

OPERATOR STUDY GUIDE

BASIC WATER DISTRIBUTION

MATH

1. If a pump runs for 24 hours and delivers 180,000 gallons, what is the gpm flow rate?
2. How many gallons will a 40-ft-high tank with a circumference of 283 feet hold full?
3. What is the per capita production in gallons per day for a system that produces 3,000 gpm for a population of 22,000?
4. What is the detention time in minutes of a 20-ft. diameter tank that is 12 feet deep with a flow of 1.5 MGD?
5. How long will it take to fill a tank that is 16 feet wide, 20 feet long and 8 feet deep with a flow of 30 gpm?
6. What is the maximum gpm pumping rate of a 400-HP pump with 450 feet of total head?
7. What would be the resultant dosage in mg/L of putting 100 lbs. of 65% HTH chlorine in a tank with a circumference of 283 feet with 32 feet of water in it with no demand?
8. What is the total head loss in 5,700 feet of 16-inch pipe if the flow is 2,400 gpm and the head loss is calculated at 0.31 feet per hundred feet of pipe?
9. If a chlorine residual at a disinfection facility is 1.2 mg/L and the residual in the distribution system is 0.5 mg/L, what is the chlorine demand?
10. What is the drawdown in a well if the static water level is 172 feet below the well seal and the pumping water level is 201 feet?
11. What is the velocity in fps of an 8-inch pipe with a flow of 520 gpm?
12. How many gallons of 5% hypochlorite will be needed to disinfect a 12-inch well that is 280 feet deep with a water level that is 130 feet below the surface of the ground to a dosage of 50 mg/L?
13. What depth of water would create a force of 105 psi?
14. How many cubic feet per second of water would be used to produce 2.5 MGD?
15. What is the pumping rate in gpm of a 400-HP pump with 600 feet of head?
16. If a 10-ml portion of water was used for a bacteriological test and it developed 3 coliform bacteria colonies, what is the number of colonies per 100 ml?
17. How many pounds of gas chlorine would be needed for a dosage of 1.5 mg/L on a 4.25 mile long 24-inch pipeline flowing at 2.1 cfs?
18. Convert parts per million to parts per billion.
19. Convert one million gallons to cubic feet per second.

OPERATION AND MAINTENANCE

1. What factors are considered in sizing customer meters, why is it done and how often should they be tested?
2. What are the correct procedures to follow in collecting bacteriological samples?
3. What do the following abbreviations stand for and what do they mean: gpm, MGD, TTHM, psi, HAA, NTU, and mg/L.
4. What do the following terms represent in reference to water quality: total coliform, fecal coliform, and presence/absence.
5. What is the purpose of a sanitary survey, how often are they required and who is authorized to perform them?
6. What are the aesthetic concerns of drinking water and what do they indicate?
7. What is the main purpose of a finished water storage reservoir?
8. What would be the appropriate application for the following types of valves: gate valve, air and vacuum relief valve, altitude valve, pressure sustaining valve, butterfly valve, check valve, pressure relief and pressure regulating valve.
9. What is hardness in water and what chemicals cause it?
10. What are chloramines, how are they formed, and do they have any beneficial use?
11. What is a cross connection, what two types of backflow can cause one, and what methods of protection can be used to prevent them?
12. What is water hammer, how is it caused, and how can it be prevented?
13. Define the following terms: cross connection, backsiphonage, backpressure, air gap, double check valve assembly, reduced pressure principal assembly, and pressure vacuum breaker assembly.
14. What causes friction head loss, what factors can affect it, and how does it relate to velocity in pipe lines?
15. Why do electric motors normally draw more power when starting?
16. What do the following terms mean in relation to drinking water quality: disinfection, pathogenic, toxic, pH, aesthetic, culinary and potable.
17. What is pH, how does it affect distribution water quality, and on what type of a scale is it measured?
18. What effect will wear have on meter accuracy over an extended period of time?
19. Why do electric motors normally draw more power when starting?
20. What is a drain hole used for in a fire hydrant? What is a dry barrel fire hydrant, what does the term hydrant bury refer to and when should flow testing of fire hydrants take place?
21. What is the relationship between mg/L and ppm; ug/L and ppb?
22. What is thrust blocking, where is it used, and how does it work?
23. What is the primary purpose of drinking water storage tanks?
24. What is the C-factor and what does it indicate in a water pipe?
25. What is wire-to-water efficiency and how is it calculated?
26. What is a positive displacement type meter; a velocity type meter?
27. What is unaccountable water loss and what percentage is generally acceptable?

28. What is a lightning arrestor and what is it used for?
29. What would be the correct actions to take in the event a consumer calls and complains that the drinking water has made him sick?
30. What types of concerns would be caused by high levels of iron in drinking water?
31. What is DPD used for in the water system and how does it work?
32. What does the membrane filter test analyze with regards to bacteriological sampling?
33. What are the proper sampling techniques for microbiological sampling?
34. What screen size and protection should air vacuum release valves have above and below ground?
35. What is the minimum horizontal distance between a sewer and a water main?
36. What causes electrolysis in a water main?
37. With regards to fire hydrants, what does the term stringing mean?
38. What is the best method for controlling cross connections?
39. When a water main has been installed in a trench, what is the procedure for placing the first layer of backfill?
40. What is thermal expansion and what are the considerations with regards to backflow assemblies and devices?
41. What type of material would require less surface area when designing a thrust block?

PUMPS

1. What does drawdown refer to when operating a well and why should you keep accurate drawdown records?
2. What is packing, what does it do. What is a packing gland, what are the correct procedures to follow in replacing and adjusting the packing in a centrifugal pump?
3. What would be the probable cause of a severe vibration when a pump is first started?
4. What is the difference between a velocity pump and a positive displacement pump and what would be the best applications for each? What valving precautions should be taken with each?
5. How can ball bearing failure in a pump shaft bearing generally be first detected?
6. What is the purpose of the curved diffuser vanes on the inside of a pump volute?
7. What would be the advantage of starting and stopping a centrifugal pump against a closed discharge valve? What precautions should be taken when opening and closing the discharge valve?
8. What effect could over-lubrication of grease-packed bearings have on a pump shaft?
9. What are the three different designs of impellers in relation to shrouds that are used on centrifugal pumps?

10. Describe the following terms: head loss, friction head loss, static head, dynamic head, total dynamic head, suction head, and suction lift.
11. What is a hydraulic grade line and how can it be determined?
12. What advantages does packing have over mechanical seals and vice-versa?
13. What is the main cause of inefficiency in pumps and motors?
14. Identify the following parts of a centrifugal pump along with the purpose of each: impeller, wear rings, shaft sleeves, seal water, lantern ring, volute, concentric reducer, and eccentric reducer.
15. What effect will water running backwards through a centrifugal pump have on the pump and how can it be prevented?
16. What is the purpose of "priming" a centrifugal pump?
17. What type of oil should be used for a culinary well pump?
18. What is a multistage pump and what does addition of stages do to the discharge?
19. What is cavitation, how is it caused, and how can it be prevented?
20. What purpose do air and/or vacuum release valves serve on well casings?
21. What is a sanitary seal and what purpose does it serve on a wellhead?
22. What are the functions of a well casing and well casing perforations?
23. What precautions should be taken before starting a water-lubricated pump?
24. How does the impeller move water from the suction to the discharge side of the pump?
25. Explain the proper maintenance and alignment techniques for pump couplings.
26. What maintenance recommendations should one follow when servicing a pump?
27. After repairs have been done on a pump, what is the last step before putting it back in service?
28. What is the proper procedure for starting a pump?
29. What is a pump curve and what are the different things are shown on it?

CHEMICAL FEED

1. Explain the following terms and their relationship to each other: free chlorine, total chlorine, demand, residual, pre-chlorination, post-chlorination, and breakpoint chlorination.
2. What is the process of chlorination called as a treatment process and how does it differ from sterilization?
3. What are the physical properties of chlorine, what hazards does it present, what advantages does it have over most other disinfectants, and how does it react with bacteria?
4. What is the purpose of a fusible plug, at what temperature does it melt, and where is it located on 150-lb. and 1-ton cylinders?
5. What is the correct procedure to follow in changing a chlorine cylinder and what

item should always be replaced with a new one in doing so?

6. How, when and where should residuals be taken and what information do they provide?
7. What is DPD used for in relation to chlorine and how does it work?
8. What is a SCBA, where should it be stored in relation to the chlorine room, and what special training should be used with it and on what frequency?
9. What are the three available forms of chlorine and what are the most common percentage strengths of each of the three forms?
10. What is HTH and what different forms and strengths is it commonly available in?
11. What effect does the addition of chlorine gas to water have on the water's pH?
12. What chemical is used to detect chlorine leaks and how is it best used?
13. What type of piping should be used for chlorine?
14. How much expansion will take place if one gallon of liquid chlorine is vaporized, and what is the specific gravity of chlorine gas?
15. What type of respiratory protection should be used when working with chlorine?
16. What are the two different types of chlorine residual and what are the advantages and disadvantages of each?
17. What are other types of disinfectants other than chlorine and what are some of the advantages and disadvantages of each?
18. How are hypochlorite solutions generally added to drinking water?
19. How many turns should the valve on a chlorine cylinder be opened and where should the valve wrench be kept?
20. What is a rotameter and what does it do?
21. What is the minimum dosage for disinfecting new water mains using the tablet method as described in AWWA C-651?
22. What effect do the following water quality parameters have on the disinfection process: temperature, pH, turbidity, organic matter, and hardness.
23. Where do most chlorine leaks occur, what type is the most serious and what action is usually taken first to stop a leak?
24. What are chloramines, how are they formed, what problems can result from their presence in a water system, and what advantages does monochloramine have over a free residual?
25. What is a yolk used for in a gas chlorination system?
26. What is a chlorinator that works off of the pressure of a chlorine cylinder called?
27. When chlorinating water, what does an injection check valve do?
28. What is the maximum chlorine feed rate in a 24-hour period for a 150-lb. cylinder?
29. How pure is chlorine gas when calculating dosages?
30. What are the precautions for handling Calcium Hypochlorite?
31. What is slug method disinfection?
32. DBP's are formed when disinfectants react with what?

RULES

1. Where should the fan be located in a chlorine room?
2. What types of water systems are required to fill out chlorination reports, where are the reports to be sent and on what frequency?
3. What actions must be completed on a storage reservoir that has been taken out of service before it can be placed back on line?
4. Who has the primary responsibility for drinking water quality and sampling?
5. What are the different types of public drinking water systems, what are the different ratings, how are they assigned, and what do the ratings represent?
6. What is an MCL, and what are the MCL's for coliform bacteria, TTHM, HAA, and fluoride?
7. What would an operator need to do if the results of a routine bacteriological sample indicated that the sample was "coliform positive?" What would the lab need to do?
8. What is a bacteriological sampling site plan and why is it required?
9. What effect could an active cross connection control program have on maintaining water quality in a water system?
10. What are CEUs, why are they required, and how many are required to renew a grade 1 or 2 operator certificate?
11. What types of emergency situations must be reported to the State Division of Drinking Water or local health department, and in what time frame?
12. What is the main objective of the Utah Water Operator Certification Program?
13. What is the best method of protection against backflow?
14. What types of screens are required on air vent and drain lines for water storage tanks?
15. What is the action level for lead and copper monitoring and how is it determined?
16. What do the following terms mean in reference to operator certification: restricted, water specialist, water operator, and grandfather?
17. If the only certified operator of a system or plant leaves, what must the system do to maintain compliance with the Utah Public Drinking Water Rules?
18. What is the difference between monitoring violations and quality violations in relation to bacteriological sampling?
19. What is the minimum water pressure that must be maintained in a system?
20. Where should bacteriological samples be collected from and on what frequency?
21. What type of respiratory protection should be used when working with chlorine, where should it be stored, and what routine maintenance should be performed on it?
22. What do the following terms represent in reference to water quality: total

coliform, fecal coliform, presence/absence, acute, non-acute, routine, repeat, additional, replacement, indeterminate, treatment technique and action level.

23. What does DRC mean in relationship to operator certification and how is it defined?
24. What is the definition of a public water system?
25. What must be done to determine what type of cross connection protection is needed for a water system?
26. Define Community, Non-Community, Transient and Non-Transient in relation to water systems.
27. At what level does the public need to be notified for fluoride and what is the MCL?
28. What information is contained in the Consumer Confidence Report, how often does it need to be provided, and what methods are used to provide it?
29. What systems using chlorine are not required to sample with regards to the Stage 1 DBP rule?
30. How often are the Stage 1 DBP reports due?
31. Chlorine has an MRDL (Maximum Residual Disinfectant Level), what is it?
32. What are the different requirements for taking chlorine residual and bacteriological samples?

SAFETY & SECURITY

1. How far away from the edge of a trench should the excavated soil be kept?
2. What is the minimum safe level of oxygen content in an atmosphere?
3. What types of safety precautions should be exercised around a well site and why?
4. What safety precautions should be taken when removing a water meter?
5. What should be the first concern when an employee has inhaled chlorine gas?
6. What is the most effective means of reducing atmospheric hazards in a confined space, what particular three atmospheric hazards are of concern, and what potential hazards do each of them represent?
7. Explain the following terms as they apply to safety issues: lock-out tag-out, right-to-know, and MSDS.
8. What should be done with an electrical control circuit if it continues to blow fuses?
9. What should be used to soak up spilled acid solutions?
10. What chemical reaction takes place when chlorine gas comes into contact with body moisture and what are the effects?
11. What hazards would be present in a below-ground pump station?
12. What are the two types of electrical control safety devices found in electrical panels or control boxes?
13. What should an operator do if acid or other toxic chemicals are spilled on the

skin?

14. What procedures should be followed by an operator who is lifting heavy objects?
15. What procedures should be followed to safely enter a confined space?

16. What precautions should be used in preparing a solution of acid and water?
17. What is the main objective of a safety program?
18. What is a "B" repair kit used for?
19. What are requirements for trench protection, what three methods can be used as protection when working in trenches, and who is responsible for inspecting the trench protection and determining hazards?
20. What is the purpose of putting guards on moving parts of machines and equipment?
21. What precautions should be used when using acetylene torches?
22. What type of fire extinguisher should be used on an electrical fire and why?
23. When storing materials in a storage room, at what height should large heavy objects be stored?
24. Who is primarily responsible for maintaining a safe work place?
25. What special precautions should be used when using hypochlorite compounds and why?
26. What are the requirements for using ladders in excavations?
27. What is a SCBA, where should it be stored in relation to the chlorine room, and what special training should be used with it and on what frequency?
28. Name the various types of traffic warning devices.
29. What is the main cause of most personal injury accidents?
33. What is the first aid for excessive bleeding, first-degree burns, shock, and respiratory failure?
34. What are some of the safety concerns when installing water mains?
35. Who causes the most on-the-job injuries?
36. What are the safety concerns and first aid for exposure to large amounts of fluoride?
37. What types of areas may be considered confined spaces?
38. When placing traffic warning signs, what determines the distance of placement?
39. What is a vulnerability assessment and the steps involved?
40. What are the concerns with a water system's vulnerabilities?
41. What is a technological threat to a water system?
42. What are considered natural hazards to a water system?
43. What is an emergency response plan and what should be contained in it?
44. In an emergency, what is the Incident Command system?
45. How should sensitive documents be stored?
46. At what frequency should Emergency Response Plans be updated?
47. What is mitigation in regards to Emergency Response Planning?
48. What are the classifications of emergencies?
49. What is the threat management process and the steps involved?
50. What are the steps involved once you've determined that you have a credible

threat to your system?

51. What is the Bio-terrorism Act of 2002 and the requirements that it mandated for water systems?
52. What are examples of deterrents, detection, delay, and response in relation to water security?
53. What are some of the precautions for receiving chemicals and deliveries?
54. What considerations should employers take with hiring new employees and contracting with vendors?
55. What should be taken into consideration with weeds, trees, shrubs, and other types of vegetation around sensitive sites?
56. What are some on line monitoring parameters that water systems should consider?
57. With regards to water system computers, what precautions should you take and how often should pass codes be changed?
58. What precautions should you take with having maps and sensitive documents in your water system vehicles?
59. What are some of the methods for notifying the public in a contamination event?
60. What procedures should be in place for investigating customer complaints?