

# FULL-LENGTH PRACTICE TESTS

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## Practice Test 11: Plumbing Codes, Testing, Commissioning, And Sustainable Practices – Chapter 11

### Questions 1–50

1. Which model plumbing code is most widely adopted for commercial construction in the United States?
  - A. The National Standard Plumbing Code
  - B. The International Plumbing Code
  - C. The Uniform Plumbing Code
  - D. NFPA 5000 Building Construction and Safety Code
  
2. What is the relationship between model plumbing codes and locally enforced codes?
  - A. Model codes are automatically enforceable upon publication
  - B. Model codes replace all local amendments when adopted
  - C. Model codes serve as advisory guidelines with no legal authority
  - D. Jurisdictions adopt model codes as law, often adding local amendments
  
3. What is the primary role of the authority having jurisdiction in commercial plumbing?
  - A. Reviewing plans, issuing permits, and enforcing plumbing code compliance
  - B. Designing the plumbing systems for the building
  - C. Manufacturing plumbing fixtures and piping materials

D. Providing plumbing installation labor for the project

4. When must the plumbing contractor obtain a permit from the AHJ?

A. After the plumbing installation is complete

B. Only if fire suppression piping is included

C. Before beginning any plumbing installation work

D. Only for projects exceeding a specified dollar value

5. What does the plumbing plan review process verify before a permit is issued?

A. That the plumbing contractor submitted the lowest bid

B. That the proposed design complies with the adopted plumbing code

C. That the plumbing fixtures match the interior design palette

D. That the plumbing budget fits the owner's financial plan

6. What is the primary purpose of plumbing inspections during construction?

A. Determining the plumbing contractor's payment amount

B. Photographing the installation for marketing materials

C. Evaluating the plumbing contractor's workforce productivity

D. Verifying that the installation complies with approved plans and code

7. When must underground and under-slab plumbing be inspected?

A. After the concrete slab has been poured and finished

B. After the building is fully enclosed and heated

- C. Before the piping is backfilled or covered with concrete
- D. Only during the final occupancy inspection

8. What is the primary purpose of a rough-in plumbing inspection?

- A. Verifying concealed piping is correctly installed and code-compliant before finishes are applied
- B. Confirming that all plumbing fixtures have been connected
- C. Testing the fire suppression system for code compliance
- D. Verifying that all material certifications have been obtained

9. What does the plumbing inspector verify during the final inspection?

- A. That the HVAC system has been commissioned and balanced
- B. That all fixtures are installed, operational, and the complete system functions without leaks
- C. That the electrical system serving plumbing equipment meets NEC requirements
- D. That the fire alarm system has been tested and accepted

10. What is the consequence of failing a plumbing inspection?

- A. The plumbing contractor's license is automatically revoked
- B. The building owner must hire a different plumbing contractor
- C. The project is permanently halted by the building department
- D. The contractor must correct deficiencies and request re-inspection

11. How is the minimum number of plumbing fixtures for a commercial building determined?

- A. By the building's occupancy type and occupant count per code fixture tables

- B. By the building owner's preference for restroom quantity
- C. By the architect's aesthetic vision for restroom layout
- D. By the plumbing contractor's standard fixture package

12. What factors determine the required number of water closets and lavatories?

- A. The total building construction cost and fixture cost ratio
- B. The distance from the building to the nearest public restroom
- C. The occupancy classification, occupant count, and code fixture ratio tables
- D. The number of floors times a standard fixture count per floor

13. What accessibility standard must commercial plumbing fixtures comply with?

- A. NFPA 72 fire alarm accessibility provisions
- B. The ADA and ICC A117.1 Accessible and Usable Buildings standard
- C. ASHRAE Standard 90.1 energy efficiency requirements
- D. SMACNA duct accessibility standards

14. What are the key accessibility requirements for an ADA-compliant restroom?

- A. Only a wider entry door with no fixture modifications
- B. Only grab bars at the water closet
- C. Only a lower lavatory mounting height
- D. Wheelchair clearances, proper mounting heights, grab bars, and accessible controls

15. What is the primary purpose of hydrostatic testing on domestic water piping?

- A. Verifying leak-free joints and structural integrity above normal operating pressure
- B. Determining the maximum flow rate at the most remote fixture
- C. Measuring the incoming municipal water quality
- D. Calibrating the pressure reducing valve at the service entrance

16. What are the typical hydrostatic test parameters for domestic water piping?

- A. Atmospheric pressure with visual inspection only
- B. Normal operating pressure for 10 minutes
- C. Code-required elevated pressure maintained for the specified duration while monitoring for pressure drop
- D. 500 psi for 24 hours regardless of pipe material

17. What testing is required for sanitary drainage and vent piping before concealment?

- A. Only a visual inspection of accessible joints
- B. A water test to flood level or an air test at code-specified pressure for the required duration
- C. A high-pressure hydrostatic test identical to domestic water testing
- D. A flow test using dyed water at every fixture drain

18. What is the typical air test pressure and duration for drainage piping?

- A. 100 psi maintained for 60 minutes
- B. 50 psi maintained for 30 minutes
- C. Equal to the drainage system's normal operating pressure

D. 5 psi gauge pressure with no loss for a minimum of 15 minutes

19. What documentation must be maintained for all plumbing pressure tests?

A. Written records of the system tested, pressure, duration, results, witness, and date

B. Only verbal confirmation from the plumbing foreman

C. Only a photograph of the test gauge

D. Only the plumbing inspector's signature on the permit card

20. What is the primary purpose of plumbing system commissioning?

A. Selecting the plumbing fixtures and equipment for the project

B. Negotiating the plumbing contractor's contract value

C. Verifying that all plumbing systems operate as designed and meet the owner's requirements

D. Training the plumbing contractor's workforce on techniques

21. What plumbing systems are typically included in the commissioning scope?

A. Only the fire suppression sprinkler system

B. Only the sanitary drainage system below grade

C. Only the domestic hot water system

D. Domestic water, hot water, drainage, venting, specialty systems, and associated controls

22. What is the primary purpose of pre-functional checklists in plumbing commissioning?

A. Calculating the plumbing contractor's final payment

B. Verifying equipment and piping is installed and ready for functional testing

- C. Determining plumbing fixture color selections
- D. Scheduling the plumbing inspector's final visit

23. What does functional performance testing verify for a domestic hot water system?

- A. Only that hot water flows from one representative faucet
- B. Only that the water heater nameplate matches the specification
- C. Heater operation, delivery temperatures, recirculation function, mixing valve calibration, and safety device response
- D. Only that the gas connection is leak-free

24. What is the commissioning authority's responsibility when deficiencies are found?

- A. Documenting deficiencies, communicating them to the contractor, and tracking resolution through retesting
- B. Personally repairing the deficient plumbing equipment
- C. Immediately reporting the contractor to the building department
- D. Approving the deficiency as an acceptable field condition

25. What document does the commissioning authority produce at completion?

- A. The plumbing contractor's warranty certificate
- B. The building's certificate of occupancy
- C. The plumbing permit closure document
- D. A final commissioning report summarizing all testing, findings, and resolutions

26. What is the primary purpose of ASHRAE Standard 188 in commercial plumbing?

- A. Establishing maximum fixture flow rates for water conservation
- B. Establishing Legionella risk management requirements for building water systems
- C. Specifying pipe sizing methods for domestic water distribution
- D. Defining minimum plumbing fixture counts for commercial occupancies

27. What does a building water management plan per ASHRAE 188 require?

- A. Risk assessment, control measures, monitoring protocols, corrective actions, and documentation
- B. Only an annual water heater temperature reading
- C. Only a quarterly visual inspection of cooling towers
- D. Only testing the backflow preventer at the service entrance

28. What temperature control measure is essential for Legionella prevention?

- A. Maintaining hot water below 100 degrees Fahrenheit
- B. Cycling the water heater on and off every 30 minutes
- C. Storing water at 140 degrees or above with mixing valves at fixtures to prevent scalding
- D. Adding ice to the hot water storage tank daily

29. What building water system components carry the highest Legionella risk?

- A. Fire sprinkler piping and fire pump test headers
- B. Cooling towers, domestic hot water systems, and any system with stagnant water between 77 and 113 degrees
- C. Chilled water piping serving air handling cooling coils

D. Compressed air receivers and pneumatic control tubing

30. What is the primary water conservation standard for commercial plumbing fixtures?

A. ASHRAE Standard 62.1 ventilation rate procedure

B. NFPA 13 sprinkler system water supply requirements

C. ASHRAE Standard 90.1 energy efficiency standard

D. The EPA WaterSense program and the Energy Policy Act

31. What are the current federal maximum flow rates for commercial plumbing fixtures?

A. 5.0 gpm for all fixtures regardless of type

B. 10.0 gpm for lavatories and 5.0 gpf for water closets

C. Public lavatories at 0.5 gpm, private lavatories at 2.2 gpm, showerheads at 2.5 gpm, water closets at 1.6 gpf

D. No federal maximum flow rate requirements exist for commercial fixtures

32. What is the primary benefit of specifying WaterSense-labeled fixtures?

A. At least 20 percent water savings over standard fixtures with equivalent performance

B. Automatic qualification for fire protection code exemptions

C. Elimination of backflow prevention requirements

D. Reduced electrical energy consumption throughout the building

33. What is the primary purpose of graywater recycling in sustainable plumbing?

A. Providing potable drinking water from recycled wastewater

- B. Eliminating the need for a municipal sewer connection
- C. Increasing the building's fire protection water supply
- D. Reusing lavatory and shower water for non-potable applications like toilet flushing

34. What are the essential requirements for a code-compliant graywater system?

- A. Only a storage tank with no treatment needed
- B. Proper treatment, separation from potable supply, identified non-potable piping, and AHJ approval
- C. Direct connection to the potable system for distribution
- D. Discharge to the storm sewer without treatment

35. What is the primary purpose of rainwater harvesting in sustainable plumbing?

- A. Providing potable water for drinking fountains and kitchens
- B. Increasing the building's sanitary sewer discharge volume
- C. Collecting and treating rainwater for non-potable uses to reduce municipal water demand
- D. Replacing the building's fire suppression water supply

36. What components make up a complete commercial rainwater harvesting system?

- A. Collection surfaces, first-flush diverters, filtration, storage, treatment, pumps, and non-potable distribution
- B. Only a roof drain connected directly to toilet flush valves
- C. Only a storage tank with no treatment or filtration
- D. Only a gravity-fed system with no pumps or treatment

37. What is the primary benefit of sub-metering water consumption in commercial buildings?

- A. Increasing water pressure at individual metered fixtures
- B. Providing fire alarm activation based on water flow detection
- C. Replacing the utility's main water revenue meter
- D. Identifying high consumption areas, detecting leaks, and enabling targeted conservation

38. What is the primary purpose of a stormwater management plan?

- A. Providing additional potable water from collected rainwater
- B. Managing the quantity, quality, and rate of site stormwater runoff
- C. Increasing stormwater discharge velocity to the municipal system
- D. Eliminating all stormwater by storing 100 percent permanently on site

39. What stormwater management techniques are commonly used on commercial sites?

- A. Discharging all stormwater directly to streams without treatment
- B. Connecting all roof drains to the sanitary sewer system
- C. Detention basins, permeable paving, bioswales, green roofs, and underground storage
- D. Increasing impervious surface area for maximum drainage efficiency

40. What is the primary stormwater function of a green roof system?

- A. Absorbing and retaining rainwater to reduce runoff volume and improve water quality
- B. Providing structural support for rooftop mechanical equipment
- C. Increasing roof reflectivity to reduce cooling loads
- D. Replacing the building's conventional storm drainage system entirely

41. What plumbing code provision addresses water conservation?

- A. Only the minimum fixture count tables based on occupancy
- B. Maximum flow rates, flush volumes, and metering faucet requirements for public restrooms
- C. Only the pipe sizing tables for domestic water distribution
- D. Only the backflow prevention assembly requirements

42. What is the primary goal of hot water demand reduction strategies?

- A. Increasing water heater storage temperature above 180 degrees
- B. Eliminating hot water service to all fixtures
- C. Installing larger diameter hot water distribution piping
- D. Reducing water heating energy through low-flow fixtures, efficient equipment, and recirculation controls

43. What is the primary purpose of plumbing maintenance programs?

- A. Maintaining performance, preventing failures, and extending equipment life through scheduled activities
- B. Only repairing systems after failures occur
- C. Only replacing all fixtures on an annual schedule
- D. Only reading the water meter monthly for billing

44. What ongoing testing is required for backflow prevention assemblies?

- A. Testing only if the water utility requests certification
- B. Testing only when a visible leak is detected
- C. Annual testing by a certified tester with reports submitted to the utility or AHJ

D. No testing is required after initial installation

45. What is the primary purpose of plumbing as-built drawings at closeout?

A. Providing the architect with marketing brochure content

B. Documenting actual installed locations, sizes, and routing for future maintenance and renovations

C. Calculating the final construction cost for plumbing

D. Providing the structural engineer with pipe weight data

46. What training must the plumbing contractor provide to operations staff at closeout?

A. Advanced plumbing design and engineering calculations

B. Plumbing code interpretation and plan review procedures

C. Plumbing contractor license exam preparation

D. System operation, emergency shutoffs, equipment operation, and basic troubleshooting

47. What is the primary strategy for reducing total building water consumption?

A. Combining high-efficiency fixtures, leak detection, rainwater harvesting, graywater recycling, and sub-metering

B. Only installing low-flow showerheads in employee restrooms

C. Only using bottled water instead of plumbing fixtures

D. Only reducing irrigation on the building site

48. What is the primary plumbing consideration for LEED Water Efficiency credits?

A. Using only copper piping for all water distribution

- B. Installing the maximum number of fixtures allowed by code
- C. Reducing indoor potable water consumption below the LEED baseline through efficient fixtures and alternative sources
- D. Increasing hot water storage temperatures for faster recovery

49. What is the primary purpose of a plumbing condition assessment in an existing building?

- A. Establishing the original construction cost of the plumbing
- B. Evaluating current condition, remaining life, code compliance, and identifying upgrade opportunities
- C. Determining the original contractor for warranty claims
- D. Measuring current water pressure for fire protection sizing

50. What documentation must the plumbing contractor deliver at project closeout?

- A. Only the fixture warranty registration cards
- B. Only the water heater nameplate data and serial number
- C. Only the plumbing permit closure certificate
- D. As-built drawings, test reports, equipment manuals, maintenance procedures, warranties, and training records

# ANSWER KEY 11: DETAILED EXPLANATIONS — PRACTICE TEST 11 PLUMBING CODES, TESTING, COMMISSIONING, AND SUSTAINABLE PRACTICES

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## Questions 1–50

1. **B. The International Plumbing Code** — The IPC, published by the International Code Council, is the most widely adopted model plumbing code in the United States. It establishes minimum requirements for plumbing systems protecting public health and safety, and is adopted by the majority of state and local jurisdictions as their enforceable plumbing standard.
2. **D. Jurisdictions adopt model codes as law, often adding local amendments** — Model codes have no legal authority until a state or local jurisdiction formally adopts them through legislative action. Jurisdictions frequently add local amendments that modify specific provisions to address regional conditions, local practices, or policy priorities unique to their area.
3. **A. Reviewing plans, issuing permits, and enforcing plumbing code compliance** — The AHJ is the governmental entity responsible for administering and enforcing the adopted plumbing code. This includes reviewing construction documents for code compliance, issuing permits authorizing work to proceed, conducting inspections during construction, and approving completed installations.
4. **C. Before beginning any plumbing installation work** — Plumbing permits must be obtained before any installation begins. The permit application requires submission of plumbing construction documents for plan review, and approval confirms that the proposed design meets code requirements. Work performed without a permit is a code violation subject to enforcement action.
5. **B. That the proposed design complies with the adopted plumbing code** — Plan review examines the plumbing drawings and specifications to verify compliance with code requirements for fixture counts, pipe sizing, materials, venting, drainage slopes, backflow prevention, accessibility, and all other applicable provisions before authorizing construction to proceed.

6. **D. Verifying that the installation complies with approved plans and code** — Plumbing inspections occur at critical construction stages to verify that the work matches the approved plans and meets code requirements. Inspectors check materials, installation methods, pipe sizes, slopes, supports, connections, and test results before allowing work to be concealed or the building occupied.
7. **C. Before the piping is backfilled or covered with concrete** — Underground and under-slab plumbing must be inspected while fully visible and accessible because once covered with backfill or concrete, deficiencies cannot be detected or corrected without costly demolition. The inspector verifies pipe material, size, slope, joint integrity, and test results before concealment.
8. **A. Verifying concealed piping is correctly installed and code-compliant before finishes are applied** — The rough-in inspection examines all piping installed within walls, above ceilings, and in chases before drywall, ceiling tiles, and other finishes conceal the work. This is the last opportunity to verify proper installation before the piping becomes inaccessible.
9. **B. That all fixtures are installed, operational, and the complete system functions without leaks** — The final inspection verifies the completed plumbing system including all fixture installations, hot and cold water function, proper drainage, trap seal integrity, water heater operation, backflow preventer installation, and overall system performance before the building is approved for occupancy.
10. **D. The contractor must correct deficiencies and request re-inspection** — Failed inspections require the plumbing contractor to correct all identified deficiencies and schedule a re-inspection. The corrected work must pass before it can be concealed or the building occupied. Repeated failures may result in additional scrutiny and enforcement actions by the AHJ.
11. **A. By the building's occupancy type and occupant count per code fixture tables** — The plumbing code provides tables that specify the minimum number of each fixture type based on the building's occupancy classification and the calculated number of male and female occupants. These tables ensure adequate sanitary facilities for the building's intended use and population.
12. **C. The occupancy classification, occupant count, and code fixture ratio tables** — Fixture count calculations require determining the building's occupancy type, calculating the number of occupants from the building's floor area and occupant load factors, and applying the code's fixture ratio tables that specify the required number of water closets, lavatories, and other fixtures per occupant count.
13. **B. The ADA and ICC A117.1 Accessible and Usable Buildings standard** — Commercial plumbing fixtures must comply with the Americans with Disabilities Act requirements and the technical standards in ICC A117.1, which specify mounting heights, clearances, approach dimensions, and operable feature requirements that ensure accessibility for persons with disabilities.

14. **D. Wheelchair clearances, proper mounting heights, grab bars, and accessible controls** — ADA-compliant restrooms require wheelchair turning space, accessible approach clearances at each fixture, water closets at specified mounting heights with grab bars, lavatories with knee clearance beneath, lever or sensor-operated controls, and compliant signage identifying accessible facilities.
15. **A. Verifying leak-free joints and structural integrity above normal operating pressure** — Hydrostatic testing pressurizes the domestic water piping system above its normal operating pressure and holds the elevated pressure for a specified duration. Any pressure drop indicates a leak that must be located and repaired. Testing above operating pressure provides a safety margin for pressure surges during normal use.
16. **C. Code-required elevated pressure maintained for the specified duration while monitoring for pressure drop** — The plumbing code specifies test pressure, typically 1.5 times working pressure or a minimum above working pressure, and the duration the pressure must be held. The system passes if no pressure drop occurs, confirming all joints and connections are leak-free under stress.
17. **B. A water test to flood level or an air test at code-specified pressure for the required duration** — Drainage piping is tested by filling the system with water to the highest point or by pressurizing with air at the code-specified low pressure. Either test method verifies that all joints are leak-free before the piping is concealed within the building construction.
18. **D. 5 psi gauge pressure with no loss for a minimum of 15 minutes** — The air test for drainage piping uses low pressure because drainage systems operate at atmospheric pressure and are not designed to withstand high pressures. The 5 psi test pressure is sufficient to detect joint leaks without stressing the piping beyond its design capability.
19. **A. Written records of the system tested, pressure, duration, results, witness, and date** — Plumbing test documentation provides a permanent record that the installed system was tested and verified leak-free before concealment. These records are required by the plumbing inspector, referenced during commissioning, and maintained in the building's permanent files for future reference.
20. **C. Verifying that all plumbing systems operate as designed and meet the owner's requirements** — Plumbing commissioning goes beyond code compliance inspections to systematically verify that every plumbing system performs according to the design intent and owner's project requirements. It tests operational performance, control function, and system integration under actual operating conditions.
21. **D. Domestic water, hot water, drainage, venting, specialty systems, and associated controls** — Comprehensive plumbing commissioning encompasses all plumbing systems including domestic cold and hot water distribution, water heating equipment, drainage and vent systems,

specialty piping such as medical gas or acid waste, and all associated controls, pumps, and accessories.

22. **B. Verifying equipment and piping is installed and ready for functional testing** — Pre-functional checklists systematically confirm that all equipment is physically installed, piping connections are complete, electrical and control connections are made, and the system is ready for operational testing. Completing these checklists before functional testing prevents wasted time testing incomplete installations.
23. **C. Heater operation, delivery temperatures, recirculation function, mixing valve calibration, and safety device response** — Hot water functional testing exercises the complete system from heater to fixtures, verifying that the heater maintains setpoint, delivery temperatures meet design requirements at representative locations, the recirculation system maintains temperature throughout the loop, mixing valves deliver safe temperatures, and T&P relief valves operate correctly.
24. **A. Documenting deficiencies, communicating them to the contractor, and tracking resolution through retesting** — The commissioning authority identifies and formally documents each deficiency, issues written notification to the responsible contractor through the construction management team, and maintains a tracking log that records the deficiency status through correction and successful retesting verification.
25. **D. A final commissioning report summarizing all testing, findings, and resolutions** — The final commissioning report is the permanent record of the entire commissioning process, documenting all pre-functional checklists, functional performance test procedures and results, deficiencies discovered and their resolution status, and recommendations for ongoing system optimization and maintenance.
26. **B. Establishing Legionella risk management requirements for building water systems** — ASHRAE Standard 188 provides minimum requirements for Legionella risk management in building water systems. It requires building owners to conduct risk assessments, develop water management plans, implement control measures, establish monitoring protocols, and maintain documentation for systems at risk of Legionella growth.
27. **A. Risk assessment, control measures, monitoring protocols, corrective actions, and documentation** — A compliant water management plan identifies all water system components with Legionella growth potential, establishes control measures such as temperature management and stagnation prevention, defines monitoring frequency and methods, specifies corrective actions when parameters deviate, and maintains records of all activities.
28. **C. Storing water at 140 degrees or above with mixing valves at fixtures to prevent scalding** — Legionella bacteria proliferate in water between 77 and 113 degrees Fahrenheit and are killed at temperatures above 140 degrees. Maintaining storage and distribution temperatures at 140

degrees or above controls bacterial growth, while thermostatic mixing valves at point of use prevent scalding injuries.

29. **B. Cooling towers, domestic hot water systems, and any system with stagnant water between 77 and 113 degrees** — The highest Legionella risk exists in systems that maintain water within the bacterial growth temperature range and provide conditions for biofilm development. Cooling towers create aerosols that can transmit Legionella, while domestic hot water systems with dead legs, low-use fixtures, and inadequate temperatures support growth.
30. **D. The EPA WaterSense program and the Energy Policy Act** — The Energy Policy Act establishes federal maximum flow rates and flush volumes for plumbing fixtures, while the EPA WaterSense program provides voluntary efficiency criteria that exceed federal minimums. Together they establish the framework for water conservation in commercial plumbing design.
31. **C. Public lavatories at 0.5 gpm, private lavatories at 2.2 gpm, showerheads at 2.5 gpm, water closets at 1.6 gpf** — Federal standards and plumbing codes establish these maximum flow rates and flush volumes to conserve water while maintaining fixture performance. High-efficiency fixtures exceeding these standards are available, with WaterSense-labeled models achieving at least 20 percent additional reduction.
32. **A. At least 20 percent water savings over standard fixtures with equivalent performance** — WaterSense certification requires independent third-party testing that verifies fixtures use at least 20 percent less water than standard models while delivering equivalent or superior performance. This ensures water savings do not compromise user satisfaction or hygiene.
33. **D. Reusing lavatory and shower water for non-potable applications like toilet flushing** — Graywater recycling collects relatively clean wastewater from lavatories, showers, and other approved sources, treats it to appropriate quality standards, and distributes it for non-potable uses such as toilet flushing and landscape irrigation, reducing the building's municipal potable water demand.
34. **B. Proper treatment, separation from potable supply, identified non-potable piping, and AHJ approval** — Code-compliant graywater systems require treatment to specified quality levels, complete physical separation from the potable water system with no cross-connections, clearly marked purple piping identifying non-potable distribution, and formal approval from the local authority having jurisdiction.
35. **C. Collecting and treating rainwater for non-potable uses to reduce municipal water demand** — Rainwater harvesting captures precipitation from roof surfaces that would otherwise be discharged as stormwater, treats it to acceptable quality, stores it for use, and distributes it for approved non-potable applications, reducing both municipal water consumption and stormwater runoff volume.

36. **A. Collection surfaces, first-flush diverters, filtration, storage, treatment, pumps, and non-potable distribution** — A complete rainwater harvesting system includes the collection surfaces, devices to divert initial contaminated runoff, filtration to remove particulates, storage tanks, treatment systems for the intended use, pumps for pressurized distribution, and a dedicated non-potable piping system with cross-connection protection.
37. **D. Identifying high consumption areas, detecting leaks, and enabling targeted conservation** — Sub-metering measures water usage by floor, zone, tenant, or system, providing granular consumption data that enables identification of waste, detection of leaks through abnormal usage patterns, equitable cost allocation to tenants, and measurement of conservation measure effectiveness.
38. **B. Managing the quantity, quality, and rate of site stormwater runoff** — Stormwater management plans address the environmental impact of site development by controlling the volume, flow rate, and pollutant content of runoff. Most jurisdictions require that post-development runoff not exceed pre-development conditions and that runoff quality meets environmental standards.
39. **C. Detention basins, permeable paving, bioswales, green roofs, and underground storage** — These low-impact development techniques manage stormwater by slowing, storing, filtering, and infiltrating runoff on site rather than discharging it rapidly to the municipal storm system. Each technique reduces runoff volume, improves water quality, and helps maintain natural hydrologic patterns.
40. **A. Absorbing and retaining rainwater to reduce runoff volume and improve water quality** — Green roof assemblies retain rainwater in the growing media and vegetation, reducing the volume and rate of stormwater runoff from the roof. The retained water is consumed by plants through evapotranspiration, and the growing media filters pollutants from the water that eventually drains.
41. **B. Maximum flow rates, flush volumes, and metering faucet requirements for public restrooms** — Plumbing codes incorporate water conservation provisions that establish maximum allowable flow rates for faucets and showerheads, maximum flush volumes for water closets and urinals, and requirements for self-closing or metering faucets in public restroom applications.
42. **D. Reducing water heating energy through low-flow fixtures, efficient equipment, and recirculation controls** — Hot water demand reduction combines multiple strategies: low-flow fixtures reduce the volume of hot water consumed, high-efficiency water heaters minimize fuel consumption, recirculation controls limit pump runtime to periods of actual demand, and point-of-use heaters eliminate long distribution runs.
43. **A. Maintaining performance, preventing failures, and extending equipment life through scheduled activities** — Proactive plumbing maintenance programs schedule regular inspections, testing, cleaning, and component replacement to maintain system performance at designed levels,

prevent unexpected failures and water damage, ensure ongoing code compliance, and extend the useful life of plumbing equipment and piping.

44. **C. Annual testing by a certified tester with reports submitted to the utility or AHJ** — Most jurisdictions and water utilities require annual testing of backflow prevention assemblies by certified testers to verify that the check valves and relief valve operate correctly. Test reports are submitted to the water utility or AHJ, and assemblies that fail must be repaired and retested.
45. **B. Documenting actual installed locations, sizes, and routing for future maintenance and renovations** — As-built drawings record the actual installed conditions of all plumbing piping, which frequently differ from the original design drawings due to field adjustments. These accurate records are essential for locating concealed piping, planning future connections, and troubleshooting problems throughout the building's operational life.
46. **D. System operation, emergency shutoffs, equipment operation, and basic troubleshooting** — Operations staff training covers the practical knowledge needed to operate and maintain the plumbing systems daily, including normal system operation, emergency shutoff valve locations and procedures, water heater and pump operation, water management plan implementation, and basic troubleshooting of common issues.
47. **A. Combining high-efficiency fixtures, leak detection, rainwater harvesting, graywater recycling, and sub-metering** — Maximum water conservation requires a comprehensive approach that addresses every aspect of water use. Individual strategies provide incremental savings, but combining multiple approaches across fixture efficiency, alternative sources, monitoring, and management produces the greatest total reduction in municipal water consumption.
48. **C. Reducing indoor potable water consumption below the LEED baseline through efficient fixtures and alternative sources** — LEED Water Efficiency credits require demonstrating a percentage reduction in indoor potable water consumption compared to a baseline calculated using standard fixture flow rates. Higher reductions earn more credit points through high-efficiency fixtures, sensor-operated controls, and alternative water sources.
49. **B. Evaluating current condition, remaining life, code compliance, and identifying upgrade opportunities** — Condition assessments examine existing plumbing systems to determine their current physical condition, estimate remaining useful life, identify code deficiencies or safety concerns, and recommend repairs, replacements, or upgrades that improve performance, efficiency, and reliability for capital planning purposes.
50. **D. As-built drawings, test reports, equipment manuals, maintenance procedures, warranties, and training records** — The complete closeout documentation package provides the building operations team with everything needed to operate, maintain, and manage the plumbing systems throughout the building's operational life. Missing or incomplete documentation compromises the operations team's ability to maintain designed performance.