FULL-LENGTH PRACTICE TESTS

Practice Test 17: Comprehensive Plumbing Systems Review — Chapters 9–11

Questions 1–50

1. A commercial building's incoming water pressure measures 110 psi at the service entrance. What action is required per the plumbing code?

A. No action is required because 110 psi is within acceptable limits

B. A pressure reducing valve must be installed to reduce pressure to 80 psi or below

C. The water meter must be replaced with a high-pressure rated model

D. The backflow preventer must be upgraded to a double check assembly

2. A plumbing inspector rejects a hydrostatic test on domestic water piping because the gauge shows a 3 psi drop over the test period. What does this indicate?

A. The test was conducted at the wrong pressure

B. The pressure drop is within acceptable tolerances and should pass

C. The piping material is incompatible with the test water

D. A leak exists in the piping system that must be located and repaired before the test is repeated

3. During commissioning, hot water delivery temperature at a remote restroom measures 105 degrees Fahrenheit while the water heater is set to 140 degrees. What should be investigated?

A. Recirculation pump operation, return line valve positions, and piping insulation integrity between the heater and the remote fixture

B. The cold water supply pressure at the building entrance

C. The fire sprinkler system's water supply temperature

D. The grease interceptor's operating temperature

4. What is the primary reason the plumbing code requires a separate storm drainage system from the sanitary sewer?

A. Storm water requires chemical treatment before discharge

B. Storm drainage piping uses different materials than sanitary piping

C. Preventing rainwater from overloading sewage treatment plants and preventing sewage from backing up through storm drain outlets

D. Storm water must be heated before entering the municipal system

5. A facility manager receives a complaint about sewer odor in a seldom-used storage room with a floor drain. What is the most likely cause?

A. The sanitary sewer main is broken beneath the building slab

B. The floor drain trap seal has evaporated due to infrequent use, allowing sewer gas to enter the room

C. The building's vent system has been disconnected from the roof

D. The grease interceptor is overdue for cleaning

6. A building's water management plan per ASHRAE 188 identifies a dead leg in the hot water distribution system. Why is this a concern?

A. Stagnant water in the dead leg can cool into the Legionella growth range of 77 to 113 degrees, creating a colonization risk

B. Dead legs increase the building's water pressure beyond safe limits

C. Dead legs prevent the backflow preventer from operating correctly

D. Dead legs cause the water meter to register inaccurate readings

7. A plumbing engineer sizes the domestic water distribution piping using fixture unit calculations. What does this method account for?

A. The color and style of each plumbing fixture

B. The structural weight of each fixture on the floor system

C. The cost of each fixture for budget estimating purposes

D. The probability that not all fixtures operate simultaneously, using weighted demand values to determine likely peak flow

8. What plumbing code requirement ensures that persons with disabilities can use restroom facilities in a commercial building?

A. Only grab bars at the water closet location

B. Only a wider restroom entry door with no other modifications

C. ADA and ICC A117.1 compliance for mounting heights, clearances, approach dimensions, and operable fixture controls

D. Only a single accessible restroom on the ground floor

9. A new commercial kitchen requires a grease interceptor. What factors determine the required interceptor size?

A. The total building occupancy and number of restrooms

B. The number and type of contributing kitchen fixtures, peak flow rate, and grease retention capacity per jurisdiction requirements

C. The distance from the kitchen to the building's main water meter

D. The kitchen exhaust hood airflow rate and cooking equipment BTU rating

10. During a plumbing rough-in inspection, the inspector finds that a horizontal drain pipe has no slope. What is the consequence of this deficiency?

A. Solids will settle and accumulate in the flat section, eventually causing a blockage because gravity drainage requires minimum slope to maintain flow velocity

B. The pipe will experience excessive water pressure buildup

C. The vent system will not function on the affected branch

D. The flat pipe section will develop condensation on the exterior

11. A building owner wants to achieve LEED Water Efficiency credits. What plumbing design strategy most directly reduces indoor potable water consumption?

A. Installing a larger water heater to increase hot water storage

B. Increasing pipe sizes to reduce friction loss in the distribution system

C. Using only copper piping for all water distribution

D. Specifying high-efficiency WaterSense fixtures and supplementing with rainwater harvesting or graywater recycling for non-potable uses

12. A sewage ejector alarm activates in the building's basement. What does this alarm indicate?

A. The domestic water supply pressure has dropped below minimum

B. The sewage level in the ejector basin has risen above normal, indicating the pump has failed or cannot keep up with incoming flow

C. The building's main sanitary sewer is flowing normally

D. The storm drainage system is surcharging from heavy rainfall

13. What is the primary purpose of annual backflow preventer testing in a commercial building?

A. Measuring the building's total water consumption for the year

B. Calibrating the water meter for accurate billing

C. Verifying that the check valves and relief valve operate correctly to protect the municipal water supply from contamination

D. Testing the domestic water supply pressure at each fixture

14. A building's secondary roof drainage system is observed discharging water through the exterior wall during a rainstorm. What does this visible discharge indicate?

A. The primary roof drainage system is blocked or overwhelmed, and the secondary system is functioning as designed to prevent structural roof overload

B. The secondary system has a piping leak that needs repair

C. The storm drainage system has been incorrectly connected to the sanitary sewer

D. The building's domestic water supply is leaking onto the roof

15. A plumbing contractor installs PVC drainage pipe in a commercial building where the code requires cast iron. What is the primary concern?

A. PVC pipe is more expensive than cast iron in commercial sizes

B. PVC pipe has a shorter rated service life than cast iron

C. PVC connections are incompatible with standard drainage fittings

D. PVC provides significantly less sound attenuation and fire resistance than cast iron, failing to meet the code requirements for the building type

16. What must the construction team verify about all plumbing penetrations through fire-rated walls and floors?

A. That the penetrations are sealed with standard construction caulk

B. That the penetrations are left open for future maintenance access

C. That each penetration is firestopped with a listed system that maintains the fire resistance rating of the penetrated assembly

D. That the penetrations only pass through non-rated partitions

17. A building's hot water recirculation pump runs continuously on a 24-hour cycle. What operational improvement would reduce energy waste?

A. Increasing the pump speed to maximum for faster circulation

B. Installing a timer or demand-based control to operate the pump only during occupied hours or when hot water demand exists

C. Disconnecting the recirculation system entirely

D. Replacing the pump with a larger model for increased flow

18. A commissioning agent tests a thermostatic mixing valve and finds the outlet temperature fluctuates between 95 and 130 degrees. What does this indicate?

A. The mixing valve is malfunctioning and requires calibration or replacement to deliver a stable, safe outlet temperature

B. The fluctuation is normal for thermostatic mixing valves

C. The cold water supply pressure is too high for the valve

D. The hot water heater is cycling normally between setpoints

19. What is the minimum trap seal depth required by the plumbing code, and why is this depth specified?

A. 4 inches to prevent all possible sewer gas passage

B. 1 inch because deeper seals restrict drainage flow

C. 6 inches for maximum protection in all applications

D. 2 inches, providing adequate resistance to siphonage and back-pressure while allowing proper drainage flow

20. A building installs sub-meters on the cooling tower makeup, irrigation, and domestic hot water systems. What is the primary benefit of this monitoring strategy?

A. Replacing the utility's main water meter with sub-meters

B. Identifying specific areas of high consumption, detecting leaks, and enabling targeted conservation measures for each system

C. Increasing water pressure at each sub-metered system

D. Providing fire alarm activation when water flow is detected

21. During a drainage system test, the plumbing contractor elects to use an air test instead of a water test. What test parameters apply?

A. 5 psi gauge pressure maintained with no measurable loss for a minimum of 15 minutes per the plumbing code

B. 100 psi for 30 minutes identical to the domestic water test

C. Atmospheric pressure with visual inspection only

D. 50 psi for 60 minutes using compressed nitrogen

22. A plumbing engineer specifies a reduced pressure zone backflow assembly at the building's water service entrance. What hazard level does this indicate?

A. A low-hazard connection requiring only an atmospheric vacuum breaker

B. A moderate-hazard connection with no chemical risk

C. A high-hazard cross-connection where contamination could endanger public health, requiring the highest level of backflow protection

D. A fire protection connection with no health hazard potential

23. A commercial building's water heater fails during winter. The facility manager considers running the building without hot water until replacement arrives. What health and code concern does this create?

A. Increased water pressure throughout the building

B. Higher energy consumption from the cold water distribution pumps

C. Accelerated corrosion in the cold water piping system

D. Loss of required hot water for handwashing hygiene, Legionella risk from stagnant warm water in piping, and code violation for minimum fixture requirements

24. What distinguishes a sump pump from a sewage ejector in application and installation requirements?

A. There is no difference between sump pumps and sewage ejectors

B. Sump pumps handle clear water drainage while sewage ejectors handle sanitary waste, requiring sealed basins, vent connections, and alarm systems

C. Sewage ejectors are smaller and less expensive than sump pumps

D. Sump pumps require sealed basins while sewage ejectors use open pits

25. A facility manager wants to implement a graywater recycling system in an existing office building. What code requirements must be met?

A. No code requirements apply to graywater systems

B. Graywater must be discharged directly to the storm sewer without treatment

C. Proper treatment, complete separation from the potable system, clearly identified purple non-potable piping, and approval from the AHJ

D. Graywater can be connected directly to the potable system with a check valve

26. What is the primary purpose of an acid neutralization tank in a laboratory building's drainage system?

A. Treating corrosive chemical waste to an acceptable pH before discharge to the sanitary sewer, protecting sewer infrastructure and treatment processes

B. Storing acid waste for offsite hazardous material disposal

C. Filtering particulates from laboratory drainage before discharge

D. Heating acid waste to accelerate chemical decomposition

27. A plumber installs a sanitary drainage fitting using a standard 90-degree elbow at a horizontal-to-vertical connection. Why would the inspector reject this installation?

A. Standard elbows are only permitted on domestic water piping

B. Standard elbows cannot be used on piping smaller than 4 inches

C. The elbow material is incompatible with the drainage pipe

D. Drainage systems require long-sweep or sanitary-pattern fittings that maintain smooth flow and prevent blockages at direction changes

28. A building's rainwater harvesting system provides treated rainwater for toilet flushing. What cross-connection protection is required?

A. No protection is needed because treated rainwater is potable quality

B. Complete physical separation from the potable system with an air gap, and the non-potable piping must be clearly identified to prevent cross-connection

C. Only a check valve between the rainwater and potable systems

D. Only a sign at the main water meter identifying the dual system

29. What is the primary purpose of a hydrostatic pressure test on domestic water piping before the system is concealed?

A. Verifying that all joints are leak-free and the piping maintains structural integrity at pressures above normal operating conditions

B. Measuring the maximum flow rate available at each fixture

C. Calibrating the pressure reducing valve at the service entrance

D. Determining the water hardness and mineral content

30. A building's plumbing condition assessment reveals that the original galvanized steel domestic water piping has significant internal corrosion and reduced flow. What does this finding indicate?

A. The piping should be cleaned with chemical treatment and returned to service

B. The insulation should be replaced to restore flow capacity

C. The water pressure should be increased to compensate for reduced pipe diameter

D. The piping has reached the end of its useful life and should be replaced with modern materials as part of a capital improvement plan

31. A plumbing contractor fails to install cleanouts at the required locations on horizontal drainage piping. What operational consequence does this create?

A. The drainage piping will experience higher water pressure

B. The vent system will not function on the affected branch lines

C. Future blockages will be extremely difficult and expensive to clear because there is no access to insert drain cleaning equipment

D. The domestic water supply pressure will be affected

32. During commissioning, a backwater valve is tested and found to allow reverse flow. What is the consequence if this deficiency is not corrected?

A. Municipal sewer surcharges could cause sewage to back up into the building through the sewer connection, flooding below-grade spaces

B. The building's water pressure will increase beyond safe limits

C. The domestic hot water system will lose recirculation flow

D. The roof drainage system will not function during heavy rainfall

33. A building's water management plan requires monitoring domestic hot water temperatures at representative locations. What is the target temperature range?

A. 60 to 80 degrees Fahrenheit at the fixture

B. 140 degrees or above at the water heater and recirculation return, with safe delivery temperatures at fixtures controlled by thermostatic mixing valves

C. 180 degrees or above at all fixture outlets

D. 100 degrees at the water heater with no mixing valve required

34. What is the primary sustainable plumbing benefit of installing low-flow WaterSense fixtures throughout a commercial building?

A. Increasing the building's fire suppression water supply capacity

B. Eliminating the need for a backflow preventer at the service entrance

C. Reducing the building's wastewater discharge to the sanitary sewer

D. Reducing potable water consumption by at least 20 percent compared to standard fixtures while maintaining equivalent performance

35. A plumbing engineer designs a domestic water booster pump system with variable speed drives. What is the primary energy advantage?

A. The VFD adjusts pump speed to match actual demand, maintaining constant pressure while consuming significantly less energy during partial demand periods

B. The VFD eliminates the need for a pressure reducing valve

C. The VFD allows the pump to operate at maximum speed continuously

D. The VFD provides backup power during utility outages

36. A commercial building's expansion tank on the hot water system is found to be waterlogged during commissioning. What is the consequence?

A. The hot water temperature will drop below the design setpoint

B. The hot water recirculation pump will lose prime and stop circulating

C. System pressure will increase excessively when water is heated because the waterlogged tank cannot absorb thermal expansion

D. The cold water supply pressure will fluctuate throughout the building

37. What must the construction team verify about below-grade drainage piping before concrete is placed?

A. Only that the piping material matches the specification color

B. Pipe elevations, slopes, connection locations, joint integrity, and test results because the piping will be inaccessible and extremely costly to correct after the slab is poured

C. Only that the pipe manufacturer's label is visible

D. Only that the trench depth matches the excavation plan

38. A building's green roof system reduces stormwater runoff. How does this benefit the building's storm drainage system?

A. It increases the flow velocity in the storm drainage piping

B. It eliminates the need for a secondary roof drainage system

C. It increases the required size of the primary roof drains

D. It reduces the peak flow rate and total volume entering the storm drainage system, potentially allowing smaller pipe sizes and reduced detention requirements

39. A plumbing contractor provides closeout documentation that includes only the water heater warranty card. Why is this insufficient?

A. The warranty card is the only document needed for plumbing closeout

B. Only the plumbing permit certificate is needed for closeout

C. Complete closeout requires as-built drawings, test reports, equipment manuals, valve schedules, maintenance procedures, and all warranty documents for the entire plumbing system

D. Only the fixture specification sheets are required at closeout

40. What ongoing testing does the plumbing code require for the building's backflow prevention assembly after initial installation?

A. Annual testing by a certified backflow prevention tester with reports submitted to the water utility or AHJ

B. Testing only when the water utility performs main line maintenance

C. Testing only if a visible leak develops at the assembly

D. No testing after initial installation and acceptance

41. A building's domestic water system has multiple zones served by pressure reducing valves. During commissioning, one zone shows pressure at 95 psi. What action is required?

A. The PRV has failed or is improperly set and must be adjusted or replaced to reduce pressure to 80 psi or below

B. No action because 95 psi is acceptable for commercial buildings

C. Only a notification to the building owner is required

D. The zone piping must be upsized to handle the higher pressure

42. A facility manager notices the grease interceptor has not been pumped in over a year. What risk does this create?

A. The domestic water system will lose pressure from grease accumulation

B. The building's vent system will reverse flow

C. The storm drainage system will become contaminated

D. Accumulated grease will pass through to the sanitary sewer, causing blockages, sewer overflows, and potential code violations and fines

43. What is the primary purpose of a trap primer on a commercial floor drain?

A. Automatically maintaining the trap seal with periodic water additions to prevent sewer gas from entering the building through infrequently used drains

B. Increasing the water pressure at the floor drain location

C. Filtering debris from entering the drainage system

D. Heating the trap water to prevent freezing in cold areas

44. A plumbing engineer specifies point-of-use tankless water heaters for remote restrooms distant from the central water heater. What is the primary benefit?

A. Providing higher water pressure at remote fixtures

B. Increasing the building's total hot water storage capacity

C. Eliminating long distribution piping runs that waste energy and water while waiting for hot water to arrive from the distant central heater

D. Replacing the building's central water heating system entirely

45. What must the plumbing contractor demonstrate during the final plumbing inspection?

A. Only that the water meter has been installed at the service entrance

B. That all fixtures are installed, operational, and leak-free, drainage flows properly, hot water is delivered at required temperatures, and the complete system complies with approved plans

C. Only that the backflow preventer has been installed

D. Only that the plumbing permit card has been signed

46. A building's stormwater management plan includes permeable paving, bioswales, and a detention basin. What is the combined purpose of these elements?

A. Increasing the velocity of stormwater discharge to the municipal system

B. Providing potable water for the building's domestic water system

C. Replacing the building's fire suppression water supply

D. Reducing the volume, rate, and pollutant content of stormwater runoff from the building site

47. What training must the plumbing contractor provide to the building operations staff as part of project closeout?

A. System operation, emergency shutoff locations, water heater operation, water management plan implementation, and basic troubleshooting procedures

B. Advanced plumbing design and engineering calculations

C. Plumbing contractor licensing exam preparation

D. Plumbing code interpretation and plan review techniques

48. A commissioning agent finds that the hot water recirculation system maintains only 105 degrees at the return line, well below the 140-degree heater setpoint. What deficiencies could cause this?

A. The cold water supply temperature is too high

B. The expansion tank is oversized for the system

C. Insufficient pump flow, inadequate pipe insulation, excessive system length without balancing, or a failed recirculation pump

D. The thermostatic mixing valves are set too high

49. A building's plumbing as-built drawings show the original design routing, but several field changes were made during construction. Why is this a problem?

A. Field changes always improve the system beyond the original design

B. Inaccurate as-built drawings prevent the operations team from locating concealed piping, valves, and cleanouts for future maintenance, troubleshooting, and modifications

C. Field changes automatically void the plumbing contractor's warranty

D. The plumbing inspector will not accept any field modifications

50. What comprehensive documentation must the plumbing contractor deliver at project closeout to ensure effective ongoing system management?

A. Only the plumbing fixture color selections and manufacturer names

B. Only the water heater serial number and warranty registration

C. Only the plumbing permit closure certificate from the AHJ

D. As-built drawings, pressure test reports, equipment manuals, valve schedules, maintenance procedures, warranty information, water management plan, and training records

ANSWER KEY 17: DETAILED EXPLANATIONS — PRACTICE TEST 17 COMPREHENSIVE PLUMBING SYSTEMS REVIEW

Questions 1–50

1. **B. A pressure reducing valve must be installed to reduce pressure to 80 psi or below** — The IPC limits maximum static water pressure at fixtures to 80 psi. Incoming pressure of 110 psi exceeds this limit and would cause fixture damage, excessive noise, water hammer, and premature component wear. A PRV at the service entrance reduces downstream pressure to a safe operating range.

2. **D. A leak exists in the piping system that must be located and repaired before the test is repeated** — Hydrostatic testing requires the system to maintain the test pressure for the specified duration with no measurable pressure drop. Any pressure loss indicates a leak at a joint, fitting, or valve that must be located, repaired, and the system retested until it holds pressure without loss.

3. **A. Recirculation pump operation, return line valve positions, and piping insulation integrity between the heater and the remote fixture** — A 35-degree temperature drop between the heater and a remote fixture indicates the hot water is losing heat in the distribution piping. The investigation should verify the recirculation pump is running, return line valves are open, the recirculation loop reaches the remote area, and pipe insulation is intact throughout.

4. **C. Preventing rainwater from overloading sewage treatment plants and preventing sewage from backing up through storm drain outlets** — Separate systems ensure that large volumes of rainwater flow to storm sewers without entering the sanitary treatment system, and that sanitary sewage cannot back up through exterior storm drain outlets during heavy rain events. Combined systems create both public health and environmental risks.

5. **B. The floor drain trap seal has evaporated due to infrequent use, allowing sewer gas to enter the room** — Trap seals in floor drains evaporate over time when the drain receives no regular water flow. Once the water seal is depleted, sewer gases pass freely through the open trap into the occupied space. Installing a trap primer or manually adding water periodically maintains the seal.

6. **A. Stagnant water in the dead leg can cool into the Legionella growth range of 77 to 113 degrees, creating a colonization risk** — Dead legs are sections of hot water piping with no flow that allow water to stagnate and cool to temperatures ideal for Legionella proliferation. ASHRAE 188 water management plans identify and address dead legs through removal, recirculation extension, or periodic flushing protocols.

7. **D. The probability that not all fixtures operate simultaneously, using weighted demand values to determine likely peak flow** — Fixture unit calculations assign demand values to each fixture type based on flow rate and usage frequency. These values are totaled and converted to probable peak flow using diversity curves that account for the statistical probability that only a fraction of all fixtures operate at any given time.

8. **C. ADA and ICC A117.1 compliance for mounting heights, clearances, approach dimensions, and operable fixture controls** — Accessible plumbing fixture design requires compliance with specific dimensional and operational requirements including wheelchair clearances, lavatory knee space, water closet mounting heights, grab bar placement, and controls operable with limited dexterity, ensuring persons with disabilities can use restroom facilities independently.

9. **B. The number and type of contributing kitchen fixtures, peak flow rate, and grease retention capacity per jurisdiction requirements** — Grease interceptor sizing calculates the total drainage load from all kitchen fixtures that produce grease-laden waste, determines the peak flow rate, and applies the jurisdiction's sizing methodology to establish the required retention capacity. Undersized interceptors allow grease to pass through to the sewer.

10. **A. Solids will settle and accumulate in the flat section, eventually causing a blockage because gravity drainage requires minimum slope to maintain flow velocity** — Horizontal drainage piping relies on gravity to maintain sufficient flow velocity to carry solids through the system. Without minimum slope, the velocity drops below the self-cleaning threshold, allowing solids to settle, accumulate, and eventually obstruct the pipe.

11. **D. Specifying high-efficiency WaterSense fixtures and supplementing with rainwater harvesting or graywater recycling for non-potable uses** — LEED Water Efficiency credits require reducing indoor potable water consumption below a calculated baseline. High-efficiency fixtures provide the primary reduction, while alternative water sources such as harvested rainwater and recycled graywater for toilet flushing and irrigation provide additional reduction toward higher credit levels.

12. **B. The sewage level in the ejector basin has risen above normal, indicating the pump has failed or cannot keep up with incoming flow** — Sewage ejector high-level alarms indicate that the basin is filling beyond its normal operating range. This means the pump is not removing sewage at the rate it is entering, typically due to pump failure, impeller obstruction, check valve failure, or electrical supply interruption requiring immediate attention.

13. **C. Verifying that the check valves and relief valve operate correctly to protect the municipal water supply from contamination** — Annual testing by a certified tester confirms that each check valve seats tightly and the relief valve opens at the correct differential pressure. Without annual verification, undetected valve deterioration could allow contaminated building water to backflow into the municipal supply.

14. **A. The primary roof drainage system is blocked or overwhelmed, and the secondary system is functioning as designed to prevent structural roof overload** — Secondary roof drainage systems are specifically designed to discharge at a visible exterior location as an alert mechanism. The visible water flow signals building maintenance that the primary drains require immediate inspection and clearing to prevent continued reliance on the emergency overflow system.

15. **D. PVC provides significantly less sound attenuation and fire resistance than cast iron, failing to meet code requirements for the building type** — Cast iron is required in many commercial building types because its dense material mass significantly reduces drainage noise transmission to occupied spaces and its noncombustible nature provides inherent fire resistance. PVC produces noticeably more noise and requires additional fire protection at penetrations.

16. **C. That each penetration is firestopped with a listed system that maintains the fire resistance rating of the penetrated assembly** — Every plumbing pipe penetration through a fire-rated wall or floor creates an opening that compromises the assembly's fire rating. Listed firestop systems compatible with the pipe material and assembly type must seal each penetration to restore the full fire resistance rating.

17. **B. Installing a timer or demand-based control to operate the pump only during occupied hours or when hot water demand exists** — Running the recirculation pump continuously wastes energy by circulating hot water 24 hours a day including unoccupied periods when no one needs hot water. Timer controls limit operation to occupied hours, while demand-based controls activate the pump only when a hot water request is detected.

18. **A. The mixing valve is malfunctioning and requires calibration or replacement to deliver a stable, safe outlet temperature** — Thermostatic mixing valves are designed to maintain a constant, safe outlet temperature regardless of supply fluctuations. A 35-degree temperature swing indicates the valve's thermal element is not responding properly, creating both scalding risk at the high end and inadequate temperature at the low end.

19. **D. 2 inches, providing adequate resistance to siphonage and back-pressure while allowing proper drainage flow** — The 2-inch minimum trap seal depth balances two competing requirements: sufficient depth to resist pressure variations that could break the seal, and shallow enough to allow proper drainage without excessive resistance. The 4-inch maximum prevents seals so deep they impede flow and increase self-siphonage risk.

20. **B. Identifying specific areas of high consumption, detecting leaks, and enabling targeted conservation measures for each system** — Sub-metering individual water-consuming systems

provides granular data that the main meter cannot. The facility manager can identify which system consumes the most water, detect leaks through abnormal consumption patterns, and measure the effectiveness of conservation measures applied to specific systems.

21. **A. 5 psi gauge pressure maintained with no measurable loss for a minimum of 15 minutes per the plumbing code** — The air test for drainage piping uses low pressure because drainage systems operate at atmospheric conditions and are not designed for pressurization. The 5 psi test pressure is sufficient to detect joint leaks through pressure drop without overstressing the drainage piping or fittings.

22. **C. A high-hazard cross-connection where contamination could endanger public health, requiring the highest level of backflow protection** — RPZ assemblies are required for the highest hazard level where backflow contamination could cause illness or death. The RPZ provides two independent check valves with an intermediate relief valve that discharges to atmosphere if either check fails, providing the maximum protection level.

23. **D. Loss of required hot water for handwashing hygiene, Legionella risk from stagnant warm water in piping, and code violation for minimum fixture requirements** — Operating without hot water eliminates the required handwashing temperatures for hygiene, creates conditions where water in the distribution piping may stagnate at temperatures favorable for Legionella growth, and violates plumbing code requirements for minimum hot water delivery to fixtures.

24. **B. Sump pumps handle clear water drainage while sewage ejectors handle sanitary waste, requiring sealed basins, vent connections, and alarm systems** — The fundamental distinction is the waste type handled. Sewage ejectors must contain human waste in sealed, gas-tight basins with vent connections to prevent sewer gas release and alarm systems for failure notification. Sump pumps handle clean water with simpler installation requirements.

25. **C. Proper treatment, complete separation from the potable system, clearly identified purple non-potable piping, and approval from the AHJ** — Graywater systems must treat water to safe quality levels, maintain absolute physical separation from the potable supply to prevent cross-contamination, use clearly marked purple piping identifying non-potable distribution, and receive formal approval from the local authority having jurisdiction before operation.

26. **A. Treating corrosive chemical waste to an acceptable pH before discharge to the sanitary sewer, protecting sewer infrastructure and treatment processes** — Acid neutralization tanks contain limestone media or chemical dosing that raises the pH of acidic laboratory waste to the acceptable range of 5.0 to 12.5 before entering the sanitary sewer. Untreated acid waste would corrode sewer piping and interfere with wastewater treatment processes.

27. **D. Drainage systems require long-sweep or sanitary-pattern fittings that maintain smooth flow and prevent blockages at direction changes** — Standard 90-degree elbows create abrupt direction changes that cause turbulence, slow flow velocity, and create pockets where solids

accumulate. Sanitary-pattern fittings provide gradual sweeping transitions that maintain smooth flow and self-cleaning velocity through direction changes.

28. **B. Complete physical separation from the potable system with an air gap, and the non-potable piping must be clearly identified** — Any non-potable water system connected to building plumbing must maintain complete physical separation from the potable supply to prevent cross-contamination under any condition. Air gaps provide the highest level of separation, and purple piping with clear labeling prevents accidental cross-connections during future modifications.

29. **A. Verifying that all joints are leak-free and the piping maintains structural integrity at pressures above normal operating conditions** — Hydrostatic testing pressurizes the domestic water piping above normal operating pressure for a specified duration. The elevated pressure stresses joints and connections to reveal defects that might not leak under normal conditions, ensuring long-term reliability before the piping is concealed.

30. **D. The piping has reached the end of its useful life and should be replaced with modern materials as part of a capital improvement plan** — Galvanized steel piping develops internal corrosion and mineral buildup over decades that progressively reduces the internal diameter and flow capacity. Once significant restriction is present, the corrosion will continue to worsen. Replacement with copper or PEX restores full flow capacity and provides decades of reliable service.

31. **C. Future blockages will be extremely difficult and expensive to clear because there is no access to insert drain cleaning equipment** — Cleanouts provide essential access points for inserting mechanical drain cleaning equipment to clear blockages. Without cleanouts at code-required intervals and locations, the only options for clearing blockages involve opening walls, ceilings, or floors to access the piping, creating costly and disruptive repairs.

32. **A. Municipal sewer surcharges could cause sewage to back up into the building through the sewer connection, flooding below-grade spaces** — Backwater valves prevent reverse flow from the municipal sewer during surcharge events caused by heavy rainfall or downstream blockages. A failed backwater valve allows sewage from the overloaded municipal system to flow backward into the building, flooding basement and below-grade areas with raw sewage.

33. **B. 140 degrees or above at the water heater and recirculation return, with safe delivery temperatures at fixtures controlled by thermostatic mixing valves** — ASHRAE 188 and Legionella prevention best practices require maintaining hot water at 140 degrees or above throughout the storage and distribution system to prevent bacterial colonization. Thermostatic mixing valves at the point of use then blend the hot water to safe delivery temperatures that prevent scalding.

34. **D. Reducing potable water consumption by at least 20 percent compared to standard fixtures while maintaining equivalent performance** — WaterSense certification requires independent

testing confirming that fixtures use at least 20 percent less water while delivering performance equal to or exceeding standard fixtures. Building-wide installation of WaterSense fixtures provides measurable water savings and contributes to LEED and sustainability goals.

35. **A. The VFD adjusts pump speed to match actual demand, maintaining constant pressure while consuming significantly less energy during partial demand periods** — Variable speed booster pumps reduce speed as building demand decreases, maintaining the target discharge pressure while consuming less energy. Since pump energy varies with the cube of speed, even modest speed reductions during partial demand yield substantial energy savings compared to constant-speed operation.

36. **C. System pressure will increase excessively when water is heated because the waterlogged tank cannot absorb thermal expansion** — A waterlogged expansion tank has lost its air cushion and cannot compress to absorb the volume increase when water is heated. With no expansion capacity, the temperature and pressure relief valve will discharge repeatedly, or system pressure will exceed safe limits potentially damaging piping and equipment.

37. **B. Pipe elevations, slopes, connection locations, joint integrity, and test results because the piping will be inaccessible after the slab is poured** — Below-grade drainage piping becomes permanently inaccessible once encased in concrete. Every dimension, slope, connection, and joint must be verified and the system must pass its pressure test before concrete placement. Errors discovered after the pour require costly concrete demolition for correction.

38. **D. It reduces the peak flow rate and total volume entering the storm drainage system, potentially allowing smaller pipe sizes and reduced detention requirements** — Green roofs absorb and retain significant rainfall in the growing media and vegetation, releasing water slowly through evapotranspiration and delayed drainage. This reduces both the peak flow rate and total runoff volume, potentially reducing the required capacity of downstream storm drainage infrastructure.

39. **C. Complete closeout requires as-built drawings, test reports, equipment manuals, valve schedules, maintenance procedures, and all warranty documents** — A single warranty card provides almost none of the information the operations team needs to manage the plumbing systems. Complete closeout documentation enables the team to locate piping, reference test results, perform scheduled maintenance, identify valve locations, and manage equipment warranties across all plumbing systems.

40. **A. Annual testing by a certified backflow prevention tester with reports submitted to the water utility or AHJ** — Annual testing verifies that backflow preventer check valves and relief valves continue to function correctly. Valve components degrade over time from mineral deposits, wear, and corrosion. Annual testing identifies degradation before it compromises the device's ability to protect the municipal water supply.

41. **A. The PRV has failed or is improperly set and must be adjusted or replaced to reduce pressure to 80 psi or below** — Zone pressure of 95 psi exceeds the code maximum of 80 psi, indicating the pressure reducing valve serving that zone has failed or drifted above its setpoint. The valve must be adjusted, repaired, or replaced to bring the zone pressure within the code-required range before occupancy.

42. **D. Accumulated grease will pass through to the sanitary sewer, causing blockages, sewer overflows, and potential code violations and fines** — Grease interceptors have limited retention capacity that requires regular pumping. When the accumulated grease exceeds the interceptor's capacity, it passes through into the sanitary sewer, solidifying in the piping and causing blockages, overflows, and regulatory violations with associated fines.

43. **A. Automatically maintaining the trap seal with periodic water additions to prevent sewer gas from entering the building through infrequently used drains** — Trap primers connect to the domestic water supply and periodically release small volumes of water into the floor drain trap to replenish the seal as it evaporates. This automated approach ensures continuous sewer gas protection without relying on manual water additions by maintenance staff.

44. **C. Eliminating long distribution piping runs that waste energy and water while waiting for hot water to arrive from the distant central heater** — Long hot water runs to remote fixtures waste energy through heat loss in the piping and waste water while occupants wait for hot water to arrive. Point-of-use tankless heaters provide instant hot water at the fixture location, eliminating both distribution losses and wait-time water waste.

45. **B. That all fixtures are installed, operational, and leak-free, drainage flows properly, hot water is delivered at required temperatures, and the complete system complies with approved plans** — The final plumbing inspection verifies the complete installed system including every fixture connection, proper drainage function, hot and cold water operation, adequate hot water temperature, backflow preventer installation, code-compliant accessibility, and overall compliance with the approved construction documents.

46. **D. Reducing the volume, rate, and pollutant content of stormwater runoff from the building site** — These low-impact development techniques work together to manage stormwater on site. Permeable paving infiltrates water into the ground. Bioswales filter pollutants and slow flow. Detention basins store runoff and release it at controlled rates. Combined, they reduce environmental impact and comply with stormwater regulations.

47. **A. System operation, emergency shutoff locations, water heater operation, water management plan implementation, and basic troubleshooting procedures** — Operations staff training provides the practical knowledge needed for daily system management including normal operation, emergency valve locations and procedures, water heater monitoring and adjustment, implementation of the ASHRAE 188 water management plan, and recognition and resolution of common plumbing problems.

48. **C. Insufficient pump flow, inadequate pipe insulation, excessive system length without balancing, or a failed recirculation pump** — A 35-degree temperature drop in the recirculation return indicates excessive heat loss in the distribution loop. The investigation should evaluate pump flow rate against design, insulation condition and completeness, loop length and balancing valve settings, and whether the pump is actually operating and delivering design flow.

49. **B. Inaccurate as-built drawings prevent the operations team from locating concealed piping, valves, and cleanouts for future maintenance, troubleshooting, and modifications** — As-built drawings must reflect actual installed conditions including all field changes. When drawings show the original design routing rather than actual installation, the operations team cannot accurately locate concealed piping, valves, and cleanouts, leading to unnecessary exploratory demolition and costly mistakes during future work.

50. **D. As-built drawings, pressure test reports, equipment manuals, valve schedules, maintenance procedures, warranty information, water management plan, and training records** — The complete closeout package transfers all knowledge and records from the construction team to the building operations team. Each document serves a specific ongoing purpose, from locating concealed infrastructure to maintaining equipment, managing water quality, and ensuring continued code compliance throughout the building's operational life.