water closet models
- D. 380 mm (15 inches) from the finished wall surface for commercial flushometer water closet models

44. A twostorey building has a bathroom on each floor. Both bathrooms connect to the same soil stack. During a simultaneous flush of both toilets, what prevents the upper floor's trap seal from being lost?

- A. The increased pipe diameter at the base of the stack absorbs the combined flow without turbulence
- B. The vent system provides air to equalize pressure in the stack, preventing siphonage of trap seals
- C. The lower floor's water closet acts as a buffer that absorbs the pressure wave from the upper flush
- D. The stack is sized large enough that both flushes can flow simultaneously without filling the full bore

45. What is the primary difference between a building drain and a building sewer?

- A. The building drain is horizontal and the building sewer is vertical, reflecting their respective orientations
- B. The building drain carries only greywater and the building sewer carries both greywater and blackwater
- C. The building drain uses larger pipe than the building sewer to accommodate higher fixture unit loads
- D. The building drain is inside the building and the building sewer extends from the building to the main

46. A plumber discovers during a video inspection that a section of building sewer has a belly — a low point holding standing water. What problem does this cause?

- A. Standing water in the belly traps debris and solids, causing recurring blockages at that location
- B. The belly creates excessive velocity that erodes the pipe material at the low point over time

- C. The standing water generates enough pressure to push backward through the upstream piping
- D. The belly causes the downstream pipe section to run dry, starving the municipal sewer of flow

47. A septic system's disposal field has failed — effluent is surfacing on the ground above the field. The septic tank has not been pumped in over 10 years. What is the most likely cause of the failure?

- A. The distribution box has corroded and is no longer dividing flow evenly among the field trenches
- B. The building sewer between the house and the tank has partially collapsed, restricting flow to the tank
- C. Solids from the neglected tank have migrated to the field and clogged the absorption soil
- D. The percolation rate of the native soil has changed due to drought conditions compacting the ground

48. A plumber installs a combination wye and eighth bend at the base of a soil stack. What advantage does this fitting provide over a shortpattern 90degree elbow at the same location?

- A. It is physically smaller and requires less space in the building's mechanical chase or wall cavity
- B. It provides a smooth, gradual change of direction that minimizes turbulence and prevents back pressure
- C. It allows the building drain to be connected at a steeper slope than a standard 90degree fitting permits
- D. It eliminates the need for a cleanout at the base of the stack by providing builtin access for cleaning

49. In a circuitvented system serving a row of eight water closets in a commercial washroom, what additional component may be required on long horizontal branches?

- A. An air admittance valve at each water closet to supplement the circuit vent's air supply capacity
- B. A dedicated individual vent for each water closet in addition to the circuit vent pipe on the branch
- C. An expansion joint in the horizontal branch to accommodate thermal movement of the DWV piping
- D. A relief vent at specified intervals along the branch to supplement air circulation in the system

50. A plumber tests an existing DWV system with a smoke test and observes smoke emerging from a wall on the second floor. What does this indicate?

- A. A crack or defect in the concealed DWV piping inside the wall is allowing smoke (and sewer gas) to escape
- B. The vent terminal on the roof is blocked, forcing smoke to find an alternate exit path through the wall
- C. The trap on a secondfloor fixture has evaporated, allowing smoke to enter the room through the drain
- D. The smoke machine is malfunctioning and producing smoke that penetrates through wall materials

51. A plumber must install a floor drain in an unoccupied basement storage room that will rarely receive water. What device prevents the trap seal from evaporating over time?

- A. A trap seal primer that automatically delivers water to the drain at regular intervals to maintain the seal
- B. A deeperthanstandard trap with a 150 mm (6inch) seal depth that takes longer to evaporate
- C. A sealed cover over the floor drain that prevents air movement across the trap's water surface
- D. A chemical additive poured into the trap that floats on the water surface and prevents evaporation

52. A municipal building inspector rejects a DWV rough-in because a 3-inch horizontal branch drain connecting to another horizontal drain uses a sanitary tee fitting. What fitting should have been used?

- A. A standard pressure-type tee because horizontal-to-horizontal connections do not require sweep fittings
- B. A short-pattern 90-degree elbow to redirect the branch flow into the horizontal main at a right angle
- C. A wye or combination wye and eighth bend to provide a smooth, swept entry into the horizontal main
- D. A long-radius reducing coupling to transition the 3-inch branch down to a 2-inch main connection

53. What determines whether a pipe in a DWV system is classified as a "soil pipe" versus a "waste pipe"?

- A. Soil pipe is underground piping and waste pipe is aboveground piping in the same drainage system
- B. Soil pipe carries water closet or urinal discharge; waste pipe carries only greywater without fecal matter
- C. Soil pipe is made of cast iron and waste pipe is made of plastic in all DWV piping installations
- D. Soil pipe serves commercial buildings and waste pipe serves residential buildings under the code

54. A plumber is installing a sewage ejector system for a basement bathroom. The discharge pipe must connect to the gravity drainage system above the flood level rim of which fixture?

- A. The lowest fixture on the ground floor directly above the basement bathroom being installed
- B. The building's main floor toilet, which is typically the highest-volume fixture in the drainage system
- C. Any fixture on the ground floor, as long as the connection point is above the basement ceiling level
- D. The highest fixture served by the ejector system, preventing the gravity system from backfeeding

55. A building sewer video inspection reveals offset joints — where successive pipe sections are misaligned at the joint, creating a ledge inside the pipe. What problem do offset joints cause?

- A. Debris catches on the internal ledge at each offset joint, gradually building up and causing blockages
- B. The offset joints allow excessive groundwater infiltration that overwhelms the building's sump pump
- C. The misaligned joints create noise that transmits through the soil and is audible inside the building
- D. The offset joints cause the pipe to flex excessively during ground movement, leading to full separation

56. The National Plumbing Code requires that storm drainage and sanitary drainage remain separate in buildings connected to separated municipal sewer systems. What is the consequence of connecting a roof drain to the sanitary sewer?

- A. The roof drain will not function properly because sanitary sewers operate at higher pressure than storm
- B. No consequence — roof drains carrying only rainwater are acceptable connections to any sewer type
- C. During heavy rain, the additional stormwater volume overwhelms the sanitary sewer and treatment plant
- D. The sanitary sewer gases will escape through the roof drain and create an odour problem on the roof

57. A municipal water supply enters a building at 620 kPa (90 psi). The plumbing code limits fixture pressure to a maximum of 550 kPa (80 psi). What must be installed?

- A. A booster pump to increase the pressure to a level that provides adequate flow to all building fixtures

- B. A pressure-reducing valve (PRV) on the water service to reduce the supply pressure below 550 kPa
- C. An expansion tank on the water service to absorb the excess pressure and protect the building piping
- D. A pressure relief valve that discharges water when the system pressure exceeds the 550 kPa maximum

58. A plumber is sizing a water supply system. The available pressure at the meter is 415 kPa (60 psi). The highest fixture is 12 metres above the meter. Friction losses total 70 kPa. What is the approximate residual pressure at the highest fixture?

- A. 345 kPa, calculated by subtracting only the friction losses from the available supply pressure
- B. 250 kPa, calculated by subtracting the elevation loss but not the friction losses from the supply
- C. 115 kPa, calculated by subtracting both a doubled friction loss and elevation from supply pressure
- D. 228 kPa, calculated by subtracting both the elevation loss (118 kPa) and friction loss (70 kPa)

59. A plumber installs a double check valve assembly (DCVA) on the water supply connection to an irrigation system without chemical injection. What hazard classification does this level of protection address?

- A. Severe (health) hazard, requiring the highest level of mechanical backflow protection available
- B. No hazard classification — DCVAs are installed for pressure regulation rather than backflow prevention
- C. Minor (nonhealth) hazard, where the contaminant could affect taste or appearance but not cause illness

D. Both severe and minor hazards simultaneously, providing universal protection against all contamination

60. A homeowner reports that water hammer occurs every time the washing machine's fill valve shuts off. Where should the water hammer arrestor be installed?

A. On the main water service line at the point where it enters the building near the water meter

B. On both the hot and cold supply lines at the washing machine connection point behind the machine

C. On the hot water supply line only, since hot water creates more thermal shock than cold water

D. Inside the washing machine by replacing the standard fill valve with a slowclosing fill valve model

61. A plumber is connecting a new residential water service using HDPE pipe. What advantage does HDPE offer over copper for this underground application?

A. HDPE is significantly heavier than copper, providing greater resistance to ground movement forces

B. HDPE requires no special tools for joining and can be connected using standard threaded fittings

C. HDPE has a shorter expected service life than copper but is less expensive as an initial investment

D. HDPE's fused joints are as strong as the pipe itself, eliminating joint leaks and root intrusion

62. What is the primary function of the corporation stop installed on the municipal water main?

A. It provides the first shutoff point for the individual building's water service at the main connection

- B. It measures the water pressure in the municipal main for monitoring by the water utility company
- C. It filters sediment from the municipal main before the water enters the building's service pipe
- D. It reduces the municipal main pressure to a safe level before the water enters the service pipe

63. A plumber is installing a backflow preventer on a connection to a laboratory's deionized water system. The system contains chemicals that pose a health hazard. Which device is required?

- A. A double check valve assembly (DCVA) rated for the system's maximum operating pressure
- B. An atmospheric vacuum breaker (AVB) installed 150 mm above the highest downstream outlet
- C. A reduced pressure principle (RP/RPZ) assembly because the crossconnection is a health hazard
- D. A pressure vacuum breaker (PVB) installed 300 mm above the highest laboratory fixture outlet

64. In a hot water recirculation system, what happens if the return piping is not insulated?

- A. The circulator pump motor will overheat due to the increased thermal load from the uninsulated pipe
- B. Heat lost from the uninsulated return pipe wastes energy and forces the water heater to work harder
- C. The water in the return pipe will freeze during winter months if the pipe runs through unheated spaces
- D. Condensation will form on the exterior of the uninsulated return pipe, causing moisture damage to walls

65. A plumber must install a water supply to a dental office. The dental equipment uses chemicals for sterilization. What level of backflow protection is required on the dental unit's water connection?

- A. A dual check valve without test ports installed on the supply tube beneath the dental treatment chair
- B. An atmospheric vacuum breaker integrated into each dental handpiece connection at the chair unit
- C. No backflow prevention because dental offices use only potable water in their treatment equipment
- D. A reduced pressure (RP) device or an air gap because dental chemical systems are a severe hazard

66. A plumber observes that the pressure gauge downstream of a PRV reads 520 kPa (75 psi) — significantly above the PRV's 415 kPa (60 psi) set point. What is the most likely explanation?

- A. The PRV has failed or is worn out and is no longer regulating pressure to its set point accurately
- B. The expansion tank has lost its air charge, causing thermal expansion pressure to exceed the set point
- C. The water meter upstream of the PRV is restricting flow, which artificially raises the gauge reading
- D. The pressure gauge is malfunctioning and should be replaced before any diagnosis is attempted

67. What is the maximum hot water delivery temperature permitted at a public lavatory faucet in a healthcare facility?

- A. 60°C (140°F), matching the storage temperature in the water heater for Legionella prevention
- B. 49°C (120°F), matching the standard maximum for showers and bathtubs in residential buildings

C. 43°C (110°F), which some jurisdictions require for public lavatories in healthcare and institutional settings

D. 38°C (100°F), which provides a comfortable handwashing temperature without any scald risk

68. A building has a pressurized water supply system that operates as a closed system (PRV installed). During the day, the system pressure is stable at 415 kPa. At 3:00 AM, with no fixtures running, the pressure has risen to 480 kPa. What is causing this?

A. The municipal supply pressure increases at night when demand on the main drops throughout the city

B. Thermal expansion from the water heater's recovery cycle is raising the pressure in the closed system

C. The circulator pump in the hot water recirculation system is generating additional pressure at night

D. Air trapped in the piping is expanding as the ambient temperature in the mechanical room rises overnight

69. A plumber needs to test all backflow prevention assemblies in a commercial building. How often must testable backflow preventers (DCVAs, PVBs, RP devices) be tested?

A. Every 5 years, coinciding with the scheduled replacement interval for the internal check valve seats

B. Only after a known backflow event has been reported to the local water utility by the building owner

C. Monthly, with the results reported to the local health authority within 24 hours of each test

D. Annually, by a certified crossconnection control tester with results reported to the authority

70. A plumber is installing copper water supply piping in a building with aggressive water chemistry (low pH, high dissolved oxygen). Which copper tube type provides the greatest corrosion allowance?

- A. Type K, which has the thickest wall and therefore the greatest material available to resist corrosion
- B. Type L, which has a specialized interior coating that resists corrosive water chemistry attack
- C. Type M, which is manufactured from a corrosion-resistant copper alloy for aggressive water service
- D. Type DWV, which has enhanced chemical resistance due to its drainage-grade manufacturing process

71. A new commercial building is 18 storeys tall. The municipal supply pressure is adequate for the lower floors but insufficient for upper floors. How is the water supply system typically configured?

- A. A single booster pump at the service entry increases the pressure for the entire building simultaneously
- B. The entire building operates on gravity from a rooftop storage tank filled by the municipal supply
- C. The building is divided into pressure zones, with booster pumps serving the upper zones independently
- D. Each floor has its own dedicated PRV that progressively increases the supply pressure per floor

72. A plumber discovers that a building's water supply piping was installed with 3/4-inch copper tube on a branch that requires 1-inch tube based on the fixture unit calculation. What is the consequence?

- A. The branch will leak at the joints because the undersized pipe creates excessive joint stress
- B. The undersized pipe causes higher velocity, increased friction loss, and reduced pressure at fixtures

- C. The fixtures on the branch will receive excessive pressure due to the venturi effect in small pipe
- D. There is no practical consequence because copper pipe sizing provides generous safety margins

73. A plumber must install an air gap for a commercial dishwasher's drain connection. What defines a proper air gap?

- A. A physical separation of at least twice the supply pipe diameter (minimum 25 mm) between the outlet and receiving vessel
- B. A mechanical check valve installed between the dishwasher drain and the floor sink receptor
- C. A high loop in the drain hose that reaches above the flood level rim of the receiving fixture
- D. A physical separation of at least twice the drain pipe diameter (minimum 25 mm) between the outlet and flood rim

74. What is the primary function of the dip tube inside a storage water heater tank?

- A. It directs incoming cold water to the bottom of the tank where the heat source is located
- B. It circulates hot water from the top of the tank down to the bottom to prevent stratification
- C. It provides a passage for the anode rod to extend from the top of the tank to the bottom
- D. It serves as the vent pipe for combustion gases to exit the tank through the top connection

75. A plumber installs a pressure vacuum breaker (PVB) on an irrigation system supply. At what minimum height above the highest sprinkler head must the PVB be installed?

- A. 150 mm (6 inches) above the highest downstream sprinkler head in the irrigation zone layout
- B. At grade level, since PVBs are designed for underground installation near the irrigation valves
- C. 300 mm (12 inches) above the highest downstream sprinkler head in the irrigation zone layout
- D. At the same elevation as the highest sprinkler head, with no additional height requirement

76. A plumber troubleshoots a system where the water heater T&P relief valve discharges every evening around 7:00 PM — the time when the family takes showers. The system has a PRV and an expansion tank. What should be checked first?

- A. The T&P relief valve itself, which may have weakened and is opening at a lower pressure than rated
- B. The water heater thermostat, which may be set above 60°C and is causing overheating during recovery
- C. The municipal supply pressure, which may spike during evening peak hours above the T&P setting
- D. The expansion tank precharge, which may have been lost, making the tank unable to absorb expansion

77. What is the purpose of a strainer (Ystrainer) installed upstream of a pressure-reducing valve on a water service?

- A. It measures the flow rate through the service to help size the PRV for the building's demand level

- B. It captures debris and sediment that could foul the PRV's internal diaphragm or spring mechanism
- C. It reduces the water pressure slightly before the PRV for smoother and more accurate regulation
- D. It provides a secondary pressure reduction in case the primary PRV fails or exceeds its set point

78. A plumber connects a boiler fill valve to the domestic water supply for a hydronic heating system. What must be installed at this connection?

- A. A backflow prevention device because boiler water may contain chemicals that contaminate the supply
- B. A thermal expansion tank to protect the domestic supply from pressure generated by the boiler
- C. A pressure-reducing valve to step the domestic supply pressure down to the boiler's operating level
- D. A water meter to track the volume of domestic water consumed by the hydronic heating system

79. What happens to water velocity in a supply pipe when the pipe diameter is reduced while maintaining the same flow rate?

- A. Velocity decreases because the smaller pipe creates more friction that slows the water movement
- B. Velocity remains unchanged because the flow rate determines the velocity regardless of pipe size
- C. Velocity increases because the same volume of water must pass through a smaller cross-sectional area
- D. Velocity fluctuates unpredictably because the transition from large to small pipe creates turbulence

80. A plumber installs a wall-hung water closet with a concealed carrier in a commercial washroom. What structural requirement applies to the carrier?

- A. The carrier must be bolted to the finished wall surface with toggle bolts rated for the fixture weight
- B. The carrier bracket need only support the fixture's empty weight since the flush water exits quickly
- C. The carrier may be attached to the floor only with no wall connection required for wallhung bowls
- D. The carrier must be anchored to the building structure and rated to support the fixture and user weight

81. A plumber is replacing a residential electric water heater. After installation, the heater does not produce hot water. The circuit breaker is on. What should be checked next?

- A. The anode rod, which may need to be replaced before the heater can begin producing hot water
- B. The highlimit reset button on the upper thermostat, which may have tripped during installation
- C. The T&P relief valve, which may be stuck open and releasing hot water before it reaches fixtures
- D. The expansion tank, which may be preventing cold water from entering the heater tank properly

82. A dualflush water closet offers two flush options. What is the typical volume for the reduced (liquid waste) flush?

- A. 3 to 4 litres (0.8 to 1.0 gallons), which is approximately half the full flush volume for solid waste
- B. 6 litres (1.6 gallons), matching the standard fullflush volume for all current water closet models
- C. 1 litre (0.26 gallons), which provides the minimum volume needed to clear liquid waste from the bowl
- D. 9 litres (2.4 gallons), which is the reduced flush for older dualflush models manufactured before 2010

83. A water softener's regeneration brine must drain to the building's drainage system. What must be provided at the drain connection?

- A. A direct connection to the nearest sanitary drain using a permanent solventcemented PVC pipe joint
- B. A check valve on the drain line to prevent sewer gas from entering the softener through the drain tube
- C. An air gap between the softener's drain tube and the receptor to prevent backsiphonage from the drain
- D. A grease interceptor on the drain line to capture sodium chloride before it enters the sanitary sewer

84. A plumber is installing a bathtub drain. The wasteandoverflow assembly connects the drain fitting at the bottom of the tub to what other component?

- A. The hot water supply valve, which shares a common connection point beneath the bathtub deck
- B. The vent pipe serving the bathtub, which must connect below the tub's flood level rim for code compliance
- C. The building drain directly, bypassing the Ptrap to reduce the number of fittings in the connection
- D. The overflow fitting on the tub wall, combining both into a single tailpiece connected to the Ptrap below

85. A plumber installs a pointofuse tankless electric water heater under a kitchen sink. What is the primary limitation of this type of heater compared to a wholehouse gas tankless unit?

- A. Electric tankless heaters cannot produce water temperatures above 40°C (104°F) under any conditions

- B. Electric tankless heaters have limited flow capacity and may not serve multiple fixtures simultaneously
- C. Electric tankless heaters require a dedicated gas line in addition to the electrical connection for ignition
- D. Electric tankless heaters produce hot water less safely than gas models due to submersed heating elements

86. A plumber is connecting a residential dishwasher. The dishwasher manufacturer's instructions require a high loop in the drain hose. At what height must the high loop reach?

- A. As high as possible beneath the countertop, typically to the underside of the counter surface
- B. Exactly 150 mm (6 inches) above the floor to clear the cabinet's toekick area during installation
- C. At the same height as the kitchen sink's flood level rim for equalized drainage during operation
- D. No specific height is required — any visible loop in the drain hose satisfies the code requirement

87. What type of water treatment system uses a semipermeable membrane to remove dissolved solids, heavy metals, and contaminants at the molecular level?

- A. An activated carbon filtration system that uses adsorption to capture dissolved organic compounds
- B. An ion exchange water softener that replaces hardness minerals with sodium ions on a resin bed
- C. A reverse osmosis (RO) system that forces water through a membrane under pressure
- D. A sediment filtration system that uses a mechanical barrier to trap particles above a specific size

88. A plumber notices that the glass bulb on a residential fire sprinkler head in a kitchen has turned from red to clear. What does this color change indicate?

- A. The bulb colour is a factory identifier for the head's flow rate and has no operational significance
- B. The bulb colour indicates the activation temperature — different colours represent different ratings
- C. The clear bulb means the head has been deactivated and will not discharge water during a fire event
- D. The bulb has changed colour due to heat exposure and the sprinkler head should be replaced

89. A plumber is installing supply connections to a wallmounted commercial lavatory. What type of supply tube is recommended for modern installations?

- A. Rigid chromeplated copper supply tubes cut and bent precisely to match the valvetofaucet distance
- B. Flexible stainless steel braided supply tubes that accommodate minor misalignment and simplify installation
- C. Soft copper tube with compression fittings at each end, annealed in place after the connection is made
- D. PEX tubing with pushfit connectors at both the stop valve and faucet inlet for toolfree installation

90. A water heater's energy factor (EF) or uniform energy factor (UEF) rating compares different models. What does a higher EF/UEF number indicate?

- A. Greater energy efficiency — more of the input energy is converted to usable hot water output

- B. Greater storage capacity — the tank holds more hot water available for immediate delivery to fixtures
- C. Greater recovery rate — the heater reheats the tank contents faster after a large hot water draw
- D. Greater maximum temperature — the heater can produce hotter water than lowerrated models

91. A plumber is replacing the cartridge in a singlehandle pressurebalanced shower valve. Before removing the cartridge, what must be done?

- A. Turn off the water heater to prevent hot water from being delivered to the valve during the repair
- B. Open another hot water fixture on the same floor to relieve pressure in the supply lines locally
- C. Shut off the hot and cold supply lines to the shower valve using the fixture stop valves or main shutoff
- D. Remove the showerhead to provide an outlet for any residual water pressure remaining in the valve body

92. A commercial building's water treatment system includes an ultraviolet (UV) disinfection unit. What does UV disinfection accomplish that filtration and softening cannot?

- A. It adjusts the pH of the water to neutral levels for compatibility with copper supply piping systems
- B. It removes dissolved minerals that cause hardness, scale buildup, and staining on plumbing fixtures
- C. It removes chlorine, taste, and odour compounds that are present in the municipally treated supply water
- D. It destroys bacteria, viruses, and other microorganisms by disrupting their DNA with UVC light

93. A fire sprinkler system flow switch activates an audible alarm in the building. What event triggers this alarm?

- A. A sprinkler head has activated and water is flowing through the system to suppress a fire in progress
- B. The system pressure has dropped below the minimum operating level due to a leak in the supply pipe
- C. The fire alarm control panel has detected smoke and preactivated the sprinkler system for standby
- D. The building's fire department connection has been charged by firefighters arriving on the scene

94. A plumber is installing an undersink reverse osmosis system. Where must the reject (waste) water line connect?

- A. To the hot water supply line so the concentrated minerals can be diluted by the heated water flow
- B. To the building's exterior through a dedicated waste pipe that discharges onto the ground surface
- C. To an approved drain through an air gap connection to prevent backsiphonage into the RO system
- D. To the cold water supply line upstream of the RO unit to recirculate and improve the recovery ratio

95. A plumber installs a water heater in a garage where vehicles are parked. If the water heater has a standing pilot light or an ignition source near the floor, what safety concern must be addressed?

- A. Carbon monoxide from vehicle exhaust may be drawn into the water heater's combustion air intake
- B. Gasoline vapours (heavier than air) pooling at floor level could be ignited by the lowmounted flame

- C. Vibration from vehicles entering and exiting the garage may loosen the water heater's gas connections
- D. Road salt and moisture tracked in by vehicles will corrode the water heater's exterior cabinet rapidly

96. A hydronic heating system with an ECM (electronically commutated motor) variable speed circulator automatically reduces pump speed when zone valves close. What is the primary benefit of this feature?

- A. It eliminates the need for an expansion tank because the reduced flow prevents thermal expansion
- B. It prevents damage to the boiler heat exchanger by maintaining minimum flow at all operating speeds
- C. It increases the supply water temperature to compensate for the reduced flow through open zones
- D. It reduces energy consumption and eliminates the need for a bypass valve in the system design

97. A plumber is commissioning a new hydronic heating system. After filling the system, air must be removed. What is the correct procedure?

- A. Open the manual air bleed valves on each emitter starting at the lowest and working upward to the highest
- B. Run the circulator at maximum speed for 24 hours to force air bubbles through the system automatically
- C. Drain the entire system and refill it slowly from the lowest point to push air upward and out through vents
- D. Add a chemical air removal agent to the system water that dissolves trapped air into the circulating water

98. A hydronic boiler's operating aquastat is set to maintain a supply water temperature of 77°C (170°F). The highlimit control is set at 93°C (200°F). What happens if the operating aquastat fails in the "on" position?

- A. The boiler will continue to fire indefinitely and the water temperature will rise without any safety limit
- B. The highlimit control will shut off the burner when the water temperature reaches 93°C, preventing overheating
- C. The circulator will increase speed to remove excess heat and prevent the water from reaching the limit
- D. The expansion tank will absorb the excess heat energy and prevent the water temperature from rising

99. A plumber is troubleshooting a hydronic system where the boiler fires and the circulator runs, but all radiators remain cold. What is the most likely cause?

- A. The boiler's highlimit control has tripped and is preventing the water from reaching operating temperature
- B. The air separator has failed and is blocking water flow between the boiler and the distribution piping
- C. The system water has been completely lost through a leak, and the circulator is running on an empty system
- D. All zone valves are closed because no thermostats are calling for heat in any of the building's zones

100. In a onepipe steam system, fasterheating radiators near the boiler can be balanced with slowerheating radiators farther away by adjusting what component?

- A. The steam supply valve on each radiator, throttling it to equalize the steam arrival time across zones
- B. The thermostatic air vent on each radiator — faster vents on distant radiators, slower vents on close ones
- C. The boiler's operating pressure control, increasing pressure to push steam to distant radiators faster
- D. The condensate return pitch on each radiator, increasing the slope to speed up condensate drainage

101. A condensing boiler is installed with baseboard heating throughout the building. The system operates with supply water at 77°C and return water at 66°C. Is this boiler operating in condensing mode?

- A. Yes, because all condensing boilers operate in condensing mode regardless of the return water temperature
- B. No, because condensing boilers only achieve condensing mode during the initial startup of each cycle
- C. No, because the return water temperature of 66°C is above the ~55°C dew point required for condensation
- D. Yes, because the temperature differential between supply and return is sufficient to trigger condensation

102. What type of expansion tank has an internal flexible diaphragm separating the air charge from the system water?

- A. A diaphragm (bladder) expansion tank, which prevents the air charge from being absorbed into the water
- B. A standard (plain steel) expansion tank, which uses an open airwater interface without any separation

C. A compression tank, which uses a mechanical piston to separate the air and water chambers under pressure

D. An atmospheric tank, which is open to air at the top and maintains the air charge through direct contact

103. A plumber notices that a hydronic system's pressure gauge reads 69 kPa (10 psi) when the system is cold — significantly below the normal coldfill pressure of 103 kPa (15 psi). What does this indicate?

A. The expansion tank air precharge is set too high, pushing water out of the tank and lowering pressure

B. The boiler's highlimit control has tripped, preventing the system from reaching normal operating temperature

C. The circulator pump is creating a vacuum condition on the suction side that depresses the gauge reading

D. The system has a water leak or the automatic fill valve is not maintaining the correct fill pressure

104. In a primarysecondary hydronic system, what happens to the primary loop flow when no secondary zone is calling for heat?

A. The primary loop circulator shuts off because there is no load requiring heat from the boiler circuit

B. The primary loop continues to circulate through the boiler and the closely spaced tees with no secondary flow

C. The primary loop reverses direction and flows backward through the secondary loops to maintain circulation

D. The primary loop flow rate doubles to compensate for the lack of secondary flow and maintain boiler output

105. A steam boiler's gauge glass shows no visible water level — the glass appears to be full of steam. What does this critical condition indicate?

- A. The boiler water level has dropped below the bottom of the gauge glass, indicating a dangerous lowwater condition
- B. The gauge glass is fogged from the temperature differential between the glass and the surrounding air
- C. The boiler is operating at maximum capacity and the water level is temporarily above the gauge glass top
- D. The gauge glass drain valve is partially open, allowing water to drain faster than it enters the glass

106. A thermostatic radiator valve (TRV) is installed on a radiator in a private office. The occupant complains that the office is always too warm. What adjustment should be made?

- A. Replace the TRV with a fixed orifice balancing valve that provides constant flow regardless of temperature
- B. Remove the TRV and install a manual gate valve that the occupant can open and close as desired
- C. Turn the TRV dial to a lower number setting, which reduces the temperature at which the valve closes
- D. Install a bypass pipe around the radiator that allows excess heat to dissipate without entering the room

107. What causes a standard (plain steel) expansion tank to become waterlogged over time?

- A. The tank shell corrodes through and allows air to escape, which is replaced by water from the system

- B. The automatic fill valve continuously adds water to the tank beyond its rated capacity over many cycles
- C. The circulator pump generates pressure surges that force water into the air space during each cycle
- D. Air in the tank is gradually absorbed into the system water (Henry's Law), and water fills the vacated space

108. A twopipe steam system has a radiator that heats only partially — the supply side is hot but the return side is cold. No water hammer is present. What is the most likely cause?

- A. The steam supply valve is partially closed, restricting the amount of steam entering the radiator body
- B. The steam trap is partially blocked with debris, allowing some condensate to pass but restricting full flow
- C. The radiator is oversized for the heat load of the room and only needs partial output to satisfy demand
- D. Air is trapped in the radiator, preventing steam from fully penetrating to the return side of the unit

109. A plumber installs a new condensing boiler with PVC vent piping. What characteristic of the condensing boiler's exhaust allows PVC venting?

- A. The exhaust temperature is low enough (below PVC's softening point) due to maximum heat extraction
- B. The exhaust contains no moisture and therefore cannot cause degradation of the PVC vent material
- C. The PVC vent pipe is pressurized by the inducer fan, which prevents condensate from contacting the pipe
- D. The PVC pipe is treated with a heatresistant coating at the factory specifically for condensing exhaust

110. A building owner reports that the pressure relief valve on a hydronic boiler discharges water every morning when the system heats up. The system has a diaphragm expansion tank. What should be checked?

- A. The boiler's operating aquastat setting, which may be set too high causing excessive temperature rise
- B. The pressure relief valve itself, which may have a weakened spring opening below its rated pressure
- C. The zone valves, which may all be closing simultaneously and blocking flow from leaving the boiler
- D. The expansion tank's air precharge pressure, which may have been lost, rendering the tank ineffective

111. Which hydronic heating emitter provides the most uniform floortoceiling temperature distribution in a room?

- A. A ceilingmounted fan coil unit that blows heated air downward from the highest point of the room
- B. A wallmounted baseboard convector that heats air at floor level and relies on natural convection upward
- C. Radiant floor heating, which heats the floor surface and distributes warmth evenly upward through the room
- D. A freestanding cast iron radiator positioned beneath a window to counteract cold air infiltration

112. A medical gas system requires a 24hour standing pressure test. What test medium is used?

- A. The actual medical gas (oxygen, nitrogen, etc.) that the system will carry in patient service
- B. Oilfree, dry nitrogen pressurized to 1.5 times the system's maximum working pressure

- C. Compressed air from the building's standard compressed air system filtered to medical grade
- D. Distilled water pressurized hydrostatically to 1.5 times the system's maximum working pressure

113. In a compressed air distribution system, what is the function of a drip leg installed at a low point on the main header?

- A. It collects condensate that accumulates in the header, preventing moisture from reaching branch outlets
- B. It provides a connection point for additional branch lines to be added to the system in the future
- C. It reduces the air pressure at the low point to prevent excessive velocity in the downstream piping
- D. It anchors the main header pipe to the building structure at the low point to prevent sagging

114. A swimming pool pump has a strainer basket (hair and lint trap) on the suction side. What happens if the strainer basket becomes completely clogged with debris?

- A. The pool water level will rise because filtered water cannot be returned fast enough to the pool shell
- B. The pump will circulate water normally because the strainer is only a secondary filtration component
- C. The chemical treatment system will overdose chlorine because the reduced flow increases contact time
- D. The pump may lose prime or overheat because the restricted suction starves the pump of water flow

115. A plumber is installing gas piping using CSST (Corrugated Stainless Steel Tubing). What electrical requirement must be met before the system is put into service?

- A. The CSST must be connected to a dedicated 15amp electrical circuit for cathodic protection against corrosion
- B. An isolation transformer must be installed between the building's electrical panel and the gas meter
- C. The CSST must be properly bonded to the building's electrical grounding system for lightning protection
- D. Each section of CSST must be wrapped in a conductive metallic tape connected to an earth ground rod

116. A plumber winterizes an irrigation system in November. During the compressed air blowout, water continues to mist from one sprinkler head after all other heads on the zone have cleared. What does this indicate?

- A. The sprinkler head is at the highest elevation in the zone and collects the last remaining water by gravity
- B. The sprinkler head is located at a low point or at the end of the lateral where water collects by gravity
- C. The compressor pressure is too low to evacuate water from that head and must be increased above 50 psi
- D. The sprinkler head is defective and is trapping water inside its body due to a failed internal mechanism

117. What is the DISS (Diameter Index Safety System) used for in medical gas installations?

- A. It measures the diameter of medical gas piping to verify that the correct size was installed per design
- B. It calculates the safe operating pressure for each medical gas based on the pipe diameter and length
- C. It colorcodes the medical gas cylinders to ensure correct identification during cylinder changeover

D. It provides gasspecific outlet connectors that are mechanically unique, preventing wronggas connections

118. An oil interceptor in an automotive repair shop must be cleaned by a licensed waste hauler. Why can't the accumulated oil simply be poured down the drain?

A. Petroleumbased oil is toxic to wastewater treatment plant biological processes and is an environmental pollutant

B. Pouring oil down the drain would damage the PVC drainage piping downstream of the interceptor

C. The oil would solidify in the building sewer and create a blockage similar to a grease interceptor failure

D. Disposal of waste oil is regulated by the plumbing code and must be performed by a licensed plumber

119. A process piping installation requires acidresistant drainage to carry waste from a laboratory to a neutralization tank. Which pipe material is appropriate?

A. Black steel pipe with threaded joints, which provides strength and is standard for industrial applications

B. Copper Type L with soldered joints, which is used for laboratory water supply and drainage systems

C. CPVC or polypropylene pipe, which provides chemical resistance to acids at moderate temperatures

D. Cast iron pipe with nohub couplings, which is standard for all commercial drainage installations

120. In a swimming pool system, chemical injection (chlorine) must be located where in the circulation loop?

- A. Before the pump suction to ensure chemicals are distributed evenly through the entire circulation system
- B. After the filter and heater on the return line, so concentrated chemicals do not damage those components
- C. Directly into the pool through a wallmounted chemical dispenser that meters chemicals into the water
- D. In the skimmer basket, where the turbulence from the suction distributes the chemical through the water

121. A plumber connects a propane gas supply to a basement water heater. What special consideration applies to propane installations in belowgrade spaces?

- A. Propane installations in basements are unrestricted because modern gas appliances have sealed combustion
- B. Propane appliances in basements must have electronic gas detectors installed at or near floor level
- C. Propane appliances are never installed in basements because the building code prohibits all gas in basements
- D. Propane is heavier than air and pools in low areas, requiring specific ventilation and detection measures

122. A medical gas installer has completed all brazing on an oxygen system. Before the crossconnection test, what test is performed first?

- A. The 24hour standing pressure test at 1.5 times working pressure using oilfree dry nitrogen
- B. The purity test using a calibrated oxygen analyser to verify gas concentration at each outlet
- C. The flow test to verify that each outlet delivers adequate flow and pressure under design conditions
- D. The final verification of outlet labeling, color coding, and DISS connector gasspecific configuration

123. A compressed air system serves pneumatic controls for HVAC equipment in a commercial building. What type of air dryer is most appropriate to prevent moisture from damaging the control instruments?

- A. A desiccant dryer that produces extremely dry air with dew points as low as 40°C for critical applications
- B. A refrigerated dryer with a 3°C dew point, which is adequate for all pneumatic control applications
- C. A coalescing filter that removes liquid water but does not reduce the moisture content of the air stream
- D. No dryer is needed because HVAC pneumatic controls are designed to operate with moisture in the air

124. A plumber is laying out the piping for a residential irrigation system. The system will have five zones. Why is the system divided into zones rather than operating all heads simultaneously?

- A. Zoning allows different plant types to receive customized watering schedules based on their needs
- B. The water supply cannot provide enough pressure and flow to operate all heads at once
- C. Municipal bylaws limit the number of sprinkler heads that may operate simultaneously on one property
- D. Zoning prevents water hammer that would occur if all heads opened and closed at the same time

125. A plumber installs a sand interceptor on the drainage from a dental office. What contaminant is the interceptor designed to capture before it enters the building drainage system?

- A. Mercury amalgam particles, which are captured by a dedicated amalgam separator on each dental unit
- B. Chlorhexidine antiseptic solution used during dental procedures that is harmful to drainage pipe materials
- C. Biological waste from dental procedures that must be sterilized before entering the sanitary sewer system
- D. Dental stone, plaster, and grit from impression materials that would settle and block drainage piping

Practice Exam 3: Answer Key and Explanations

1. D — Crystalline silica dust requires a half-face respirator with P100 particulate filters that capture 99.97% of airborne particles. Silica causes silicosis, an irreversible and progressive lung disease. Organic vapour cartridges filter chemical vapours, not particulates, and N95 masks — while filtering 95% of particles — do not provide the level of protection required for known silica exposure.

2. B — An unmarked secondary container is a WHMIS violation. The plumber must not use the product and must report the unmarked container so a proper workplace label (product identifier, safe handling precautions, and SDS reference) can be applied. Using an unidentified product risks exposure to unknown hazards and violates workplace safety legislation.

3. C — Verification of zero energy at the point of work is the critical step that must occur after locks and tags are applied but before work begins. The plumber must test for zero voltage at the electrical disconnect and confirm zero water pressure by opening a bleed valve or test port downstream of the isolation valves. Skipping verification is one of the leading causes of lockout/tagout injuries.

4. A — At 45 kg, the load nearly doubles the recommended single-person lifting limit of approximately 23 kg under ideal conditions. The plumber must use mechanical assistance (hand truck, hoist, or equipment dolly) or a second worker to perform the lift safely. Lifting beyond the recommended limit risks serious musculoskeletal injury to the back, shoulders, and knees.

5. D — Only Grade 80 or Grade 100 alloy steel chain is manufactured, tested, and rated for overhead lifting. Grade 30 (proof coil), Grade 43 (high-test), and Grade 70 (transport) chains are not designed for

overhead lifting and can fail catastrophically without warning under dynamic sling loads. Check the grade marking on every chain before use.

6. B — In standard plumbing drawing conventions, a solid thick line represents cold water supply piping. Hot water supply is typically shown as a dashed thick line (long dashes). Sanitary drainage, storm drainage, vent, and gas piping each have their own distinct line patterns with letter designations. Always verify with the project-specific legend.

7. A — The worker must exit the confined space following the established egress procedure. The attendant must never enter the confined space — their role is to remain at the surface, maintain communication, and summon rescue if needed. Continuous occupancy of the space by the attendant is not required and is in fact prohibited.

8. C — $\text{Area} = \pi \times d^2 \div 4 = 3.14159 \times 9 \div 4 = 7.07$ square inches. This formula calculates the cross-sectional area of a circular pipe from its diameter. Using the radius form ($\pi \times r^2$) gives the same result: $3.14159 \times 1.5^2 = 3.14159 \times 2.25 = 7.07$ square inches.

9. D — "Danger" indicates a more severe hazard than "Warning" within the same hazard class. Both are signal words required on WHMIS 2015 supplier labels, but "Danger" is reserved for the more severe categories (e.g., highly flammable, acutely toxic) while "Warning" is used for less severe categories (e.g., flammable, harmful).

10. B — Spoil piles must be set back a minimum of 1 metre (3 feet) from the trench edge. The weight of the spoil material adds load to the trench wall and increases the risk of collapse. Additionally, the setback prevents loose material from falling on workers below and provides clear access along the trench edge.

11. A — $45 \text{ psi} \times 6.895 \text{ kPa/psi} = 310.3 \text{ kPa}$ (approximately 310 kPa). This imperial-to-metric pressure conversion is essential for plumbers working with specifications and equipment rated in different measurement systems. The conversion factor of 6.895 kPa per psi should be memorized.

12. C — A combination square provides both a 90-degree (right angle) reference for marking square cuts and a 45-degree reference for marking angled cuts. It also includes a built-in ruler for measuring short distances. The 90-degree reference is used most frequently for marking square pipe cuts.

13. D — In addition to the daily pre-entry inspection, trenches must be reinspected after any rainfall, thaw, freeze-thaw cycle, seismic event, or any other occurrence that could affect the stability of the trench walls. Rain saturates the soil, significantly increasing its weight and reducing the cohesion that holds the walls together.

14. B — Effective mentoring requires stopping the incorrect work immediately, explaining why the sanitary tee is wrong for a horizontal-to-horizontal connection (it creates a pocket where solids accumulate), demonstrating the correct fitting (wye or combination wye and eighth bend), and having the apprentice redo the work correctly. Immediate, specific, hands-on correction is the most effective teaching method.

15. A — Specifications describe quality, material, and performance requirements that drawings cannot convey — such as pipe material standards (ASTM specifications), joint compound requirements, testing procedures, workmanship standards, and manufacturer/model requirements. Drawings show where things go; specifications describe what they must be.

16. C — A 2-inch pipe requires a minimum slope of 1/4 inch per foot (pipe 3 inches and smaller). Over 60 feet: $1/4 \times 60 = 15.0$ inches of total fall. The 1/8-inch-per-foot slope applies only to pipe 4 inches and larger. This two-tier slope rule is one of the most commonly tested code provisions.

17. B — Black steel pipe with threaded joints is the standard material for natural gas and propane distribution piping inside buildings. It is strong, heat-resistant, and code-approved for gas service. PVC, PEX, and standard copper (with soldered joints) are not approved for interior gas piping installations.

18. D — ABS solvent cement bonds without a primer — the cement itself is sufficient to soften the ABS surface and create the chemical fusion. PVC and CPVC require a separate primer step to soften the plastic before cement is applied. This distinction between ABS (no primer) and PVC/CPVC (primer required) is frequently tested.

19. A — The maximum horizontal support spacing for ABS and PVC DWV pipe is 1.2 metres (4 feet). Plastic pipe requires closer hanger spacing than metal pipe because it is more flexible and has a greater tendency to sag between supports — especially at elevated temperatures when carrying hot wastewater.

20. C — Capillary action draws molten solder into the narrow gap between the pipe and fitting socket through surface tension forces. The gap must be clean, fluxed, and at the correct temperature for capillary action to work. The solder follows the heat — it flows toward the hottest part of the joint, filling the entire circumference.

21. B — A riser clamp transfers the cumulative weight of the vertical stack above the clamp to the building structure at that floor level. Without riser clamps, the full weight of a multi-storey stack would bear on the lowest fitting at the base, potentially causing joint failure, cracking, or separation.

22. A — NPT (National Pipe Thread) uses a taper of 1/8 inch per inch (equivalent to 3/4 inch per foot or approximately 1 degree 47 minutes). This taper creates a progressively tighter fit as the connection is assembled, providing both mechanical engagement and a pressure seal enhanced by thread sealant.

23. A — BCuP series (copper-phosphorus) brazing alloys are self-fluxing when used on copper-to-copper joints — the phosphorus content acts as a deoxidizer, eliminating the need for external flux. When brazing copper to brass, bronze, or other dissimilar metals, external flux is still required even with BCuP alloys.

24. C — A 6-inch steel pipe weighs approximately 19 pounds per foot empty but approximately 33 pounds per foot when filled with water — nearly double. The hanger system must be designed for the full-of-water (operating) weight, not the empty weight. Designing for empty weight risks hanger failure and pipe sagging when the system is filled.

25. B — The PEX cut must be square, clean, and free of burrs or deformation. A crooked or burred cut prevents the fitting barb from inserting fully and evenly, which can compromise the seal created by the crimp ring. PEX tubing cutters (shear-type) produce the cleanest, squarest cuts.

26. C — A floor drain in a commercial kitchen that receives only occasional mop water will lose its trap seal to evaporation between uses. A trap seal primer automatically delivers small volumes of water to maintain the seal. Without it, sewer gas will enter the kitchen through the dry trap — an especially unacceptable condition in a food preparation environment.

27. A — Both sides of the trap at the same low temperature indicate no steam is reaching the radiator — the trap has failed closed, blocking condensate from draining and preventing new steam from entering. A trap stuck open would show both sides at steam temperature. The closed trap must be repaired or replaced to restore heat.

28. D — A 4-inch pipe at 1/8-inch-per-foot slope handles 180 DFU, which exceeds the building's 85 DFU load with substantial margin for future expansion. The pipe diameter is adequate. There is no code requirement for commercial buildings to use 6-inch minimum, and 1/8 inch per foot is an acceptable slope for 4-inch pipe.

29. B — S-traps are prohibited for new installations because the vertical leg creates a self-siphonage condition. During renovation, existing S-traps should be replaced with P-traps and the trap arm routed horizontally to a wall drain connection. Adding devices to an S-trap or double-trapping are not acceptable code-compliant solutions.

30. C — A percolation rate of 3 minutes per inch indicates very fast-draining soil (sand or gravel). While it absorbs effluent easily, the effluent passes through too quickly for the soil's biological treatment processes to work effectively. An engineered system (sand filter, treatment mound) may be required to ensure adequate treatment before the effluent reaches groundwater.

31. A — Horizontal sections of vent piping must be installed above the flood level rim of the highest fixture served by the vent. If the horizontal vent section is below the flood rim, a backed-up fixture could fill the vent with water, converting it from a vent to a drain and eliminating its air-supply function.

32. D — Oil interceptors must be cleaned on a regular, documented schedule based on the rate of oil accumulation, as required by local environmental and plumbing regulations. Waiting for a blockage means the interceptor has already failed in its treatment function, potentially allowing petroleum products to enter the sewer system.

33. A — This question tests DWV sizing knowledge. A 2-inch horizontal branch drain at code minimum slope accommodates a maximum of 6 DFU. This is a pipe capacity question — the 6 DFU limit determines which fixture combinations can be connected to a 2-inch branch (e.g., a bathtub at 2 + shower at 2 + lavatory at 1 = 5 DFU fits; adding a water closet at 3 DFU would not).

34. A — A cleanout accessible from the surface is typically installed at or near the property line where the building sewer connects to the municipal main. This provides maintenance access from both the building side and the municipal side of the connection, facilitating blockage location and clearing.

35. C — In areas with heavy snowfall, the vent terminal must extend high enough above the roof surface to remain above the expected snow accumulation. A vent terminal buried in snow cannot function — the snow blocks the air passage, preventing sewer gas from escaping and air from entering the drainage system.

36. D — An inflatable rubber test plug (test ball) is the standard device for temporarily sealing DWV pipe openings during air and water pressure tests. The plug is inserted into the pipe and inflated to create a seal, then deflated and removed after the test. It leaves no permanent modification to the piping.

37. B — The DWV system must have passed the required pressure test (air or water) before the rough-in inspection. The inspector will review the test results as part of the inspection. Fixtures are not installed at rough-in stage, walls must not be closed, and the building sewer connection is a separate inspection.

38. A — Circuit venting is the most efficient method for a battery of identical fixtures on a single horizontal branch. One circuit vent pipe connected between the last two fixtures serves all six lavatories, requiring far less vent piping than six individual vents while still meeting code requirements for air supply.

39. C — The rubber gasket in PVC bell-and-spigot joints creates a continuous, tight seal that leaves no gap for roots to penetrate. Older clay pipe joints relied on mortar or oakum packing that deteriorated over time, creating gaps at every joint. The continuous elastomeric seal is the key improvement.

40. B — Half of 4 inches = 2 inches. The code requires the vent serving a soil stack to be at least half the stack's diameter, with a minimum of 1-1/2 inches. Since 2 inches exceeds the 1-1/2-inch minimum, the minimum vent diameter is 2 inches. Note that the absolute minimum for any vent in the system remains 1-1/4 inches.

41. D — A garbage disposal significantly increases the solid waste load entering the septic tank — ground food waste decomposes slowly in the anaerobic environment and accelerates sludge accumulation. The tank will require more frequent pumping (potentially annually instead of every 3–5 years), and the additional solids increase the risk of premature disposal field failure.

42. A — The cleanout at the base of every stack provides access for drain cleaning equipment — cable machines, cameras, and jettors — to clear blockages in the stack and in the building drain downstream. Without accessible cleanouts, maintenance requires cutting into the piping to gain access, which is destructive and expensive.

43. C — The standard rough-in distance for most residential water closets is 305 mm (12 inches) from the finished wall surface. This is the most commonly installed dimension and the most commonly tested rough-in value on the exam. Compact models use 254 mm (10 inches) and older/specialty models use 356 mm (14 inches).

44. B — The vent system provides air to equalize pressure in the stack during simultaneous discharge events. Without venting, the combined volume of two toilet flushes falling through the stack would create pressure fluctuations that siphon trap seals on connected fixtures. The vents supply air to prevent this siphonage.

45. D — The building drain is the lowest horizontal drain piping inside the building, collecting discharge from all stacks and branches. The building sewer begins where the drain exits the building (at or near the foundation wall) and extends to the municipal sewer main or private disposal system. The transition point is typically at the foundation wall.

46. A — Standing water in a belly traps debris, solids, grease, and sediment that would otherwise be carried along by the flowing water. Over time, this accumulation narrows the pipe's effective diameter at the belly and creates a recurring blockage point that requires repeated cleaning. The permanent fix is excavation and re-establishment of correct slope.

47. C — When a septic tank is neglected for over 10 years, sludge and scum accumulate until they encroach on the clear effluent zone and begin flowing out of the tank into the disposal field. The solid particles clog the gravel and absorption soil, creating a biomat that prevents effluent from percolating. Once the soil is clogged, the field must be replaced entirely.

48. B — The combination wye and eighth bend provides a long, smooth, gradual 90-degree change of direction that minimizes turbulence, prevents hydraulic jump, and reduces back pressure at the base of the stack. A short-pattern 90-degree elbow creates an abrupt direction change that causes violent turbulence and pressure waves.

49. D — On long circuit-vented horizontal branches (particularly those serving many fixtures), a relief vent at specified intervals supplements the air circulation provided by the single circuit vent. The relief vent prevents the buildup of pressure differentials along the extended branch that could affect trap seals on distant fixtures.

50. B — Smoke emerging from a wall indicates a crack, defect, or failed joint in the concealed DWV piping inside that wall. Under normal conditions, sewer gas would escape through the same defect, entering the wall cavity and potentially migrating into occupied spaces. The defect must be located, exposed, and repaired.

51. A — A trap seal primer automatically delivers small volumes of water to the floor drain at regular intervals (either triggered by pressure fluctuations in a nearby supply line or by a timed solenoid valve), maintaining the trap seal indefinitely without relying on manual attention or fixture use. This is the code-recognized solution for infrequently used drains.

52. C — A wye or combination wye and eighth bend must be used for horizontal-to-horizontal DWV connections. The sanitary tee's swept branch is designed for horizontal-to-vertical connections only. Using it flat for horizontal-to-horizontal creates a pocket at the bottom where solids accumulate, which is why the inspector correctly rejected the installation.

53. B — The distinction is defined by the type of waste carried: a soil pipe carries the discharge of water closets or urinals (which contains fecal matter), while a waste pipe carries only greywater discharge from lavatories, sinks, bathtubs, showers, and similar fixtures without fecal content. This classification affects code requirements for pipe sizing, fitting selection, and venting.

54. D — The sewage ejector's force main must connect to the gravity drainage system above the flood level rim of the highest fixture served by the ejector. This prevents the gravity system from back-feeding wastewater into the ejector pit during normal operation or during a surcharge condition in the gravity drainage.

55. A — Offset joints create internal ledges where debris, grease, roots, and sediment catch and accumulate with every drainage event. Each offset acts as a trap point that gradually builds up material, eventually restricting or blocking flow. Offset joints also provide entry points for root intrusion.

56. C — Connecting roof drains to the sanitary sewer introduces massive stormwater volumes during heavy rain events, overwhelming the sanitary sewer's capacity and the downstream treatment plant. This overloading can cause sanitary sewer overflows, treatment plant bypasses, and combined sewage discharge to waterways — all significant environmental violations.

57. B — When the municipal supply pressure exceeds the code maximum of 550 kPa (80 psi) at any fixture, a pressure-reducing valve (PRV) must be installed on the water service to reduce the pressure to a safe level. Excessive pressure causes fixture damage, noise, water hammer, accelerated wear on valves, and increased water waste.

58. D — Residual pressure = Available pressure – elevation loss – friction loss. Elevation loss = $12 \text{ m} \times 9.81 \text{ kPa/m} = 117.7 \text{ kPa}$ (approximately 118 kPa). Total losses = $118 + 70 = 188 \text{ kPa}$. Residual = $415 - 188 = 227 \text{ kPa}$ (approximately 228 kPa). This exceeds the 140 kPa minimum required at most fixtures.

59. C — A DCVA protects against both back-siphonage and back-pressure but is rated for minor (non-health) hazard cross-connections only. An irrigation system without chemical injection is classified as a

minor hazard because the contaminants (soil, fertilizer residues at ambient levels) affect taste and appearance but are not acutely toxic.

60. B — Water hammer arrestors must be installed as close as possible to the quick-closing valve causing the problem — in this case, on both the hot and cold supply lines at the washing machine connection. Installing arrestors at the meter or water heater allows the pressure wave to travel through the piping before reaching the arrestor, leaving the intervening piping unprotected.

61. D — HDPE's butt-fused joints are molecularly bonded and are as strong as the pipe itself, creating a continuous, root-proof, leak-proof pipeline with no gaskets or mechanical components to fail. This is HDPE's primary advantage over copper (which uses mechanical fittings underground) and PVC (which uses gasketed joints that can eventually admit roots).

62. A — The corporation stop is the valve installed directly on the municipal water main at the point where the service pipe is tapped. It provides the first shutoff point for the individual building's service, allowing the utility to isolate that one service without affecting the rest of the main.

63. C — A laboratory's deionized water system with chemicals is a severe (health) hazard cross-connection requiring a reduced pressure principle (RP/RPZ) assembly. The RP device provides the highest level of mechanical protection, with dual check valves and a relief zone that discharges to atmosphere if either check fails.

64. B — Uninsulated return piping loses heat continuously to the surrounding environment. The water heater must work harder (burning more fuel or consuming more electricity) to reheat the cooled return water, increasing energy consumption and operating costs. Both the supply and return piping in a recirculation system must be insulated.

65. D — Dental equipment with chemical sterilization systems represents a severe (health) hazard cross-connection. An RP device or an air gap is required. Chemicals used in dental sterilization (glutaraldehyde, disinfectants) are toxic and could cause serious illness if back-siphoned into the potable supply.

66. A — A PRV reading significantly above its set point indicates the valve has failed or is worn to the point where it can no longer regulate effectively. PRVs have a finite service life (typically 10–15 years) and gradually lose regulation accuracy as internal springs and diaphragms wear. The PRV should be adjusted or replaced.

67. C — Some jurisdictions require a maximum delivery temperature of 43°C (110°F) at public lavatories in healthcare and institutional settings. This lower limit provides additional scald protection for vulnerable populations (elderly, pediatric, cognitively impaired) who may have reduced sensation or slower reaction times.

68. B — The pressure rise at 3:00 AM (when no fixtures are running) is caused by the water heater's recovery cycle. The heater fires to maintain the storage temperature, heating and expanding the water. In the closed system (PRV installed), the expanded water has nowhere to go, and the pressure rises. An expansion tank absorbs this volume increase.

69. D — All testable backflow prevention assemblies (DCVAs, PVBs, RP/RPZ devices) must be tested annually by a certified cross-connection control tester. The test verifies proper operation of all internal components. Test results must be documented and reported to the local authority having jurisdiction.

70. A — Type K copper has the thickest wall of the three standard types, providing the greatest amount of material between the water and the exterior surface. In aggressive water conditions (low pH, high dissolved oxygen), this additional wall thickness provides a larger corrosion allowance — more material that can corrode before the tube is compromised.

71. C — Tall buildings are divided into pressure zones — typically every 8 to 12 storeys. Lower floors are served directly by municipal pressure (possibly through a PRV), while upper floors are served by booster pumps that add pressure appropriate to their elevation. Each zone operates at its own pressure, preventing the lower floors from being over-pressurized and the upper floors from being under-pressurized.

72. B — Undersized pipe forces the same flow rate through a smaller cross-sectional area, increasing the water velocity above the recommended 2.4 m/s maximum. The higher velocity increases friction loss (reducing pressure at downstream fixtures), causes audible noise, and accelerates erosion of pipe and fitting surfaces at direction changes.

73. D — An air gap for a drain connection is a physical separation of at least twice the drain pipe diameter (minimum 25 mm) between the appliance's drain outlet and the flood level rim of the receiving fixture (typically a floor sink or receptor). This physical separation prevents back-siphonage from the drain into the appliance.

74. A — The dip tube directs incoming cold water to the bottom of the tank, directly above the heat source (gas burner or lower electric element). Without the dip tube, cold water would enter at the top and mix with the hottest water, reducing the available hot water temperature and the tank's effective output.

75. C — A pressure vacuum breaker (PVB) must be installed at least 300 mm (12 inches) above the highest downstream sprinkler head in the irrigation system. This height ensures the PVB can break any siphon that might develop if supply pressure drops below atmospheric — the air vent must be above the potential siphon height.

76. D — When the system has both a PRV and an expansion tank but the T&P valve still discharges during heating, the expansion tank is the prime suspect. If the tank's air pre-charge has been lost (waterlogged), it cannot absorb the expanded water volume, and the pressure rises to the T&P valve's relief setting. Check the pre-charge pressure with a tire gauge on the Schrader valve.

77. B — The Y-strainer installed upstream of the PRV captures debris, sediment, and scale particles from the water supply before they reach the PRV's internal diaphragm and spring mechanism. Foreign material in the PRV can jam the valve open (losing regulation) or closed (blocking flow), or cause erratic pressure fluctuation.

78. A — The boiler fill connection represents a cross-connection between the potable domestic water supply and the non-potable hydronic heating water (which may contain corrosion inhibitors, antifreeze, or other chemicals). A backflow prevention device is required to prevent this treated boiler water from contaminating the drinking water supply.

79. C — When pipe diameter decreases and flow rate remains constant, velocity increases because the same volume of water must pass through a smaller cross-sectional area per unit of time. The relationship is $Q = A \times V$ — if Q is constant and A decreases, V must increase proportionally. This is why undersized pipe causes noise and excessive friction.

80. D — A concealed carrier for a wall-hung water closet must be anchored to the building structure (steel framing, blocking, or concrete) and rated to support the combined weight of the fixture, water during flushing, and the user (which can exceed 200 kg during use). Wall-hung fixtures transfer all loads to the carrier — there is no floor support.

81. B — The high-limit reset button (a red button on the upper thermostat) is a safety device that trips if the water temperature exceeds a safe maximum. It commonly trips during installation when the tank is

initially heated or when an element shorts. Pressing the reset button restores power to the heating elements. If it trips repeatedly, the element or thermostat is faulty.

82. A — The reduced flush for liquid waste on a dual-flush water closet is typically 3 to 4 litres (0.8 to 1.0 gallons), approximately half the full flush volume of 6 litres for solid waste. This dual-flush capability significantly reduces daily water consumption in households and commercial buildings.

83. C — The water softener's regeneration brine drain must connect to the drainage system through an air gap to prevent wastewater from back-siphoning into the softener and contaminating the building's treated water supply. This is the same indirect waste connection requirement that applies to all water treatment equipment drains.

84. D — The waste-and-overflow assembly connects the drain fitting at the bottom of the tub to the overflow fitting on the tub wall, combining both into a single tailpiece that connects to the P-trap below. This integrated assembly allows the tub to drain normally through the stopper mechanism and provides an overflow protection path.

85. B — Point-of-use electric tankless heaters have limited flow capacity (typically 2–4 L/min at the required temperature rise in cold Canadian climates) and may not serve multiple fixtures simultaneously. Whole-house gas tankless units have significantly higher capacity because gas burners deliver far more heating energy per unit of time than electric elements.

86. A — The high loop must reach as high as possible beneath the countertop — typically to the underside of the counter surface. This maximizes the air break between the dishwasher's drain outlet and the sink's drain connection, providing the greatest protection against gravity back-siphonage when the sink fills with water.

87. C — Reverse osmosis forces water through a semi-permeable membrane under pressure, blocking dissolved solids, heavy metals, nitrates, fluoride, and most microorganisms at the molecular level. The membrane allows water molecules to pass while rejecting contaminants 95–99% effectively — the most thorough point-of-use treatment technology commonly installed by plumbers.

88. D — Sprinkler head glass bulb colour indicates the activation temperature rating. If the bulb colour has changed (particularly if it appears clouded, cracked, or different from its original factory colour), the bulb may have been compromised by heat exposure or aging. The head should be replaced because its activation reliability is uncertain.

89. B — Flexible stainless steel braided supply tubes are the recommended standard for modern fixture installations. They accommodate minor misalignment between the stop valve and faucet inlet, are faster to install than rigid tubes, resist kinking, and provide reliable leak-free connections without precise bending.

90. A — A higher energy factor (EF) or uniform energy factor (UEF) indicates greater energy efficiency — a larger proportion of the input energy (gas, electricity) is successfully converted to usable hot water at the fixture. A UEF of 0.95 means 95% of the energy input is delivered as hot water; a UEF of 0.60 means only 60%.

91. C — Before removing the cartridge, the hot and cold supply lines to the shower valve must be shut off using the fixture stop valves (if accessible) or the main building shutoff. Working on a pressurized valve results in uncontrolled water discharge when the cartridge is pulled, causing water damage and making the repair impossible.

92. D — Ultraviolet (UV) disinfection uses UV-C light (wavelength 254 nm) to destroy bacteria, viruses, protozoa, and other microorganisms by disrupting their DNA, rendering them unable to reproduce. Filtration removes particles, softening removes minerals, and carbon removes chlorine — but none of these kill microorganisms.

93. A — The flow switch detects water movement in the sprinkler piping that occurs when a sprinkler head activates and water begins flowing through the system. The switch triggers an audible alarm to alert occupants to evacuate and may also signal the fire alarm panel to notify the fire department.

94. C — The RO system's reject water line must connect to an approved drain through an air gap to prevent wastewater from the building's drainage system from back-siphoning into the RO unit and contaminating the purified water storage tank and delivery faucet. This is a standard indirect waste connection requirement.

95. B — Gasoline vapours are heavier than air (specific gravity approximately 3.0–4.0) and pool at floor level. A water heater with a standing pilot light, open burner, or any ignition source near floor level can ignite these vapours, causing an explosion and fire. Gas-fired water heaters in garages must have their ignition source elevated at least 450 mm (18 inches) above the floor.

96. D — An ECM variable-speed circulator automatically reduces pump speed when zone valves close, matching energy consumption to actual demand. This eliminates the energy waste of a fixed-speed pump

running at full power against closed valves and eliminates the need for a bypass valve that would otherwise be required to prevent dead-heading.

97. A — The correct procedure is to open the manual air bleed valves on each emitter, starting at the lowest point in the system and working progressively upward to the highest. Air naturally migrates upward, so starting low ensures that air pushed upward by the rising water level is captured and vented at each successive level.

98. B — If the operating aquastat fails in the "on" position (continuously calling for heat), the boiler will fire continuously. The high-limit control is the safety backup — it will shut off the burner when the water temperature reaches its 93°C setting, preventing the water from reaching dangerous temperatures. This is exactly why the high-limit is set above the operating temperature.

99. D — If the boiler fires and the circulator runs but all radiators are cold, no zone thermostats are calling for heat, so all zone valves are closed and no water flows through any distribution circuit. The hot water circulates only within the boiler loop (if it is a primary-secondary system) or dead-heads at the closed zone valves.

100. B — In a one-pipe steam system, balancing is achieved by adjusting the thermostatic air vents on each radiator. Faster-venting radiators on distant runs allow air to escape more quickly, letting steam arrive sooner. Slower-venting radiators near the boiler delay steam arrival to prevent overheating. This equalizes the heating rate across the system.

101. C — At 66°C return water temperature, the boiler is NOT operating in condensing mode. The flue gas dew point for natural gas combustion products is approximately 55°C — return water must be below this temperature for the water vapour in the exhaust to condense and release its latent heat. At 66°C, the exhaust leaves dry and the efficiency advantage of condensing is lost.

102. A — A diaphragm (bladder) expansion tank has an internal flexible membrane that physically separates the air charge from the system water. This prevents the air from being absorbed into the water over time (which causes waterlogging in standard plain-steel tanks) and allows the air pre-charge to be maintained and checked through a Schrader valve.

103. D — Low system pressure (below the cold-fill setpoint) indicates either a water leak in the system or a malfunctioning automatic fill valve that is not maintaining the correct fill pressure. The plumber should check for visible leaks throughout the system and verify that the fill valve is opening and delivering water when the pressure drops below its setpoint.

104. B — When no secondary zone calls for heat, the primary loop circulator continues to circulate water through the boiler and past the closely spaced tees. Because the closely spaced tees create negligible pressure differential, no water flows into or out of the secondary loops — the primary loop simply recirculates through the boiler independently.

105. A — No visible water in the gauge glass with the glass appearing full of steam is a critical low-water emergency. The water level has dropped below the bottom of the gauge glass, meaning the heating surfaces may be exposed to flame without the cooling effect of water. The burner must be shut off immediately and the low-water cutoff should have already triggered — if it did not, the LWCO has failed.

106. C — Turning the TRV dial to a lower number reduces the temperature setpoint at which the valve closes. The thermostatic element will close the valve at a lower room temperature, reducing heat output to the office. TRVs provide individual room control without wiring — the occupant simply adjusts the dial.

107. D — In a standard (plain steel) expansion tank with no diaphragm, the air cushion and system water share the same space. Over time, the air is gradually absorbed into the water according to Henry's Law (gas dissolves into liquid proportionally to pressure). As air is absorbed, water fills the vacated space until the tank is completely waterlogged and cannot absorb expansion.

108. D — In a two-pipe system, a radiator that is hot at the supply end but cold at the return end with no water hammer has trapped air blocking steam from fully penetrating the radiator. Air collects at the return side (farthest from the supply entry), preventing steam from reaching that portion. Bleeding the air or checking the trap's thermostatic air vent resolves the issue.

109. A — Condensing boilers extract so much heat from the combustion gases that the exhaust temperature drops below 65°C — well below the softening point of PVC pipe (approximately 75°C). This low exhaust temperature is what makes PVC or CPVC vent piping safe for condensing appliances, whereas conventional atmospheric boilers produce exhaust above 200°C that requires metal venting.

110. D — If the expansion tank's air pre-charge has been lost, the tank fills with water and becomes a solid mass that cannot absorb thermal expansion. Every time the boiler fires and heats the water, the expanding volume has nowhere to go, the system pressure spikes, and the relief valve opens. Checking and restoring the pre-charge (or replacing the tank) resolves the daily discharge.

111. C — Radiant floor heating provides the most uniform floor-to-ceiling temperature distribution because the entire floor surface acts as a low-temperature, large-area heat emitter. Heat radiates upward evenly, creating consistent temperatures from floor to ceiling with virtually no stratification. Convection-based emitters (baseboard, fan coils) create warmer air at the ceiling and cooler air at the floor.

112. B — The 24-hour standing pressure test for medical gas systems uses oil-free, dry nitrogen (never the actual medical gas) pressurized to 1.5 times the system's maximum working pressure. Nitrogen is inert, dry, and safe — using oxygen would create a fire hazard, and using the actual medical gas would waste expensive product and introduce contaminants.

113. A — A drip leg at a low point on the compressed air header collects condensate that accumulates as moisture-laden compressed air cools in the piping. The drip leg is drained periodically (manually or through an automatic drain trap) to remove the collected water before it can travel to branch outlets and damage tools or instruments.

114. D — A completely clogged strainer basket starves the pump of water on the suction side. The pump may lose prime (draw air instead of water), cavitate (form destructive vapour bubbles at the impeller), or overheat (the flowing water normally cools the pump seals and motor). Regular basket cleaning prevents this condition.

115. C — CSST must be properly bonded to the building's electrical grounding system to protect against lightning-induced electrical surges. Without bonding, a lightning strike can induce an electrical current that arcs through the thin corrugated stainless steel wall, puncturing the tubing and causing a gas leak — a fire and explosion hazard.

116. B — The sprinkler head at a low point in the lateral piping collects the last remaining water in that zone by gravity. All other heads at higher elevations have already cleared because gravity drains their water toward the lower point. Additional blowout time may be needed for that specific head, or the head may need to be manually drained.

117. D — The Diameter Index Safety System (DISS) provides gas-specific outlet connectors that are mechanically unique for each medical gas. An oxygen outlet connector physically cannot accept a nitrogen adapter, and vice versa. This prevents the most dangerous possible error in a medical gas system — delivering the wrong gas to a patient through an incorrect connection.

118. A — Petroleum-based oil is toxic to the biological processes that wastewater treatment plants rely on to treat sewage. Discharging oil to the sewer kills the bacteria that break down organic waste, disrupts the treatment process, and violates environmental regulations. Accumulated oil must be removed by a licensed waste hauler and disposed of at approved facilities.

119. C — CPVC and polypropylene pipe provide chemical resistance to acids at moderate temperatures, making them appropriate for laboratory acid waste drainage. Black steel corrodes rapidly in acid, copper dissolves in acid, and standard cast iron deteriorates quickly in acidic conditions. Chemical-resistant plastic is the correct choice.

120. B — Chemical injection (chlorine) must be located after the filter and heater on the return line to the pool. Concentrated chemicals would damage the filter media (particularly DE and cartridge elements) and corrode the heater's heat exchanger. Injecting on the return line ensures that only clean, heated water contacts the chemical before it enters the pool.

121. D — Propane (LP gas) has a specific gravity of 1.52 — it is heavier than air and sinks to the lowest available point. In a basement, leaked propane pools at floor level creating invisible explosive pockets. Specific code requirements for propane in below-grade spaces include ventilation provisions, gas detection equipment at floor level, and in some jurisdictions, prohibition of certain appliance types.

122. A — The 24-hour standing pressure test is performed first, before cross-connection, purity, or flow tests. It verifies the mechanical integrity of every joint in the system under sustained pressure. Only after the piping passes this fundamental leak test does the more specialized testing sequence proceed.

123. A — Desiccant dryers produce extremely dry air with dew points as low as -40°C , which is essential for protecting sensitive pneumatic control instruments. Refrigerated dryers at 3°C dew point may allow sufficient moisture to damage precision instruments. For HVAC pneumatic controls, the desiccant dryer provides the highest level of moisture protection.

124. B — The water supply typically cannot provide enough pressure and flow to operate all sprinkler heads in the entire system simultaneously. Dividing the system into zones allows each zone's heads to receive adequate pressure and flow when that zone is active, while other zones are off. The controller activates zones sequentially throughout the watering schedule.

125. D — The sand interceptor in a dental office captures dental stone, plaster, impression material grit, and similar heavy particulates that would settle in the drainage piping and cause blockages. Mercury

amalgam is captured by a separate, dedicated amalgam separator (required by environmental regulations) installed on each dental unit before the drainage reaches the interceptor.