1 Water Sources

1. Which one of the following best defines the term aquifer?

 (a) A low lying area where water pools
 (b) Water-bearing stratum of rock, sand, or gravel
 (c) Impervious stratum near the ground surface
 (d) Treated water leaving the water system

2. The height to which water will rise in wells located in an artesian aquifer is called the

 (a) Pumping water level
 (b) Water table
 (c) Piezometric surface
 (d) Drawdown
 (e) Radius of influence

3. What percentage of all the earth's water is readily available as a potential drinking water supply in the form of lakes, rivers, and near-surface groundwater? (a) 97 (b) 50 (c) 2 (d) 1 (e) 0.34

4. To prevent the entry of surface contamination into a well is the purpose of (a) The well casing (b) The water table (c) The louvers or slots (d) Well development (e) The annular grout seal

5. An aquifer that is located underneath an aquiclude is called

 (a) An unconfined aquifer
 (b) A confined aquifer
 (c) A water table
 (d) Unreachable groundwater
 (e) An Artesian spring

6. The process by which water changes from the gas to the liquid phase is termed

 (a) Condensation .
 (b) Evaporation
 (c) Percolation
 (d) Precipitation
 (e) Runoff

7. The free surface of the water in an unconfined aquifer is known as the

 (a) Pumping water level
 (b) Artesian spring
 (c) Water table
 (d) Drawdown
 (e) Percolation

8. The transfer of liquid water from plants and animals on the surface of the earth into water vapor in the atmosphere is called

(a) Transpiration
(b) Evaporation
(c) Condensation
(d) Runoff
(e) Percolation

9. The elevation of water in the casing of an operating well is called the

(a) Piezometric surface
(b) Water table
(c) Pumping water level
(d) Drawdown
(e) Radius of influence

10. An aquifer under pressure is often termed

(a) Unconfined
(b) Pacific
(c) Artesian
(d) Alluvial
(e) Elevated

11. An aquifer is usually composed of

(a) Sand and gravel (b) Clays and silts
(c) Bedrock
(d) Large voids in the soil, resembling underground lakes
(e) None of the above

12. Which of the following best defines the term specific capacity?

(a) Amount of water a given volume of saturated rock or sediment will yield to gravity
(b) Amount of water a given volume of saturated rock or sediment will yield to pumping
(c) Rate at which water would flow in an aquifer if the aquifer were an open conduit
(d) Amount of water a well will produce for each foot of drawdown

13. The most common type of well used for public water supply systems is a

(a) Jetted well
(b) Driven well
(c) Drilled well
(d) Bored well

14. Which of the following best defines the term static water level?

(a) Water level in a well after a pump has operated for a period of time
(b) Water level in a well when the well is not in operation
(c) Water level in a well measured from the ground surface to the drawdown water level
(d) Waterlevel in a well measured from the natural water level to the drawdown water level

15. The residual drawdown of a well is defined as

(a) Water level in a well after a pump has operated over a period of time
(b) Measured distance from the ground to the pumping level
(c) Water level below the normal level that persists after a well pump has been off for a period of time
(d) Measured distance between the water level and the top of the screen

16. A well is located in an aquifer with a water table elevation 20 feet below the ground surface. After operating for three hours, the water level in the well stabilizes at 50 feet below the ground surface. The pumping water level is:

(a) 20 feet
(b) 30 feet
(c) 50 feet
(d) 70 feet
(e) 100 feet

17. What percentage of all the earth's water is readily available as a potential drinking water supply in the form of lakes, rivers, and near-surface groundwater?
(a) 97%
(b) 50%
(c) 2%
(d) 1%
(e) 0.34%

18. To prevent the entry of surface contamination into a well is the purpose of

(a) The well casing
(b) The water table
(c) The louvers or slots
(d) Well development
(e) The annular grout seal

19. The process by which water changes from the gas to the liquid phase is termed

(a) Condensation .
(b) Evaporation
(c) Percolation
(d) Precipitation
(e) Runoff

20. The free surface of the water in an unconfined aquifer is known as the

(a) Pumping water level
(b) Artesian spring
(c) Water table
(d) Drawdown
(e) Percolation

21. The transfer of liquid water from plants and animals on the surface of the earth into water vapor in the atmosphere is called

(a) Transpiration
(b) Evaporation
(c) Condensation
(d) Runoff
(e) Percolation

22. The term for the combined processes which transfer liquid water on the earth's surface into water in the gas phase in the atmosphere is

(a) Percolation
(b) Evapotranspiration
(c) Sublimation
(d) Overdraft
(e) Precipitation

23. A primary advantage of using surface water as a water source includes:

(a) Usually higher in turbidity
(b) Generally softer than groundwater
(c) Easily contaminated with microorganisms
(d) Can be variable in quality

24. Which source of water has the greatest natural protection from bacterial contamination?

(a) Shallow well (b) Deep well
(c) Surface water
(d) Spring

25. A water-bearing formation in the soil is referred to as

(a) An aquitard or aquiclude
(b) An aquifer
(c) An aqueduct
(d) The drawdown
(e) The static water level

26. An operating well will drain the water from a volume of soil around the well during pumping. This volume is referred to as the

(a) Pumping water level
(b) Radius of influence
(c) Drawdown
(d) Cone of depression
(e) Recharge zone

27. One acre is 43,560 square feet. If this acre is covered with one foot of water, it contains

(a) 1 acre-foot
(b) 43,560 cubic feet
(c) 325,829 gallons
(d) All of the above
(e) None of the above

28. The safe yield of an aquifer is

(a) Determined by the Department of Health Services
(b) Variable, depending on rainfall
(c) The average amount of water that can be withdrawn each year without causing a long-term drop in the water table
(d) The difference between the static water level and the pumping water level
(e) All of the above

29. The movement of water from the surface of the earth into the soil is called

(a) Condensation
(b) Evaporation
(c) Evapotranspiration
(d) Runoff
(e) None of the above

30. The freezing point of water is

(a) 0°F
(b) 32°C
(c) 32°F
(d) 0°C (e) 100°F

31. The movement of water from the atmosphere to the surface of the earth is called

  (a) Condensation
  (b) Evaporation
  (c) Evapotranspiration
  (d) Runoff
  (e) Precipitation

32. The movement of water on the surface of the earth is called
  (a) Percolation
  (b) Evaporation
  (c) Evapotranspiration
  (d) Runoff
  (e) Infiltration

33. A formation in the soil that resists water movement (such as a clay layer) is called (a) An aquitard or aquiclude
  (b) An aquifer
  (c) An aqueduct
  (d) The drawdown

34. Another term for the percolation that transports water from the surface into an aquifer is
  (a) Artesian springs
  (b) Recharge
  (c) Extraction
  (d) Overdraft
  (e) Runoff

35. Water that is safe to drink is called water.
  (a) Potable
  (b) Palatable
  (c) Good
  (d) Clear

36. Groundwaters generally have consistent water quality that include
  (a) having a higher total dissolved solids content than surface water
  (b) having a lower mineral content than surface waters
  (c) having lower pH values than surface waters
  (d) having a higher amount of bacteria than surface waters

37. What is the middle layer of a stratified lake called?
    (a) Thermocline
    (b) Benthic Zone
    (c) Epilimnion
    (d) Hypolimnion

38. What is the conversion of liquid water to gaseous water known as?
    (a) Advection
    (b) Condensation
    (c) Precipitation
    (d) Evaporation

39. Water weighs
    (a) 7.48lbs/gal
    (b) 8.34lbs/gal
    (c) 62.4lbs/ft^3
    (d) Both B. and C.

40. What is the static level of an unconfined aquifer also known as?
    (a) Drawdown
    (b) Water Table
    (c) Pumping Water Level
    (d) Aquitard

41. A water bearing geologic formation that accumulates water due to its porousness
    (a) Aquifer
    (b) Lake
    (c) Aquiclude
    (d) Well

42. What kind of stream flows continuously throughout the year?
    (a) Ephemeral
    (b) Perennial
    (c) Intermittent
    (d) Stratified

43. The surface to atmosphere movement of water is known as (a) Precipitation (b) Percolation (c) Stratification (d) Evapotranspiration

44. An aquifer that is underneath a layer of low permeability is known as (a) Confined aquifer (b) Water Table aquifer (c) Unconfined aquifer (d) Unreachable groundwater

45. What is the middle layer of a stratified lake known as?
    (a) Hypolimnion
    (b) Benthic Zone
    (c) Thermocline
    (d) Epilimnion

46. The amount of water that can be pulled from a aquifer without depleting
    (a) Drawdown
    (b) Safe yield
    (c) Overdraft
    (d) Subsidence

47. The primary origin of coliforms in water supplies is
    a. Natural algae growth
    b. Industrial solvents
    c. Fecal contamination by warm-blooded animals
    d. Acid raid

48. A primary source of volatile organic chemical (VOC) contamination of
    water supplies is
    a. Agricultural pesticides
    b.Industrial solvents
    c. Acid rain
    d. Agricultural fertilizers

49. The term "surface runoff" refers to
    a. Rainwater that soaks into the ground
    b. Rain that returns to the atmosphere from the earth's surface
    c. Surface water that overflows the banks of rivers
    d. Water that flows into rivers after a rainfall

50. A disease that can be transferred by water is
    a. Gonorrhea
    b. Malaria
    c. Mumps
    d. Typhoid

51. Final determination of vulnerability is made by

   a. Private contractor/consultants
   b. The primacy agency
   c. The water supplier
   d. All of the above

52. To prevent the entry of surface contamination into a well is the purpose of
    a. The well casing
    b. The water table
    c. The louvers or slots
    d. Well development
    e. The annular grout seal

53. Potable water may be defined as

    a. Water high in organic content
    b. Any water that occasionally may be polluted from another source
    c. Any water that, according to recognized standards, is safe for consumption
    a. Water that indicates a septic condition e. Water that has been transported from outside the service area

54. An operating well will drain the water from a volume of soil around the well during pumping. This volume is referred to as the

    a. Pumping water level
    b. Radius of influence
    c. Drawdown
    d. Cone of depression
    e. Recharge zone

55. A well screen must be installed in

    a. deep wells
    b. consolidated materials
    c. shallow wells
    d. unconsolidated materials

56. A well is acidified in order to

    a disinfect
    b. increase yield
    c. remove objectionable gases
    d. remove disinfection by-products

57. The amount of water that a well will produce for each foot of drawdown is called:

    a. specific head
    b. static yield
    c. yield/feet
    d. specific capacity

58. Surging a well to loosen scale deposits on the screen refers to:

a. turning the pumps on and off as fast as possible to cause a water hammer
b. pumping the water in and out of a well
c. sending shock waves through the aquifer to cause a surge of water
d. using a water jet to surge around the well casing.

59. A well is acidized in order to

a. Disinfect the water
b. Increase yield
c. Remove objectionable gasses
d. Remove disinfection by-products

60. To prevent the entry of surface contamination into a well is the purpose of

a, The well casing
b. The water table
c. The louvers or slots
d. Well development
e. The annular grout seal

61. The variation in water demand during the course of a day is termed a. Seasonal variation

b. Fire flow requirements
c. Emergency storage variation
d. The straight line equalization method
e. Diurnal variation

62. The maximum momentary load placed on a water supply system is known as

a. Average daily flow
b. Average daily demand
c. Rated capacity
d. A System float
d. Peak demand

63. The term aquifer refers to:

a. A special type of aqueduct.
b. A natural source of water.
c. A potable water.
d. Water bearing strata.

64. The use of a well supply as a source normally results in: a. Water that is high in nitrates

b. Water of consistent quality

c. Water very high in mineral content

d. Water that is considered "soft".

65. Maximum Safe Yield of a water source is defined as:

a) Where the state health department has approved the source of use.

b) The quantity of water that can be taken from a source of supply over a period of years without depleting the source permanently - beyond it's ability to replenish in wet years.

c) Water that is free of bacteria.

d) Quantity of water that may be treated in the plant.

66. Movement of water through the ground is called:

a) Hydraulic subsidence

b) Runoff

c. Percolation

d. Infiltration

67. A primary source of volatile organic chemical (VOC) contamination of water supplies is

a. Agricultural pesticides

b. Industrial solvents

c. Acld rain

d. Agricultural fertilizers

68. Surging a well to loosen scale deposits on the screen refers to:

a. turning the pumps on and off as fast as possible to cause a water hammer

b. pumping the water in and out of a well

c. sending shock waves through the aquifer to cause a surge of water d. using a water jet to surge around the well casing.

69. A sanitary well seal is used to:

a. seal the clear well

b. seal the top of the well casing

c. seal the water tower

d. seal a break in the distribution system

70. The amount of water that a well will produce for each foot of drawdown is called: a. specific head b. static yield c. yield/feet d. specific capacity

71. After replacing a repaired pump back into a well, the operator should first: a put the seal on tight to avoid contamination

b. add chlorine to disinfect the well and surrounding aquifer

c. start the pump to make sure that it will pump water

d. open the valve to let the pressure off the line

2 Chapter Assessment

2.1 Multiple Choice

1. Which of the following is an indicator organism?

(a) Giardia
(b) Cryptosporidium
(c) Hepatitis
(d) E. Coli

2. What is the primary origin of coliform bacteria in water supplies?

(a) Natural algae growth
(b) Industrial solvents
(c) Animal or human feces
(d) Acid rain

3. What ls the term for water samples collected at regular intervals and combined in equal volume with each other?

(a) Time grab samples
(b) Timo flow samples
(c) Proportional time composite samples

4. What is the basis for the number of samples that must be collected for utilities monitoring for lead and copper that are in compliance or have installed corrosion control'?

(a) Size of distribution system
(b) Population
(c) Amount of water produced
(d) Number of raw water sources

5. Where should bacteriological samples be collected in the distribution system? (a) Uniformly distributed throughout the system based on area

(b) At locations that are representative of conditions within the system
(c) Always from extreme locations in the system but occasionally at other locations
(d) Uniformly throughout the system based on population density

6. The quantity of oxygen. that can remain dissolved in water is related to

(a) Temperature
(b) pH
(c) Turbidity
(d) Alkalinity

7. In coliform analysis using the presence-absence test, a sample should be incubated for

(a) 24 hours at 25°C
(b) 36 hours at 35°C
(c) 24 and 36 hours at 25°0
(d) 24 and 48 hours at 35°C

8. A major source of error when obtaining water quality information is improper:

(a) Sampling
(b) Preservation
(c) Tests of samples
(d) Reporting of data

9. What is commonly used as an indicator of potential contamination in drinking water samples?

(a) Viruses
(b) Coliform bacteria
(c) Intestinal parasites
(d) Pathogenic organisms

10. The type of organisms that can cause disease are said to be microorganisms.

(a) Bad
(b) Pathogenic
(c) Undesirable
(d) Sick

11. Four types of aesthetic contaminants in water include the following:

(a) Odor, turbidity, color, hydrogen sulfide gas
(b) Pathogens, microorganisms, arsenic, disinfection by-products
(c) Odor, color, turbidity, hardness
(d) Color, pathogens, metals, organics

12. What is the purpose of adding fluoride to drinking water?

(a) Increase tooth decay
(b) Reduce tooth decay
(c) Make teeth white
(d) Government conspiracy 13. The test used to determine the effectiveness of disinfection is called the:
(a) Coliform bacteria test
(b) Color test
(c) Turbidity test
(d) Particle test

14. Turbidity is measured as:

 (a) mg/L
 (b) mL
 (c) gpm
 (d) NTU

15. Giardia and cryptosporidium are a type of:

 (a) Mineral
 (b) Organism
 (c) Color
 (d) Bird

16. Chronic contaminants are those that can cause sickness after:

 (a) Prolonged exposure
 (b) Low levels or low exposure

17. A positive total coliform test indicates that:

 (a) Disease-causing organisms may be present in the water supply
 (b) The water is safe to consume
 (c) The water supply has high iron levels
 (d) There is nothing to be concerned about

18. What is the purpose of the bacteriological site sampling plan?

 (a) To have a map showing where BacT samples are drawn
 (b) In case of a positive Bac T sample, the operator will know where to take the four repeat samples
 (c) The state will know where you are taking your repeat samples
 (d) All of the above

19. To ensure that the water supplied by a public water system meets state requirements, the water system operator must regularly collect samples and:

 (a) Have water analyzed at an approved water testing laboratory
 (b) Determine a sampling schedule based on state requirements
 (c) Send all analyses results to the state
 (d) All of the above

20. Samples taken for routine bacteriological testing should be preserved by:

 (a) Freezing
 (b) Boiling
 (c) DPD preservative
 (d) Refrigeration 21. How many coliform samples are required per month for a water system serving a population between 25 and 100 ? (a) 1 (b) 2 (c) 3 (d) 4

22. Before taking a bacteriological (BacT) water sample from a faucet, you should:
    (a) Wash hands thoroughly
    (b) Remove the faucet aerator
    (c) Flush water until you're sure water is from the main, not the service line
    (d) All of the above

23. Monthly BacT samples should be taken from:
    (a) The well pump house
    (b) The distribution system
    (c) The treatment plant
    (d) An outside hose spigot

24. If your BacT sample test is positive, how long do you have to collect four repeat samples and deliver them to the lab?
    (a) 12 hours
    (b) 24 hours
    (c) 48 hours
    (d) 72 hours

25. is a measure of the capacity of water to neutralize acids.
    (a) Concentration
    (b) Alkalinity
    (c) pH
    (d) Conductivity

26. The DPD method is used to determine the of a water sample.
    (a) Dissolved oxygen content
    (b) Conductivity
    (c) pH
    (d) Free chlorine residual

27. What color does N, N-diethyl-p-phenylenediamine (DPD) turn in the presence of chlorine?
    (a) Brown
    (b) Green
    (c) Blue
    (d) Pink

28. The presence-absence (P-A) test used for microbiological testing is also commonly referred to as

(a) Multiple Tube Fermentation (b) Membrane Filtration
(c) Confirmed Test
(d) Colilert

29. When testing for coliform bacteria with the multiple tube fermentation (MFT) method what is the best indicator for a positive test?

(a) Color change
(b) Gas bubble formation
(c) Formation of a cyst
(d) Formation of turbidity

30. Coliform bacteria share many characteristics with pathogenic organisms. Which of the following is not true?

(a) They survive longer in water
(b) They grow in the intestines
(c) There are less coliform than pathogenic organisms
(d) They are still present in water without fecal contamination

31. What is the second step in the multiple tube fermentation test?

(a) Presumptive test
(b) Negative test
(c) Completed
(d) Confirmed

32. What is the removal and deactivation requirement for Giardia?

(a) $2\log$
(b) $3\log$
(c) $4\log$
(d) There is no requirement

33. The multiple barrier approach to water treatment includes removal through which method?

(a) Filtration
(b) Coagulation
(c) Disinfection
(d) a and c

34. A pH reading of 7 is considered

(a) Slightly acidic
(b) Acidic
(c) Basic
(d) Neutral

35. EDTA titration is used to determine the of a water sample.

   (a) Hardness
   (b) Conductivity
   (c) Alkalinity
   (d) Free chlorine residual 36. A higher than normal turbidity reading could signify (a) A change in water quality (b) Nothing. Keep operating as normal (c) Microbiological contamination (d) Both $A\&C$

37. What is the ingredient used during the second multiple tube fermentation test?
   (a) Colilert
   (b) MMO/MUG
   (c) Brilliant Green Bile
   (d) Chlorine

38. When collecting a distribution system sample for bacteriological testing, the person collecting the sample should allow the water to run before filling the sample bottle.
   (a) A minimum of five minutes.
   (b) 1hr.
   (c) 30 min
   (d) only a few seconds

39. Black stains on plumbing fixtures might be attributed to
   (a) calcium.
   (b) copper.
   (c) magnesium.
   (d) manganese.

40. The multiple tube fermentation test consists of three distinct tests. These tests, in the order performed, are the:

   (a) preliminary, confirmed, and completed tests.
   (b) preliminary, presumptive and confirmed tests.
   (c) presumptive, confirmed, and completed tests.
   (d) prespumtive, preliminary, and completed tests.

41. What should the sample volume be when testing for total coliform bacteria?
   (a) 100 mL

    (b) 250 mL

    (c) 500 mL

    (d) 1,000 mL

42. pH is a measure of :
    a. conductivity
    b. water's ability to neutralize acid
    c. hydrogen ion activity
    d. dissolved solids

43. Sodium Thiosulfate is used to
    a. Buffer chlorine solutions
    b. Neutralize chlorine residuals
    c. Detect chlorine leaks
    d. Sterilize sample bottles

44. The presence of total coliforms in drinking water indicates

    a. The presence of pathogens.
    b. The absence of an adequate chlorine residual
    c. The existence of an urgent public health problem
    d. The potential presence of pathogens

45. A primary health risk associated with microorganisms in drinking water is

    a. Cancer
    b. Acute gastrointestinal diseases
    c. Birth defects
    d. Nervous system disorders

46. After 5 years use, a portion of cast iron pipe shows a white scale about 1/2 inch thick lining the inside. This means

    a. Red water will soon become a problem
    b. The water has been corrosive
    c. The water is chemically unstable and is depositing
    d. Water should flow easier since the lining is smooth

47. Hardness in water is caused by

    a. Dissolved minerals
    b. High pH.
    c. Low turbidity
    d. Alkalinity

48. The meniscus on calibrated glassware is read at the

a. Bottom of curvature for mercury but the top for water

b. Extreme point of contact between the liquid and glass, i.e., where gas, liquid, and air all meet at one point

c. Mid-height of the curvature so that beginning and ending readings will results in zero error

d. Top of curvature for mercury but at the bottom for most other liquids including water

49. An unknown substance is found on the bottom of the water within a drinking water reservoir. Which of the following statements is true of this substance?

   a. It has a specific gravity less than 1.0
   b. It has a specific gravity equal to 1.0
   c. It has a specific gravity greater than 1.0
   d. It has no specific gravity
   e. None of the above

50. The term "Chain of Custody" refers to

   a. A large accessory to a come-along
   b. An attachment to a pipe-cutter c. Employee labor laws
   d. Procedures and documentation required for water quality sampling
   e. Procedures and documentation required for chemical application

51. Water samples to be analyzed for taste and odor must be

   a. Analyzed in the field
   b. Collected in glass sample containers
   c. Dechlorinated with sodium thiosulfate
   d. Preserved with dilute hydrochloric acid
   e. None of the above

52. Bacteriological samples for a distribution system must be collected in accordance with

   a. The Surface Water Treatment Rule
   b. OSHA requirements
   c. An approved sample siting plan
   d. FLSA requirements
   e. ANSI/NSF Standard 61

53. Trihalomethanes are classified as

   a. Metals
   b. Inorganic constituents
   c. Secondary drinking water standards
   d. Radiological contaminants
   e. Volatile organic compounds

54. The multiple tube fermentation analysis consists of

   a. Positive, negative, and neutral tests
   b. Presumptive, confirmed, and completed tests
   c. Preliminary, presumptive, and confirmed tests
   d. Preliminary, confirmed, and completed tests
   e. Presence or absence testing

55. Which of the following is NOT a characteristic of coliform organisms?

   a. Intestinal origin
   b. Will produce carbon dioxide from lactose
   c. Heartier in a water environment than pathogenic organisms
   d. Far less numerous than pathogenic organisms
   e. Able to survive with or without oxygen

56. A bacteriological test that measures only the presence or absence of coliforms is

   a. ColiLert (MMO/MUG)
   b. Multiple tube fermentation
   c. Most probable number (MPN)
   d. Membrane filtration
   e. Presumptive test

57. After collection, if stored at 4°C, bacteriological samples must be processed within
   a. 1 hour
   b. 6 hours
   c. 24 hours
   d. 48 hours
   e. 72 hours

58. Sample bottles which are furnished by a certified laboratory for collection of bacteriological samples

   a. Should be rinsed with the water to be sampled before use
   b. Should be placed in boiling water for at least 10 minutes before use
   c. Should be rinsed with a chlorine solution before use
   d. Should be rinsed with distilled water before use
   e. Are ready to use

59. The standard indicator of potential fecal contamination of a water supply is
   a. Cryptosporidium
   b. pH
   c. Alkalinity

d. Hardness

e. Coliform presence/absence

60. Where should bacteriological samples be collected?

a. At different locations on each sampling cycle, to make sure the entire system is sampled

b. Only from public locations, such as drinking fountains and restrooms

c. Only from locations owned by consumers

d. Only from specially constructed sampling stations

e. From several sampling locations around the entire distribution system, in accordance with a DHS-approved sample siting plan

61. Storage of bacteriological samples during transport to a laboratory is best accomplished using

a. A clean storage box specifically designed to hold sample containers

b. An ice chest packed with ice

c. An insulated storage box with "blue ice".

d. An insulated storage box with "dry ice"

e. No particular sample storage requirements apply, as long as the samples can be delivered to a laboratory prior to the end of the work day

62. Sodium thiosulfate is added in the laboratory to bacteriological sample bottles to:

a. Thoroughly disinfect the sample bottle

b. Complete the cleaning and sterilization process

c. Neutralize any residual chlorine present in the sample at the time of collection

d. Counteract the effects of sunlight on the water sample

e. Prevent further growth of bacteria in water samples following collection

63. Radiological contaminant concentrations in drinking water are measured in a. Milligrams per liter

b. Micrograms per liter

c. Nanograms per liter

d. Picograms per liter

e. None of the above

64. Which of the following is NOT a characteristic of coliform organisms?

a. Intestinal origin

b. Will produce carbon dioxide from lactose

c. Heartier in a water environment than pathogenic organisms

d. Far less numerous than pathogenic organisms

e. Able to survive with or without oxygen

65. A water supply is found to have a calcium carbonate concentration of 50mg/L. This water would be considered
   a. soft water
   b. hard water
   c. potable water
   d. non-potable water

66. Cathodic protection refers to protection against
   a. contamination
   b. corrosion
   c. hardness
   d. alkalinity

67. An operator uses to test for residual chlorine
   a. DPD
   b. Cresol red
   c. Methyl orange
   d. Sulfuric acid

68. The meniscus on calibrated glassware is read at the:

   a. Bottom of curvature for mercury but the top for water

   b. Extreme point of contact between the liquid and glass, i.e., where gas, liquid, and air all meet at one point

   c. Mid-height of the curvature so that beginning and ending readings will results in zero error

   d. Top of curvature for mercury but at the bottom for most other liquids including water

69. The type of corrosion caused by the use of dissimilar metal in a water system is

   a. Caustic corrosion
   b. Galvanic corrosion
   c. Oxygen corrosion d. Tubercular corrosion

70. Which of the following can cause tastes and odors in a water supply?

   a. Dissolved zinc
   b. Algae
   c. High pH
   d. Low pH

71. The primary health risk associated with volatile organic chemicals.(VOCs) is a. Cancer b. Acute respiratory diseases c. "Blue baby" syndrome d. Reduced IQ. in children

72. Lead in drinking water can result in

    a. Impaired mental functioning in children
    b. Prostate cancer in men
    c. Stomach and intestinal disorders
    d. Reduced white blood cell count
    Sodium thiosulfate is used to
    a. Buffer chlorine solutions
    b. Neutralize chlorine residuals
    c. Raise pH d. Sterilize sample bottles

73. Cathodic protection means protection against
    a. contamination
    b. corrosion
    c. hardness
    d. infiltration

74. A water supply is found to have a calcium carbonate concentration of 50mg/L. This water would be considered
    a. soft water
    b. hard water
    c. potable water
    d. non-potable water

3 Regulations

Match the following:
 Answers:

A. Information Collection Rule	i. This rule provides guidelines for identifying ground water sources at risk for contamination and guidelines for taking corrective action.
B. Long Term 1-Enhanced Surface Water Treatment Rule	ii. This rule primarily addresses the reduction of risk from Cryptosporidium by limiting the turbidity levels of filter effluents.
C. Ground Water	iii. This rule requires all systems serving fewer than 10,000 people to achieve at least 99% removal or inactivation of Cryptosporidium.
D. Stage 2-Disinfectant Byproduct Rule	iv. This rule sets the monitoring and compliance requirements for coliform bacteria.
E. Long Term 2-Enhanced Surface Water Treatment Rule	v. It required large public water suppliers to undertake monitoring of microbial and disinfection byproducts in their water systems.
	vi. This rule set maximum contaminant level goals and maximum contaminant levels for trihalomethanes, five haleocetic acids, bromate and chlorite.
F. Interim Enhanced Surface Water Treatment Rule	vii. This rule required all surface waters or ground waters under the influence of surface waters to provide filtration and/or disinfection of the source to meet 3 log removal or inactivation of Giardia Lamblia cysts and 4 log removal or inactivation of enteric viruses.
G. Disinfection/Disinfection Byproduct Rule, Phase I	viii. This rule is anticipated to propose treatment techniques to improve control of microbial pathogens, specifically including Cryptosporidium. The techniques are to consider the risks of treatment for Cryptospodrium versus the potential for generation of disinfection byproducts.
H. Total Coliform Rule	
I. Surface Water Treatment Rule	ix. The purpose of this rule is to assess information and research that was not fully considered in the Stage 1 process or that has only been available since 1998, as it relates to microbial standards to protect public health.

[A.]_____ _____ _____ _____ _____ _____ _____ _____

_____

Multiple Choice:

1. What does the acronym MCL stand for?

   (a) Minimum contaminant level

   (b) Micron contaminant level

   (c) Maximum contaminant level

   (d) Milligrams counted last

2. How long do sanitary surveys have to be retained for records?

   (a) 3 years

   (b) 5 years

   (c) 7 years

   (d) 10 years

3. The most severe water system violation that requires the fastest public notification

   (a) Tier I

   (b) Tier II

   (c) Tier III

   (d) Tier IV

4. The primacy agency may grant a variance or exemption as long as

   (a) The agency is using the Best Available Technology

   (b) There is no threat to public health

   (c) There is never a scenario for a variance or exemption

(d) Both A. and B.

5. A public water system that serves at least 25 people six months out of the year

    (a) Nontransient noncommunity

    (b) Transient noncommunity

    (c) Community public water system

    (d) None of the above

6. Regulations based on the aesthetic quality of drinking water

    (a) Primary Standards

    (b) Secondary Standards

    (c) Microbiological Standards

    (d) Radiological Standards

7. The lowest reportable limit for a water sample

    (a) 0.5mg/l

    (b) Zero

    (c) Public health goal

    (d) Detection Level for reporting

8. Primary Standards are based on

    (a) Color and Taste

    (b) Aesthetic quality

    (c) Public Health

(d) Odor

9. A disease causing microorganism

    (a) Pathogen

    (b) Colilert

    (c) Pathological

    (d) Turbidity

10. According to Surface Water Treatment Rule, what is the combined inactivation and removal for Giardia?

    (a) 1.0 Logs

    (b) 2.0 Logs

    (c) 3.0 Logs

    (d) 4.0 Logs

11. What is the equivalency expressed as a percentage for the SWTR inactivation and removal of viruses?

    (a) 99.9%

    (b) 99.99%

    (c) 99.0%

    (d) 99.999%

12. A water agency that takes more than 40 coliform samples must fall under what percentile?

    (a) 10%

    (b) 7%

(c) 5%

(d) No positive samples allowable

13. The National Primary Drinking Water Regulations apply to drinking water contaminants that may have adverse effects on
    a. Water color
    b. Water taste
    c. Water odor
    d. Human health

14. Which of the following is considered an acute risk to health?
    a. Two Tier 2 violations
    b. One Tier 2 violation
    c. Two Tier 1 violations
    d. One Tier 1 violation

15. Records on turbidity analyses should be kept for a minimum of
    a. 5 years
    b. 7 years
    c. l0 years
    d. 25 years

16. Records on bacteriological analyses should be kept for a minimum of
    a. 5 years
    b. 7 years
    c. 10 years
    d. 25 years

17. Differecne between primary and secondary standard substances:
    a. Primary standards refer to substances that are carcinogenic, secondary standards do not.
    b. Primary standards refer to substances that are thought to pose a threat to human health, secondary standards do not.
    c. Primary standards refer to substances that, if not.put in check, will eventually kill humans, secondary standards do not.
    d. Secondary qualities are aesthetic qualities and will only make some people sick, while primary standards refer to substances that will make everyone sick and may possibly cause death.

18. The SDWA defines a public water system that supplies piped water for human consumption as one that has
    a. 10 service connection or serves 20 or more people for 60 or more days

per year

b. 15 service connections or serves 20 or more people for 90 or more days per year

c. 10 service connections or serves 25 or more people for 30 or more days per year

d. 15 service connections or serves 25 or more people for 60 or more days per year

19. According to the USEPA regulations, the owner or operator of a public water system that fails to comply with applicable
monitoring requirements shall give notice to the public within
a. 1 week of the violation in a letter hand-delivered to customers
b. 45 days of the violation by posting a notice at the town hall
c. 3 months of the violation in a daily newspaper in the area served by the system d. 1 year of the violation by including the notice with the water-bill ·

20. What US agency establishes drinking water standards?
a. AWWA
b. USEPA
c. NIOSH
d. NSF

21. If a water supply exceeds the MCL, whose responsibility is it to notify the consumer?
a. the testing lab
b. the supplier
c. the DOH
d. the USEPA

22. According to the Lead and Copper Rule. the action for the 90th percentile lead level is:
a. 0. 005 mg/1
b. 0. 015 mg/l
c. 0. 030 mg/l
d. 0.050 mg/l

23. The term "maximum contaminant level goal (MCLG)" means the:
a. Maximum allowable level of a given contaminant in drinking water
b. Level of a contaminant .in drinking water below which there are no known or suspected adverse health effects with a margin of safety
c. Level of a contaminant in drinking water that will trigger a Tier 1 violation

d. Minimum detectable level of a given contaminant

24. The maximum contaminant level goal (MCLG) of known or probable carcinogens is:
    a. Set by the state
    b. The same number as the maximum contaminant level (MCL)
    c. Zero
    d. The minimum detectable level of a given contaminant

25. The difference between Tier 1 and Tier 2 violations is:
    a. Tier 1 violations·potentially impose·direct and adverse health effects;- Tier 2 violations do not pose a a direct threat to public health. b. Tier 1 violations require public notification; Tier 2 violations do not require public notification
    c. Tier 1 violations are acute; Tier 2 violations are not acute
    d. Tier 1 violations have legal consequences; Tier 2 violations do not

26. The Safe Drinking Water Act requires _____ to develop a comprehensive coliform monitoring plan
    a. Large public water systems (serving >50,000 people)
    b. Large and medium public water systems (serving >3,300 people)
    c. Small and medium public water systems (serving >25 and <3,300 people)
    d. All public water systems

27. Final determination of vulnerability is made by: a. Private contractor/consultants
    b. The primacy agency
    c. The water supplier
    d. All of the above

28. The most important factor to consider in locating a well site from the health point of view is
    a. Anticipated yield
    b. Availability of electric power
    c. Distance from other wells
    d. Vulnerability

29. Trihalomethanes are classified as:
    a. Metals
    b. Inorganic constituents
    c. Secondary drinking water standards
    d. Radiological contaminants

e. Volatile organic compounds

30. The primary health risk associated with volatile organic chemicals.(VOCs) is

    a. Cancer

    b. Acute respiratory diseases

    c. "Blue baby" syndrome

    d. Reduced IQ in children

31. The term "primacy" means the

    a. Authority by the states to supersede USEPA drinking water regulations

    b. Authority by the USEPA to supersede state drinking water regulations

    c. Requirements for states to maintain drinking water regulations more stringent than USEPA regulations
    d. Primary authority for implementation and enforcement of drinking water regulations

32. The Safe Drinking Water Act requires to develop a comprehensive coliform monitoring plan
    a. Large public water systems (serving $> 50,000$ people)
    b. Large and medium public water systems (serving $> 3,300$ people)
    c. Small and medium public water systems (serving > 25 and $< 3,300$ people)
    d. All public water systems

33. Contaminant monitoring requirements can depend on

    a. The results of a vulnerability assessment

    b. The size of the water system

    c. Previous maximum contaminant level (MCL) violations

d. All of the above

34. For public water systems using surface water and groundwater under the influence of surface water, turbidity must be measure at least

    a. Every 4 hours

    b. Daily

    c. Weekly

    d. Monthly

35. The difference between Tier 1 and Tier 2 violations is

    a. Tier1-violations potentially impose-direct and adverse health effects; Tier 2 violations do not pose a direct threat to public health

    b. Tier 1 violations require public notification; Tier 2 violations do not require public notification

    c. Tier 1 violations are acute; Tier 2 violations are not acute

    d. Tier 1 violations have legal consequences; Tier 2 violations do not

36. The maximum contaminant level goal (MCLG) of known or probable carcinogens is
    a. Set by the state
    b. The same number as the maximum contaminant level (MCL)
    c. Zero
    d. The minimum detectable level of a given contaminant

37. All of the following diseases may be transmitted by contaminated water, except for:

    a. Cryptosporidiosis

    b. Giardiasis

c. Cholera

d. Typhoid

e. Tuberculosis

38. The maximum disinfectant residual allowed in a distribution system is

    a.   0.2mg/L

    b.   2.0mg/L

    c.   2.0μg/L

    d.   4.0mg/L

    e. There is no maximum disinfectant residual standard

39. What steps must be taken when a single routine sample tests positive for total coliform? a. Immediately notify the Department of Health Services

    b. Immediately notify customers

    c. Re-test a new sample taken from the original sample point

    d. Re-test a new sample taken from the original sample point, plus at points immediately upstream and downstream

    e. Flush the system around the original sample point to re-establish disinfectant levels

40. For drinking water distribution systems with over 40 routine coliform samples per month, the maximum amount of coliform-positive samples permitted is
a. 2
b. 2 %
c. 5
d. 5 %

    e. variable, depending on the size of the system

41. The regulation that establishes standards for microbiological quality in drinking water is a. The Disinfection By-Product Rule

    b. Secondary Drinking Water Standards

    c. The Total Coliform Rule

d. The Lead and Copper Rule

e. Maximum Contaminant Level

42. Primary and secondary drinking water standards are normally established with a

    a. Maximum contaminant level

    b. Minimum contaminant level

    c. Public health goal

    d. Maximum contaminant level goal

    e. Minimum contaminant level goal

43. The presence of coliform bacteria in a distribution system

    a. Is positive proof that pathogenic organisms are present

    b. Indicates that chlorine demand has increased dramatically c. Indicates that pathogenic organisms may be present also

    d. Requires the use of brilliant green bile as a secondary disinfectant

    e. Has no particular significance

44. The regulation that establishes standards for microbiological quality in drinking water is

    a. The Disinfection By-Product Rule

    b. Secondary Drinking Water Standards

    c. The Total Coliform Rule

    d. The Lead and Copper Rule

    e. Maximum Contaminant Level

45. For public water systems using surface water and groundwater under the influence of surface water, turbidity must be measured at least
    a. Every 4 hours
    b. Daily
    c. Weekly.
    d. Monthly

46. Contaminant monitoring requirements can depend on
    a. The results of a vulnerability assessment
    b. The size of the water system
    c. Previous maximum contaminant level (MCL) violations
    d. All of the above

47. The term "primacy" means the

    a. Authority by the states to supersede USEPA drinking water regulations

    b. Authority by the USEPA to supersede state drinking water regulations

    c. Requirements for states to maintain drinking water regulations more stringent than USEPA regulations

    d. Primary authority for implementation and enforcement of drinking water regulations

48. According to the Lead and Copper Rule. the action for the 90th percentile lead level is:

    a. 0.005 mg/l

    b. 0.015 mg/l

    c. 0.030 mg/l

    d. 0.050 mg/l

4   Treatment

(a) What is the recommended loading rate for copper sulfate for algae control at an alkalinity greater than 50 mg/L?

    i. 0.9 lb of copper sulfate per acre of surface area

    ii. 1.9 lb of copper sulfate per acre of surface area

    iii. 2-4 lb of copper sulfate per acre of surface area

    iv. .4 lb of copper sulfate per acre of surface area

(b) If ammonia vapor is passed over a chlorine leak in a cylinder valve, the presence of the leak is indicated by a

    i. Yellow cloud

    ii. White cloud

    iii. Gray cloud

    iv. Brown cloud

(c) What is the recommended minimum contact time water mains with the chlorine slug method?

    i. 3 hours

    ii. 6 hours

    iii. 10 hours

    iv. 12 hours

(d) The basic goal for water treatment is to _____.

    i. Protect public health

    ii. Make it clear

    iii. Make it taste good

    iv. Get stuff out

(e) Greensand can be operated in either _____ regeneration or _____ regeneration modes.

    i. Continuous or intermittent

    ii. Fast or slow

    iii. Hot or cold

    iv. Constant or unusual

(f) The two most common types of chlorine disinfection by-products include:

    i. TTHM and HAA5

    ii. TTHA of HMM5

    iii. Turbidity and color

    iv. Chloride and fluoride

(g) GAC contactors are used to reduce the amount of _____ contaminants in water.

      i. Inorganic

     ii. Turbidity

    iii. Particle

    iv. Organic

(h) List the five types of surface water filtration systems.

      i. Bag filtration, cartridge filtration, fine filtration, coarse filtration, media filtration

     ii. Conventional treatment, direct filtration, slow sand filtration, diatomaceous earth filtration, membrane filtration

    iii. Turbidity filtration, color filtration, bag filtration, fine filtration, media filtration

    iv. None of the above

(i) Describe two primary methods used to control taste and odor?

      i. Oxidation and adsorption

     ii. Filtration and sedimentation

    iii. Mixing and coagulation

    iv. Sedimentation and clarification

(j) The adsorption process is used to remove:

      i. Organics or inorganics

     ii. Bugs or salts

    iii. Organisms or dirt

    iv. Color or particles

(k) The solid that adsorbs a contaminant is called the:

      i. Adsorbent

     ii. Adsorbate

    iii. Sorbet

    iv. Rock

(l) What is a method of reducing hardness?

      i. Softening

     ii. Hardening

    iii. Lightning

    iv. Flashing

(m) Bag and cartridge filters are used to remove which two pathogenic microorganisms?

      i. Viruses and giardia

     ii. Giardia and cryptosporidium

    iii. Viruses and bacteria

    iv. None of the above

(n) The process of cleaning a filter by pumping water up through the filter media is called _____ the filter.

    i. Backwashing

    ii. Rewashing

    iii. Purging

    iv. Lifting

(o) In a typical water treatment plant, alum would be added into the _____ mixer.

    i. Speed

    ii. Large

    iii. Slow

    iv. Flash

(p) When comparing conventional treatment with direct filtration, what process unit is in the conventional treatment plant that is not in the direct filtration plant?

    i. Filter

    ii. Clarifier

    iii. Mixer

    iv. Detention

(q) List the basic processes, in the proper order, for a conventional treatment plant.

    i. Coagulation, flocculation, sedimentation, filtration

    ii. Flocculation, coagulation, sedimentation, filtration

    iii. Filtration, coagulation, flocculation, sedimentation

    iv. Coagulation, sedimentation, flocculation, filtration

(r) The four most common oxidants include:

    i. Chlorine, potassium permanganate, ozone, chlorine dioxide

    ii. Chlorides, soap, air, coagulants

    iii. Air, chemicals, sodium, chloride

    iv. Flocculants, coagulants, sediments, granules

(s) When operating a filter, one of the operational concerns is the difference between the pressure or head on top of the filter and the pressure or head at the bottom of the filter. This difference is called _____ pressure.

    i. Different

    ii. Differential

    iii. High

    iv. Low

(t) What type of polymer is used to improve the efficiency of the sedimentation process?

    i. Cationic

    ii. Nonionic

    iii. Anionic

    iv. All of the above

(u) A(n) _____ polymer is commonly used as a coagulant.

    i. Anionic

    ii. Cationic

    iii. Nonionic

    iv. Ionic

(v) A(n) _____ polymer is used to enhance flocculation.

    i. Anionic

    ii. Cationic

    iii. Nonionic

    iv. Ionic

(w) $Al_2(SO_4)_3 \bullet 18H_2O$ is the chemical formula for:

    i. Alum

    ii. Iron

    iii. Manganese

    iv. Lead

(x) Particles that are less than 1 μm in size and will not settle easily and are called:

    i. Light particles

    ii. Colloidal particles

    iii. Colored particles

    iv. Flat particles

(y) The sedimentation portion of water treatment is also called a(n):

    i. Clarifier

    ii. Filter

    iii. Adsorber

    iv. Water treater

(z) Slowly agitating coagulated materials is the process of:

    i. Flocculation

    ii. Coagulation

    iii. Sedimentation

    iv. Filtration

() The process of decreasing the stability of colloids in water is called:

    i. Flocculation

    ii. Coagulation

iii. Sedimentation

iv. Clarification

() The chemical oxidation process in water treatment is typically used to aid in the removal of :

    i. Organic contaminants

    ii. Inorganic contaminants

    iii. Large contaminants

    iv. None of the above

() Flocculation, sedimentation, filtration, and adsorption are _____ processes.

    i. Physical

    ii. Chemical

    iii. Biological

    iv. Mechanical

() Oxidation, coagulation, and disinfection are _____ processes.

    i. Physical

    ii. Chemical

    iii. Biological

    iv. Mechanical

() A precipitate can be formed after which one of the following processes:

    i. Oxidation

    ii. Flocculation

    iii. Filtration

    iv. Adsorption

() Water that is safe to drink is called _____ water.

    i. Potable

    ii. Palatable

    iii. Good

    iv. Clear

() The type of organisms that can cause disease are said to be _____ microorganisms.

    i. Bad

    ii. Pathogenic

    iii. Undesirable

    iv. Sick

() The basic goal for water treatment is to _____.

    i. Protect public health

    ii. Make it clear

    iii. Make it taste good

    iv. Get stuff out

() Four types of aesthetic contaminants in water include the following:

    i. Odor, turbidity, color, hydrogen sulfide gas

    ii. Pathogens, microorganisms, arsenic, disinfection by-products

() What does mg/L stand for?

    i. Microorganisms/Liter

    ii. Milligrams/Loser

    iii. Milligrams/Liter

    iv. None of the above

() Disinfection by-products are a product of:

    i. Filtration

    ii. Disinfection

    iii. Sedimentation

    iv. Adsorption

() Acute contaminants are those that can cause sickness after:

    i. Prolonged exposure

    ii. Low levels or low exposure

() Chronic contaminants are those that can cause sickness after:

    i. Prolonged exposure

    ii. Low levels or low exposure

() TTHMs and HAA5s can affect:

    i. Health

    ii. Aesthetics

    iii. Color

    iv. Odor

() Oxidation, coagulation, and disinfection are _____ processes.

    i. Physical

    ii. Chemical

    iii. Biological

    iv. Mechanical

() Flocculation, sedimentation, filtration, and adsorption are _____ processes.

    i. Physical

    ii. Chemical

    iii. Biological

    iv. Mechanical

() A precipitate can be formed after which one of the following processes:

   i. Oxidation

   ii. Flocculation

   iii. Filtration

   iv. Adsorption

() Giardia and cryptosporidium are a type of:

   i. Mineral

   ii. Organism

   iii. Color

   iv. Bird

14. The chemical oxidation process in water treatment is typically used to aid in the removal of :

   i. Organic contaminants

   ii. Inorganic contaminants

   iii. Large contaminants

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() The process of decreasing the stability of colloids in water is called:

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   iii. Sedimentation

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() Slowly agitating coagulated materials is the process of:

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   iii. Sedimentation

   iv. Filtration

() The sedimentation portion of water treatment is also called a(n):

   i. Clarifier

   ii. Filter

   iii. Adsorber

   iv. Water treater

() Particles that are less than 1 μm in size and will not settle easily and are called:

   i. Light particles

   ii. Colloidal particles

   iii. Colored particles

   iv. Flat particles

() One micrometer is also equal to:

    i. 0.1 mm

    ii. 0.0001 mm

    iii. 0.001 mm

    iv. 1 m

() Particles less than 0.45 μm in size are considered to be:

    i. Dissolved

    ii. Really little

    iii. Colored particles

    iv. Flat particles

() Turbidity is measured as:

    i. Mg/L

    ii. mL

    iii. gpm

    iv. NTU

() Al2(SO4)3 • 18H20 is the chemical formula for:

    i. Alum

    ii. Iron

    iii. Manganese

    iv. Lead

() A(n) _____ polymer is commonly used as a coagulant.

    i. Anionic

    ii. Cationic

    iii. Nonionic

    iv. Ionic

() A(n) _____ polymer is used to enhance flocculation.

    i. Anionic

    ii. Cationic

    iii. Nonionic

    iv. Ionic

() The concentration of a chemical added to the water is measured in:

    i. mL

    ii. mg

    iii. mg/L

    iv. Liters

() The quantity of chlorine remaining after primary disinfection is called a _____ residual.

    i. Chlorine

ii. Permaganate

iii. Hot

iv. Cold

() Primary disinfectants are used to _____ microorganisms.

    i. Hurt

    ii. Inactivate

    iii. Burn up

    iv. Evaporate

() Secondary disinfectants are used to provide a _____ in the distribution system.

    i. Color

    ii. Chemical

    iii. Smell

    iv. Residual

() What type of polymer is used to improve the efficiency of the sedimentation process?

    i. Cationic

    ii. Nonionic

    iii. Anionic

    iv. All of the above

() When operating a filter, one of the operational concerns is the difference between the pressure or head on top of the filter and the pressure or head at the bottom of the filter. This difference is called _____ pressure.

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    ii. Differential

    iii. High

    iv. Low

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    i. Coagulation, flocculation, sedimentation, filtration

    ii. Flocculation, coagulation, sedimentation, filtration

    iii. Filtration, coagulation, flocculation, sedimentation

    iv. Coagulation, sedimentation, flocculation, filtration

() The four most common oxidants include:

    i. Chlorine, potassium permanganate, ozone, chlorine dioxide

    ii. Chlorides, soap, air, coagulants

    iii. Air, chemicals, sodium, chloride

    iv. Flocculants, coagulants, sediments, granules

() When comparing conventional treatment with direct filtration, what process unit is in the conventional treatment plant that is not in the direct filtration plant?

   i. Filter

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   iii. Mixer

   iv. Detention

() In a typical water treatment plant, alum would be added into the _____ mixer.

   i. Speed

   ii. Large

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   iv. Flash

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   i. Backwashing

   ii. Rewashing

   iii. Purging

   iv. Lifting

() Bag and cartridge filters are used to remove which two pathogenic microorganisms?

   i. Viruses and giardia

   ii. Giardia and cryptosporidium

   iii. Viruses and bacteria

   iv. None of the above

() List the four types of membrane filtration processes commonly used in water treatment.

   i. MF, UF, NF, and RO

   ii. MNF, UOF, NOF, and ROO

   iii. CFM, FM, FN, and OR

   iv. None of the above

() What is a method of reducing hardness?

   i. Softening

   ii. Hardening

   iii. Lightning

   iv. Flashing

() Adsorption of a substance involves its accumulation onto the surface of a:

   i. Solid

ii. Rock

iii. Pellet

iv. Snow ball

() The solid that adsorbs a contaminant is called the:

   i. Adsorbent

   ii. Adsorbate

   iii. Sorbet

   iv. Rock

() The adsorption process is used to remove:

   i. Organics or inorganics

   ii. Bugs or salts

   iii. Organisms or dirt

   iv. Color or particles

() Describe two primary methods used to control taste and odor?

   i. Oxidation and adsorption

   ii. Filtration and sedimentation

   iii. Mixing and coagulation

   iv. Sedimentation and clarification

() List the five types of surface water filtration systems.

   i. Bag filtration, cartridge filtration, fine filtration, coarse filtration, media filtration

   ii. Conventional treatment, direct filtration, slow sand filtration, diatomaceous earth filtration, membrane filtration

   iii. Turbidity filtration, color filtration, bag filtration, fine filtration, media filtration

   iv. None of the above

() GAC contactors are used to reduce the amount of ____ contaminants in water.

   i. Inorganic

   ii. Turbidity

   iii. Particle

   iv. Organic

() Greensand can be operated in either ____ regeneration or ____ regeneration modes.

   i. Continuous or intermittent

   ii. Fast or slow

   iii. Hot or cold

   iv. Constant or unusual

() What is the cause of taste and odor problems in raw surface water?

    i. Copper sulfate

    ii. Blue-green algae

    iii. Oxygen

    iv. Lake turnover

() What chemical reduces blue-green algae growth?

    i. Chlorine

    ii. Caustic Soda

    iii. Copper Sulfate

    iv. Alum

() What is the purpose of adding fluoride to drinking water?

    i. Increase tooth decay
    ii. Reduce tooth decay
    iii. Make teeth white
    iv. Government conspiracy

() The optimal coagulant dose is determined by a

    i. Chlorine Test

    ii. Flocculation test

    iii. Jar Test

    iv. Coagulation test

() The most common primary coagulant is

    i. Alum

    ii. Cationic polymer

    iii. Fluoride

    iv. Anionic polymer

() Bacteria and Viruses belong to a particle size known as

    i. Suspended

    ii. Dissolved

    iii. Strained

    iv. Colloidal

() The purpose of coagulation is to

    i. Increase filter run times

    ii. Increase sludge

    iii. Increase particle size

    iv. Destabilize colloidal particles

() The purpose of flocculation

    i. Destabilize colloidal particles

    ii. Increase particle size

    iii. Decrease sludge

    iv. Decrease filter run times

() Primary coagulant aids used in treatment process are

    i. Poly-aluminum chloride

    ii. Aluminum sulfate

    iii. Ferric chloride

    iv. All of the Above

() How do water agencies monitor the effectiveness of their filtration process?

    i. Alkalinity

ii. Conductivity

iii. Turbidity

iv. pH

() Flocculation is used to enhance

    i. Number of particle collisions to increase floc

    ii. Charge neutralization

    iii. Dispersion of chemicals in water

    iv. Settling speed of floc

() If there is a problem with floc formation, what would you consider changing?

    i. Adjust coagulant dose

    ii. Stay the course

    iii. Adjust mixing intensity

    iv. Both A & C

() Which step in the treatment process is the shortest?

    i. Filtration

    ii. Sedimentation

    iii. Flocculation

    iv. Coagulation

() To lower the pH for enhanced coagulation the operator will add

    i. Chlorine

    ii. Sulfuric acid

    iii. Lime

iv. Caustic Soda

() The flocculation process lasts how long?

   i. Seconds

   ii. 5-10 minutes

   iii. 15-45 minutes

   iv. Over an hour

() The function of a flocculation basin is to

   i. Settle colloidal particles

   ii. Destabilize colloidal particles

   iii. Mix chemicals

   iv. Allow suspended particles to grow

() The treatment process that involves coagulation, flocculation, sedimentation, and filtration is known as

   i. Direct filtration

   ii. Slow sand Filtration

   iii. Conventional treatment

   iv. Pressure filtration

() Sedimentation produces waste known as

   i. Backwash water

   ii. Sludge

   iii. Waste water

   iv. Mud

() What kind of process is the sedimentation step?

    i. Physical

    ii. Chemical

    iii. Biological

    iv. Direct

() The weirs at the effluent of a sedimentation basin are also called

    i. Effluent weirs

    ii. Baffling

    iii. Launders

    iv. Spokes

() Sedimentation is used in water treatment plants to

    i. Settle pathogenic material

    ii. Destabilize particles

    iii. Disinfect water

    iv. Reduce loading on Filters

() Scouring is a term that describes conditions in a sedimentation tank which

    i. Could impact the rest of treatment process

    ii. Higher flow rates in the sludge zone

    iii. Re-suspends settle sludge

    iv. All of the above

The four zones in a Sedimentation basin include

    i. Inlet, sedimentation, sludge, outlet

    ii. Inlet, filter, waste, outlet

   iii. Inlet, top, bottom, outlet

   iv. Surface, sedimentation, sludge, outlet

() The removal and inactivation requirement for Giardia is?

   i. 99.9%

   ii. 99.99%

   iii. 99.00%

   iv. 90%

() Short circuiting in a sedimentation basin could be caused by

   i. Surface wind

   ii. Ineffective weir placement, or weirs covered in algae

   iii. Poor baffling in sedimentation inlet zone

   iv. All of the Above

() How much solids should be removed during sedimentation?

   i. 95% or more

   ii. $80 - 95\%$

   iii. $70 - 80\%$

   iv. $60 - 70\%$

() The type of basin that includes coagulation and flocculation is

   i. Rectangular

   ii. Triangular

   iii. Up-Flow

   iv. None of the above

() Recarbonation basins are used to stabilize water after

   i. Filtration

    ii. Disinfection

    iii. Softening

    iv. Coagulation

() Which of the following is an effective way for removing iron water?

    i. adding baffles

    ii. adding sodium chloride

    iii. aeration and filtration

    iv. flash mixing

() How can iron bacteria be controlled in a water distribution system?
a. by aeration
b. filtration
c. chlorination
d. precipitation

() Which of the following is a hazard when handling hydrofluosilicic acid?
a. fire
b. explosion
c. corrosion
d. inhalation

() Trihalomenthane may be partially removed from water by:
a. fluoridation
b. chlorination
c. oxidation
d. ultraviolet radiation

() Which of the following forms of iron is most soluble in water?
a. Ferric (Fe^{+3})
b. Ferric hydroxide [$Fe(OH_3)$]
c) Ferrous (Fe^{+2})
d. Ferrous oxide (FeO)

() Two fundamental treatment requirements for public water systems using surface sources are
a. Coagalat1on and sedimentation
b. Lime softening and disinfection
c. Filtration and aeration
d. Disinfection and filtration

() A zeolite softening unit will replace calcium and magnesium ions with _____ ions.
a. Fluoride
b. Iron
c. Sodium

d. Sulfur

() One use of polyphosphates is to:
a. Control algae
b. Improve taste
c. Sequester iron and manganese
d. Kill bacteria

() An acceptable means of corrosion control for relatively small systems is
a. Activated carbon
b. Lime-soda ash softening
c. pH control
d. zeolite softening

() Which of the following chemicals will most likely keep iron in suspension?

a. Chlorine

b. Fluoride

c. Polyphosphate

d. Lime inhibitor

() Lead in drinking water can result in

a. Impaired mental functioning in children

b. Prostate cancer in men

c. Stomach and intestinal disorders

d. Reduced white blood cell count

() If raw water turbidity changed from 10 to 300 turbidity units and the finished water turbidity had increased from 0.1 to 1.0 turbidity units, the unit process having the most impact to correct this situation is
a. Coagulation
b. Sedimentation
c. Filtration
d. Disinfection

() The problem caused by dissolved carbon dioxide in the water of the
distribution system is
a. increased Trihalomethanes
b. Corrosion
c. Excessive encrustation
d. Tastes and odors

() The presence of the coliform group of bacteria in water indicates

a. Contamination

b. Inadequate disinfection

c. Improper sampling

d. Taste and odor problems

() The granular filtration process is designed to reduce
a. Calcium and magnesium sulfates

b. True color

c. Total dissolved solids

d. Turbidity

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() Aeration in water treatment plants is used to

a. Lower the pH

b. Reduce concentrations of dissolved gasses

c. Reduce turbidity

d. Stabilize chlorine residuals

() What can the operator do if iron fouling appears to be a problem in an ion exchange softener?

a. Decrease the strength of the brine used in the regeneration stage

b. Increase backwash flow rates

c. Inçrease duration of backwash stage

d. Increase duration of service stage

() At what pH would a chlorinated water have the highest concentration of hypochlorous acid?
a. 5
b. 7
c. 9
d. 11

() One use of polyphosphates is to

a. Control algae

b. Improve taste

c. Sequester iron and manganese

d. Kill bacteria

() Which of the following can cause tastes and odors in a water supply?
a. Dissolved zinc
b. Algae
c. High pH
d. Low pH

() What happens when lime is fed to water for corrosion control?

a. Alkalinity is decreased

b. CO2 does not change

c. Turbidity is decreased

d. pH is increased

() The main characteristic of raw water that enables algae to grow is

a. Presence of copper sulfate

b. Low pH

c. High hardness

d. Presence of nutrients

() The type of corrosion caused by the use of dissimilar metal in a water system is

a. Caustic corrosion

b. Galvanic corrosion

c. Oxygen corrosion

d. Tubercular corrosion

() A zeolite softening unit will replace calcium and magnesium ions with ions.
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b. Iron
c. Sodium
d. Sulfur

() Two fundamental treatment requirements for public water systems using surface sources are

a. Coagulation and sedimentation

b. Lime softening and disinfection

c. Filtration and aeration

d. Disinfection and filtration

() A method used to soften water is
   a. Aeration
   b. Sedimentation
   c. Ion exchange
   d. Adsorption

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    d. Increase duration of service stage

() Trihalomenthane may be partially removed from water by:
    a. fluoridation
    b. chlorination
    c. oxidation
    d. ultraviolet radiation

() Temporary cloudiness in a freshly drawn sample of tap water may be caused by:
    a. air
    b. chlorine
    c. hardness
    d. silica

5 Disinfection

   i. Disinfection by-products are a product of:
      (a) Filtration
      (b) Disinfection
      (c) Sedimentation
      (d) Adsorption

  ii. Chloramine is most effective as a disinfectant.
      (a) Primary
      (b) Secondary
      (c) Third
      (d) First

 iii. Name the two types of hypochlorites used to disinfect water.
      (a) Chloride and monochloride
      (b) Sodium and calcium
      (c) Ozone and hydroxide
      (d) Arsenic and manganese

  iv. Name two methods commonly used to disinfect drinking water
      other than chlorination.
      (a) Ozone and ultraviolet light
      (b) Soap and agitation
      (c) Filtration and adsorption
      (d) Salt and vinegar

   v. In order to determine the effectiveness of disinfection, it is desir-
      able to maintain a disinfectant residual of at least mg/L entering
      the distribution system.

(a) 0.10 (b) 0.5

(c) 0.3

(d) 0.2

   i. Secondary disinfectants are used to provide a in the distribution
      system.

(a) Color

(b) Chemical

(c) Smell

(d) Residual

   i. Primary disinfectants are used to microorganisms.

(a) Hurt

(b) Inactivate

(c) Burn up

(d) Evaporate

   i. The quantity of chlorine remaining after primary disinfection is called a residual.

(a) Chlorine

(b) Permaganate

(c) Hot

(d) Cold

   i. The two most common types of chlorine disinfection by-products include:

(a) TTHM and HAA5

(b) TTHA of HMM5

(c) Turbidity and color

(d) Chloride and fluoride

   i. In order to determine the effectiveness of disinfection, it is desirable to maintain a disinfectant residual of at least mg/L entering the distribution system.

(a) 0.10

(b) 0.5

(c) 0.3

(d) 0.2

   i. A _ _ residual of chlorine is required throughout the system.

(a) Large

(b) High

(c) Trace

(d) Hot

   i. The test used to determine the effectiveness of disinfection is called the:
     (a) Coliform bacteria test
     (b) Color test
     (c) Turbidity test
     (d) Particle test

  ii. Name two methods commonly used to disinfect drinking water other than chlorination.
     (a) Ozone and ultraviolet light
     (b) Soap and agitation
     (c) Filtration and adsorption
     (d) Salt and vinegar

i. Name the two types of hypochlorites used to disinfect water.
   (a) Chloride and monochloride
   (b) Sodium and calcium
   (c) Ozone and hydroxide
   (d) Arsenic and manganese

ii. Free chlorine can only be obtained after point chlorination has been achieved.
   (a) Breakpoint
   (b) Fastpoint
   (c) Softpoint
   (d) Onpoint

iii. The meaning of the " C " and the " T " in the term CT stands for:
   (a) Concentration and time
   (b) Color and turbidity
   (c) Calcium and tortellini
   (d) Chlorine and turbidity

iv. Chloramine is most affective as a disinfectant.
   (a) Primary
   (b) Secondary
   (c) Third
   (d) First

v. TTHMs and HAA5s can affect:
   (a) Health
   (b) Aesthetics
   (c) Color
   (d) Odor

vi. The multiple barrier treatment approach includes
   (a) Sterilization and filtration
   (b) Disinfection and filtration
   (c) Disinfection and sterilization
   (d) Infection and filtration

vii. The maximum disinfectant residual allowed for chlorine in a water system is
   (a) .02mg/L
   (b) 2.0mg/L
   (c) 3.0mg/L
   (d) 4.0mg/L

viii. What is the disinfectant byproduct caused by ozonation? (a) Trihalomethanes

(b) Bromate
(c) Chlorite
(d) No DBP formation

ix. Haloacitic Acids are also known as
  (a) TTHM
  (b) HOCl
  (c) Chlorite
  (d) HAA5

x. What is the MCL for trihalomethanes?
  (a) .10mg/L
  (b) .06mg/L
  (c) .08mg/L
  (d) .12mg/L

xi. What is the MCL for Haloacitic Acids?
  (a) 100ppb
  (b) 60ppb
  (c) 80ppb
  (d) 120ppb

xii. What is the MCL for bromate?
  (a) .010mg/L
  (b) .020mg/L
  (c) .030mg/L
  (d) .040mg/L

xiii. What is residual Chlorine?
  (a) Chlorine used to disinfect
  (b) The amount of chlorine after the demand has been satisfied
  (c) The amount of chlorine added before disinfection
  (d) Film left on DPD kit to measure residual

xiv. When Chlorine reacts with natural organic matter in water it can create
  (a) Disinfectant by-products
  (b) Coliform bacteria
  (c) Chloroform
  (d) Calcium

xv. What are trihalomenthanes classified as
  (a) Salts
  (b) Inorganic compounds
  (c) Volatile organic compounds
  (d) Radio

xvi. What disinfectant is used for emergency purposes and not utilized in the water treatment industry?

(a) Chlorine
(b) Iodine
(c) Ozone
(d) Chlorine Dioxide

xvii. What is the disinfectant with the least killing power but that has the longest lasting residual?
(a) Chlorine
(b) Ozone
(c) Chlorine Dioxide
(d) Chloramines

xviii. The active ingredient in household bleach is
(a) Calcium hypochlorite
(b) Calcium hydroxide
(c) Sodium hypochlorite
(d) Sodium hydroxide

xix. Cryptosporidium is not resistant to this chemical
(a) Ozone
(b) Chlorine Dioxide
(c) Chlorine
(d) Both $A\&B$

xx. If a coliform test is positive, how many repeat samples are required at a minimum? (a) None
(b) 1
(c) 3
(d) Depends on the severity of the positive sample

xxi. Your water system takes 75 coliform tests per month. This month there were 6 positive samples. What is the percentage of samples which tested positive? Did your system violate regulations?
(a) 3% Yes
(b) 5%No
(c) 8% Yes
(d) 10% No

xxii. The form of Chlorine which is 100% available chlorine is?
(a) Sodium Hypochlorite
(b) Calcium Hypochlorite
(c) Calcium Hydroxide
(d) Gaseous Chlorine

xxiii. What is the minimum amount of chlorine residual required in the distribution system?

(a) There is no minimum

(b) mg/L

(c) 0.2mg/L

(d) mg/L

xxiv. What is the approximate pH range of sodium hypochlorite?
    (a) $4-5$
    (b) 6-7
    (c) $9-11$
    (d) $12-14$

xxv. What is the typical concentration of sodium hypochlorite utilized by water treatment professionals?
    (a) 5%
    (b) 65%
    (c) 100%
    (d) 12.5%

xxvi. Chlorine demand refers to

(a) Chlorine in the system for a given time

(b) The difference between chlorine applied and chlorine residual-usually caused by inorganics, organics, bacteria, algae, ammonia, etc.

(c) Chlorine needed to produce a higher pH

(d) None of the above

    i. What is the most effective chlorine disinfectant?
        (a) Dichloramine
        (b) Trichloramine
        (c) Hypochlorite Ion
        (d) Hypochlorous acid

    ii. What can form when chlorine reacts with natural organic matter in source water?
        (a) Disinfectant by-products
        (b) Sulfur
        (c) Algae
        (d) Coliform bacteria

    iii. What kind of solution is used to check for a gas chlorine leak?
        (a) Sodium hydroxide
        (b) Ozone
        (c) Ammonia
        (d) Calcium hypochlorite

iv. Chlorine is
    (a) Heavier than air
    (b) Lighter than air
    (c) Brown in color
    (d) not harmful to your health

v. Chlorine demand may vary due to

(a) Chlorine demand always stays the same

(b) Temperature

(c) pH

(d) Both B and C

i. What effect does high turbidity have on disinfection?

(a) It can increase chlorine demand

(b) It has no effect

(c) It gives the water a milky appearance that will clear out after some time

(d) You must increase the temperature of the water

i. What is the target chlorine:ammonia ratio?

(a) $2:1$

(b) $3:1$

(c) $4:1$

(d) $5:1$

i. What is the MCL for Nitrates?

(a) 1ppm

(b) 10ppm

(c) 5ppm

(d) None of the above

i. What is the molecular weight of Chlorine?

(a) 70

(b) 14

(c) 65

(d) 20

i. What disinfectant has the longest lasting residual?

(a) Ozone

(b) Chlorine

(c) Chloramine

(d) Chlorine Dioxide

i. What are some of the early indicators of Nitrification?

(a) Lowering chlorine residual

(b) Excess ammonia in treated water

(c) Raise in bacterial heterotrophic plate counts

(d) All of the above

  i. What are THMs classified as?

(a) Turbidity

(b) Radiological

(c) Volatile Organic Chemicals (d) Salts

  i. What method can operators employ to combat nitrification?

(a) Lower residual chlorine target

(b) Keep reservoir levels static

(c) Minimize free ammonia in treated water

(d) Increase water age

  i. How many times stronger is Chlorine compared to monochloramine?
    (a) 250 times
    (b) 20 times
    (c) 1500 times
    (d) 5 times

 ii. What chemicals are formed when chlorine is mixed with water?

(a) Hydrogen sulfide and ammonia

(b) DPD and carbon dioxide

(c) Sodium hypochlorite and calcium hypochlorite

(d) Hypochlorous acid and hydrochloric acid

  i. Chlorine residual is measured in the field using the

a. Electroconductivity method

b. EDTA titrimetric method

c. Ortho-tolidine colorimetric method

d. DPD colorimetric method

e. Differential pH method

  i. In nitrification, bacteria consume excess ammonia in the water and produce

a. Chloramines

b. Free chlorine

c. Urine

d. Nitrite

e. Sodium thiosulfate

i. Which of the following is a form of free chlorine?
  a. Nitrite
  b. Hypochlorous acid
  c. Monochloramine
  d. Hydrochloric acid
  e. Trichloramine

ii. A distribution system operator measures a total chlorine residual of 1.25mg/L. How many points on the chlorine breakpoint curve may display this residual?
  a. Zero
  b. One
  c. Two
  d. Three
  e. Four

iii. What is the chlorine dosage that must be applied when disinfecting a pipeline using the slug method?
  a. 300mg/L
  b. 100mg/L
  c. 50mg/L
  d. 25mg/L
  e. 6mg/L

iv. Which of the following is a form of combined chlorine?
  a. Hypochlorite ion
  b. Hypochlorous acid
  c. Monochloramine
  d. Hydrochloric acid
  e. Free ammonia

v. A distribution system operator measures a total chlorine residual of 1.25mg/L, and a free chlorine residual of 1.15mg/L : This indicates that

a. The system is operating with a chloramine residual

b. The chlorine demand is 0.10mg/L

c. The chlorine demand is 2.40mg/L

d. Chloramines are being destroyed by free chlorine

e. The system is operating to the right of the breakpoint on the chloramine curve

i. Which of the following is the most desirable form of combined residual chlorine?

a. Hypochlorite ion

b. Hypochlorous acid

c. Monochloramine

d. Dichloramine

e. Trichloramine

i. Of the following, which is the most effective disinfectant? a. Hypochlorite ion b. Hypochlorous acid c. Monochloramine d. Dichloramine e. Trichloramine

ii. A field chlorine residual measurement shows no reading at one minute, but 2.1mg/L after three minutes. This indicates that
a. The field DPD test kit needs to be returned to the laboratory for maintenance
b. There is no chlorine residual
c. There is no free chlorine residual, but there are 2.1mg/L of chloramines
d. There is no combined residual, but the free chlorine residual is 2.1mg/L
e. The analyst should wait an additional three minutes and re-test

iii. When disinfecting a storage tank, one method calls for the bottom 6% of the tank volume to be chlorinated for at least 6 hours with an applied chlorine dosage of

a. 50mg/L
b. 25mg/L
c. 6mg/L
d. 4mg/L
e. 0.2mg/L

i. Residual chlorine refers to

a. The amount of chlorine in the chlorinated water after several minutes

b. The chlorine needed to disinfect the water supply

c. The chlorine needed to produce floc in the water

d. The sludge in the bottom of the chlorine solution tank

e. None of the above

i. While handling sodium hypochlorite, proper safety precautions include
a. Avoiding situations that could splash hypochlorite solution
b. Using a face shield and/or goggles to avoid eye contact.
c. Minimizing skin contact with rubber gloves and/or protective clothing
d. All of the above e. None of the above are necessary

ii. The fusible plug that is in all chlorine containers

a. Is not necessary

b. May be used as a tap for the chlorine source

c. Should be removed after the cylinders are empty

d. Should never be removed or tampered with

e. Should be removed prior to withdrawing chlorine from the container

   i. Sodium hypochlorite is a a. Compound purchased in liquid solution used for disinfection

b. Dry neutralizing powder for treating chlorine burns

c. Gas delivered in 100-pound, 150-pound, or one-ton containers

d. Salt that is formed when hydrochloric acid is neutralized with caustic soda

e. None of the above

   i. The chlorine demand abruptly jumps in your source water. This may indicate that
     a. The water source has been contaminated
     b. Flow rates in the distribution system have increased
     c. The hypochlorite solution used for disinfection has deteriorated.

d. The hypochlorite solution tank is empty

e. The hypochlorite ion has a higher concentration than hypochlorous acid

   i. The chemical compound typically found in chlorination tablets and granules is

a. Sodium hypochlorite

b. Sodium hydroxide

c. Sodium chloride

d. Calcium hypochlorite

e. Calcium hydroxide

   i. The maximum rate of withdrawal of gas from a 150-pound chlorine cylinder in 24-hours is
     a. 20 pounds
     b. 40 pounds
     c. 100 pounds
     d. 150 pounds
     e. None of the above

  ii. The maximum rate of withdrawal of gas from a one-ton chlorine container in 24-hours is a. 40 pounds

b.　100 pounds
c. 400 pounds
d. One ton
e. Variable, depending on chlorine dosage requirements

iii. A chlorine leak can be detected by
a. An explosimeter
b. Checking the leak gauge
c. Applying ammonia solution
d. A tri-gas detector
e. None of the above

iv. When using the continuous feed method of disinfection, a new water main should be flushed, disinfected at 50mg/L, and held at above 25mg/L for at least a. 6 hours
b. 12 hours
c. 24 hours
d. 36 hours
e. 48 hours

v. If you encounter a liquid chlorine leak in a one-ton container, what action should you take first, to reduce the severity of the leak?
a. Apply a caustic solution
b. Apply an acidic solution
c. Spray the container with water
d. Spray the container with an ammonia solution
e. Rotate the container to place the leak at the top

vi. What should the chlorine dosage be to water that has a chlorine demand of 1.5mg/L, when a free residual of 1.0mg/L is desired?
a. 0.5mg/L
b. 1.0mg/L
c. 1.5mg/L
d. 2.5 pounds per day
e. 2.5mg/L

vii. When chlorine reacts with natural organic matter in the water, it is possible to form a. Disinfection by-products
b. Arsenic
c. MTBE
d. Coliforms
e. Synthetic organic compounds

viii. Which of the following best describes the characteristics of chlorine when used for disinfection in drinking water?

a. Colorless, flammable, heavier than air

b. Greenish-yellow, nonflammable, lighter than air

c. Greenish-yellow, flammable, lighter than air

d. Greenish-yellow, nonflammable, heavier than air

  i. Killing of pathogenic organisms in water treatment is called a. Disinfection b. Oxidätion c. Pasteurization d. Sterilization

  ii. Chlorine reacts with nitrogenous compounds to form a. Ammonia nitrate
    b. Free chlorine
    c. Chlorinated hydrocarbons
    d. Chloramines

iii. Sodium Hypochlorite is
    a. A commercially available chlorine solution
    b. A commercially available dry chlorine compound
    c. Chlorine that is available in 100- and 150-pound cylinders
    d. A reaction product of chlorine and caustic soda

iv. A hypochlorinator is

a. Used to measure residual chlorine

b. Used in the treatment of iron and turbidity

c. Used to feed a liquid solution into a water supply

d. Used to measure an adequate amount of chlorine gas into the supply

  i. When calcium hypochlorite is used for disinfecting a water supply, it should be

a. Dissolved in water, allowed to settle, and the supernatant siphoned off and fed into the water system

b. Dissolved in water as a dry chemical then injected into the water system

c. Fed as a dry chemical directly into the pipeline

d. Fed as a dry powder into the clear well

  i. The chlorine gas feed rate is usually controlled by adjusting the

a. water flow to the injector

b. valve on the chlorine cylinder

c.pressure in the chlorine cylinder d. rotameter control valve

  i. If disinfection is incomplete because the chlorine residual is in the hypochlorite ion form, what should you change to improve disinfection?

a. Calcium

b. Hardness

c. pH

d. alkalinity

i. Breakpoint chlorination is achieved when

a. Free ammonia can be tasted in the water

b. No chlorine residual is detected

c. The strong chlorine tasted at the plant did not persist in the distribution system

d. When chlorine dosage is increased, a corresponding increase in residual is detected

i. Because chlorine residual is related to the pH of the water, it may be said that

a. A higher pH requires a higher chiorine residual

b. A higher pH requires a lower chlorine residual

c. A lower pH requires a higher chlorine residual

d. pH has no effect on chlorine residual

i. As long as the temperature is steady, the pressure indicator on a chlorine cylinder will until all the chlorine has been gasified

a. Remain steady

b. Decrease slowly

c. Decrease rapidly

d. Increase slightly

i. When fresh, the typical concentration of sodium hypochlorite solution is

a. 1.25%

b. 6.5%

c. 12.5%

d. 65%

e. variable, depending on the manufacturer

i. Chlorine in a dry form is called:

a. hypochlorite

b. hypochlorous

c. hydrochlorite

d. hydroxide

i. Which of the following procedures is done when preparing to disconnect a chlorine cylinder?

a. close the cylinder valve first to allow time for the chlorine to be drawn off

b. loosen the line to the tank and then shut off the valve to the chlorine cylinder

c. shut off the water supply and allow sufficient time for the chlorille to be drawn off

d. tum the chlorinator feed rate valve off then turn the valve on the chlorinator cylinder 93. A vacuum is formed in the chlorinator by the:

a chlorine cylinder pressure

b. pressure differential through the ejector

c. chlorine feed pump

d. rotameter-

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b. A higher pH requires a lower chlorine residual

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d. A lower pH has no effect on chlorine residual

  i. If disinfection is incomplete because the chlorine residual is in the hypochlorite ion form, what should one change to improve disinfection? a. Calcium b. Hardness c. pH d. Alkalinity

  ii. Which of the following best describes "chlorine demand"?

a. The difference between the amount of chlorine added and turbidity

b. The difference between the amount of chlorine added and pH

c. The difference between the total chlorine residual and the free chlorine residual

(d.) The difference between the amount of chlorine added and the amount of residual chlorine remaining after a given contact time

6 Pumping

6.1 Multiple Choice

i. Vertical turbine pumps that are used in wells may be oil-lubricated or water-lubricated. Operators should use extreme care not to start any water-lubricated pump before making sure that the:

a. Valve on discharge side is open.

b. Bearings are dry.

c. Valve on suction side is closed.

d. Bearings are wet.

i. The head against which a pump must operate:

a. Is the sum of the static head and the head due to friction loss.

b. Must always be above the shut-off head.

c. Is the static head.

d. Is the friction head.

i. What term describes the condition that exists when the source of the water supply is below the centerline of the pump?

a. Pressure head

b. Velocity head

c. Suction lift

d. Total discharge head

i. What is the most common use today for a positive-displacement pump?

a. Raw water intake pump

b. System booster pump

c. Chemical feed pump d. Filter feed pump

i. A pumping condition where the eye of the impeller is above the water is called?

a. Dry Well

b. Suction Head

c. Wet Well

d. Suction Lift

i. The force used in an End-suction pump is called

a. Pressure

b. Centrifugal

c. Velocity

d. Kinetic

i. _ _ is the loss of energy as a result of friction.

a. Velocity loss

b. Headloss

c. Elevation Loss

d. Pump Loss

   i. As the water travels around the volute towards the discharge line the total energy shifts from

a. High Velocity Head to low PSI b. Low Velocity Head to high PSI
c. Low Velocity Head to low PSI d. High Velocity Head to high PSI

   i. The part that in an End Suction pump that is used to collect the liquid discharged from the impeller is called?

a. Shaft

b. Packing

c. Suction Head

d. Volute

   i. Head is the energy that a body has by virtue of its position or state.

a. Velocity

b. Potential

c. Kinetic

d. Pressure

   i. An impeller that has no shrouds and used to pump fluid with large objects is called?

a. Semi-open

b. Open

c. Closed

d. Very-closed

   i. A pump station design where the eye of the impeller is submerged in water is called?

a. Dry Well

b. Suction Head

c. Wet Well d. Suction Lift

   i. The discharge valve on a pump can be closed for short periods of time or during start up.

a. Piston

b. Progressive Cavity

c. Diaphragm

d. dynamic

   i. Velocity of a pump is measured in:

a. Inches per second

b. PSI

c. Feet per second

d. Yards per second

   i. An impeller that has shrouds on both sides and is used to pump fluid with little or no objects is called?

a. Semi-open

b. Open

c. Closed

d. Very - closed

   i. To change the discharge of displacement you have to change the:

a. Speed

b. Discharge valve

c. Suction valve

d. Rotation

   i. Which pump component prevents leakage from the pump discharge to the suction?

a. Lantern ring

b. Volute

c. Wear ring

d. Shaft sleeve

   i. Mechanical seals are being installed in pumps because

a. packing requires an undesirable leakage that seals eliminate.

b. seals prevent cross connections with potable water.

c. seals will take more shaft misalignment than packing.

d. there is a shortage of good packing available on the market.

   i. A major cause of pump and motor shaft coupling wear is:

a. discharge pressure too high.

b. low suction pressure.

c. misalignment between pumps and motor flanges.

d. worn-out seal.

   i. The discharge rate of a piston-type pump:

a. Is constant as the main drive rpm changes

b. Is constant at a constant speed c. Varies inversely with the head

d. Varies with the total dynamic head

   i. The flow of electrical current is measured in

a. Amperes

b. Ohms

c. Volts

d. Watts

  i. An operator hears a pinging sound coming from the pump. What is the probable cause?

a. Descaling

b. Cavitation

c. Corrosion

d. Hardness

  i. During a routine inspection on a centrifugal pump, the operator notices that the bearings are excessively hot. This is most likely caused by:

a. Over lubrication

b. The speed being too slow

c. A worn impeller

d. A worn packing

  i. The-leakage of seal-wateraround-the-packing on a centrifugal pump is required because it acts as a(n)

a. Adhesive

b. Coolant

c. Corrosion inhibitor

d. Scale inhibitor

  i. What can happen to a pump if the back pressure on the pump is allowed to drop too low and the pump is operated for a prolonged period of time?

a. Efficiency would drop off and the pump would heat up

b. No water would flow

c. Pump lubricants would disperse more efficiently

d. Water hammer would occur upstream in the distribution line

  i. At a pumping station equipped with centrifugal pumps, what can cause the discharge pressure to suddenly increase and the discharge quantity to suddenly decrease?

a. A discharge valve was closed

b. A suction valve was closed

c. The pump amperage was decreased

d. The voltage was suddenly increased

  i. The difference between water levels upstream and downstream of a pump when it is not in operation is known as the

a. Suction lift

b. Total dynamic head c. Discharge head

d. Friction loss

e. Total static head

   i. Static suction head plus friction suction head plus static discharge head plus friction discharge head is a pump's

a. Pump curve

b. Operating pressure

c. Efficiency

d. Total dynamic head

e. Velocity head

   i. Pumps are primed to

a. Replace air inside the pump with water

b. Seat the valves

c. Wet the packing

d. Provide water for flow testing

e. Overcome positive suction head

   i. Backspin is occurring after well shutdown; this indicates

a. A high water table

b. A low water table

c. A confined aquifer

d. A faulty check valve

e. A leak in the sanitary seal

   i. A water seal on a pump serves many purposes, including

a. Acts as a coolant to keep the pump bearing from overheating

b. Keeps gritty material from entering the packing box

c. Keeps the pumps primed

d. Is a reserve water supply

e. Prevents cavitation

   i. Enclosed, open, and semi-closed are terms used for the designation and selection of:

a. Impellers

b. Lantern rings

c. Sleeves

d. Stuffing boxes

e. None of the above

i. A device that converts electrical energy into mechanical or kinetic energy is called a a. Motor
   b. Generator
   c. Transformer
   d. Battery
   e. Pump

ii. If a pump sounds like it is pumping rocks, the most likely cause is

a. Cavitation
b. Corrosion
c. Over-tightening of the packing gland
d. Misalignment with the motor
e. Irregular wear of the mechanical seal

i. The flow of electrical current is measured in
   a. Amperes
   b. Volts
   c. Watts
   d. Ohms
   e. Farads

ii. The rotating element in a centrifugal pump is commonly called the
   a. Fan
   b. Impeller
   c. Rotor
   d. Volute
   e. Stator

iii. The purpose of the packing in a centrifugal pump is
   a. Comparable to a bearing and is impregnated with lubricant
   b. To prevent vibration of the shaft
   c. To provide support for the impeller
   d. To surround the bearings and lubricate them
   e. None of the above

iv. Which of the following is a positive displacement pump? a. Air lift pump
   b. Centrifugal pump
   c. Reciprocating pump
   d. Turbine pump
   e. All of the above

v. The practical maximum suction lift for a centrifugal pump in good condition is a. 0 feet

b. 2.31 feet

c.   14.7 feet

d. 20 feet to 25 -feet

e. 32 -feet to 34-feet

vi. The linkage between a centrifugal pump and its motor is commonly called the

a. Coupling

b. Impeller

c. Bearings

d. Volute

e. Stator

i. The electrical equivalent to friction in water lines is

a. Voltage

b: Resistance

c. Amperage

d. Capacitance

e. Inductance

i. The main water-containing body of a centrifugal pump is commonly called the

a. Shaft

b. Impeller

c. Bearings

d. Volute

e. Stator

i. A type of pump that produces high flow rates with low discharge heads is a

a. Radial flow

b. Axial flow

c. Vertical turbine

d. Piston

e. Mixed flow

i. Alternating current is produced by

a. A single battery

b. Two (or more) batteries in series

c. Two (or more) batteries in parallel

d. A solenoid

e. A generator

i. What do electrical transformers do?

a. Step-up or step-down current

b. Step-up or step-down voltage

c. Increase power output

d. Decrease power output

e. Reduce resistance

  i. An "Open" electrical circuit is one in which

a. Resistance is low

b. Power production is high

c. Capacitance is low

d. Conductivity is high

e. Amperage is zero

  i. Adding more stages (bowls) to a deep well turbine pump assembly will a. Increase the pump discharge capacity b. Decrease the pump discharge capacity

c. Increase the pump discharge pressure

d. Decrease the pump discharge pressure

e. None of the above

  i. When installing packing in a centrifugal pump, the packing should be

a. Water tight

b. Pre-heated

c. Staggered 90°

d. Soaked overnight in potable water

e. Re-used

  i. Standard electrical line frequency in the United States is a. 50 Hz
    b. 60 Hz
    c.   110 Hz
    d.   120 Hz
    e. 240/480 Hz

  ii. In contrast to conventional packing, mechanical seals

a. Require no adjustment

b. Do not leak

c. Are generally more expensive

d. Are more difficult to remove/replace

e. All of the above

  i. The level of water in a reservoir is 200 feet above the main line that carries water into and out of the reservoir. A standpipe in the main line a block away at the same elevation as the reservoir shows a water elevation of 185 feet. Which of the following statements is true?

a. There is no flow into or out of the reservoir

b. Water is flowing into the reservoir

c. Water is flowing out of the reservoir

d. There is a pump station adjacent to the pressure gauge

e. Nothing can be deduced from the information in this question.

  i. Pump motors draw more power starting than during normal operating conditions because:

a. check valves have to be pushed open

b. energy is required to get the water moving

c. the motor and pump have to start turning

d. all of the above

  i. Which of the following does not affect the friction loss in a given length of pipe?
    a. hardness of the water
    b. number of fittings
    c. roughness of the interior of the pipe
    d. velocity of the flow

  ii. The component of a centrifugal pump sometimes installed on the end of the suction pipe in order to hold priming is the:

a. Casing

b. Footvalve

c. Impeller

d. Lantern ring

  i. At a pumping station equipped with centrifugal pumps, what can cause the discharge pressure to suddenly increase and the discharge quantity to suddenly decrease?
    a. A discharge valve was closed
    b. A suction valve was closed
    c. The pump amperage was decreased
    d. The voltage was suddenly increased

  ii. The inlet to the pump is called:
    a. Suction
    b. Volute
    c. Impeller
    d. Effluent

  iii. The rotating element in a centrifugal pump is commonly called a(n):
    a. Fan

b. Impeller

c. Rotor

d. Volute

iv. Pumps are primed to:

    a) be sure the pump operates freely

    b) replace air with water inside the pump

    c) seat the valves

    d) wet the packing

    e) none of the above

v. The joints in the rings of pump packing should be:

a) placed in line b) placed next to the motor

c) placed next to pump

d) staggered

e) none of the above

i. A vertical turbine pump is an example of $a : a$ a) centrifugal pump b) parshall flume c) positive displacement pump

d) reciprocating pump

e) all of the above

i. Which type of pump is most commonly used for high capacity wells? a) air lift

b) centrifugal

c) positive displacement d) plunger

e) none of the above

i. What can happen to a pump if the back pressure on the pump is allowed to drop too low and the pump is operated for a prolonged period of time?

a. Efficiency would drop off and the pump would heat up

b. No water would flow

c. Pump lubricants would disperse more efficiently

d. Water hammer would occur upstream in the distribution line

i. Check valves are used to prevent

a. Excessive pump pressure

b. Priming

c. Water from flowing in two directions

d. Water hammer

i. Positive displacement pumps should be operated when

a. Suction and discharge line valves are closed

b. Suction and discharge line valves are open

c. Suction line valves are closed and discharge line valves are open

d. Suction tine valves are open and discharge line valves are closed

  i. When comparing friction loss in various types of pumps, a larger Hazen-Williams ' C ' value indicates the pipe

a. is more durable,

b. is rougher outside.

d. is able to withstand a higher pressure.

c. is smoother inside.

  i. Proper alignment between two shafts can be checked using a:

a. caliper

b. micrometer

c. straight edge d. feeler gauge

  i. The maximum practical suction lift of a properly engineered centrifugal pump is about:

a. $5-10$ft

b. $10-15$ft

c. $15-25$ft

d. $25-34$ft

  i. Which type of pump is most commonly used for high capacity wells?

a. air lift

b. centrifugal

c. positive displacement

d. plunger

e. none of the above

  i. A vertical turbine is an example of a:
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    b. parshall flume
    c. positive displacement pump
    d. reciprocating pump
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   a. is more durable.
   b. is rougher outside.
   c. is smoother inside.
   d. is able to withstand a higher pressure.

7 Distribution

7.1 Multiple Choice

i. The tensile strength of a pipe is its ability to

a. Stretch or pull without breakage
b. Resist internal pressure without breakage
c. Resist external pressure without breakage
d. Twist or bend without breakage
e. Resist heating without breakage

i. The lowest point of the inside of a pipe is known as the

a Pervert
b. Soffit
c. Invert
d. Curb stop
e. None of the above

i. A lightweight type of pipe that has a very smooth interior, is essentially corrosion-free, and which is difficult to locate when buried is

a. Polyvinyl chloride
b. Cast iron
c. Ductile iron
d. Concrete cylinder
e. Steel

i. An example of a pipe material that is relatively easy to locate underground is

a. ABS
b. PVC c. Polyethylene d. Reinforced concrete cylinder e. Asbestos-cement

i. ___ is a type of valve typically found in a storage tank of a water distribution system it closes to prevent the storage tank from overflowing when a pre-set level is reached

a. Ball valve
b. Altitude valve
c. Gate valve
d. Spring valve

i. ___ is a valve which opens by lifting a round or rectangular gate/ wedge out of the path of the fluid are designed to fully open or closed service

a. Ball valve
b. Spring valve
c. Altitude valve
d. Gate valve

ii. A _ _ _ is a form of quarter turn valve which uses a hollow perforated and pivoting to control flow through it and is a pivoted 90 degrees by the valve handle.
a. Gate valve b. Spring valve c. Ball valve d. d. Altitude valve

iii. The sudden closure of a check valve will result in a. water hammer b. flow reversal c. cavitation d. water aeration

iv. A located at the bottom end of suction pipe on a pump this valve opens when the pump operates to allow water to enter the suction pipe but closes when the pump shuts off water from flowing out of the suction pipe a. Check valve b. Foot valve c. Spring valve d. Ball valve

v. A valve that automatically shuts off flow into an elevated storage tank when the water level in the tank reaches a preset level is termed a(n) a. Gate valve b. Air/ vacuum relief valve c. Wet-barrel hydrant d. Altitude valve e. Angle valve

vi. A normally buried valve located on a street water main and leading to a water service is known as

a. Check valve
b. Gate valve
c. Corporation stop
d. Altitude valve
e. Butterfly valve

i. The risk of pipeline damage from water hammer can be reduced by

a. Installation of gate valves
b. Air release valves
c. Repair of defective pipes
d. Trimming pump impellers
e. Rapid closing of pump discharge valves

i. The valve type most commonly used for isolation in a water distribution system is:

a. Gate valve
b. Air relief valve
c. Globe valve
d. Ball valve
e. Butterfly valve

i. The proper location for air relief valves is

a. At low points along a pipeline
b. At high points along a pipeline
c. At the bottom of surge tanks
d. At the mid-line of water storage reservoirs
e. At the springline of a pipeline

i. From a sanitary standpoint, the pressure in a distribution system should never be allowed to fall to zero because

a. low pressure allows bacteria to multiply.
b. ground water may enter and back siphonage may occur.
c. the chlorine residual will drop fast.
d the main may collapse.

i. When fully open, which of the following will have the highest friction loss?

a Gate valve
b. Butterfly valve
c. Globe valve
d. Ball valve
e. All will have about the same friction loss.

i. A nutating disc is found in certain:

a. Centrifugal pumps

b. Positive displacement pumps
c. Main line valves
d. Chemical feeder
e. Water meters

i. The drain hole in a fire hydrant is designed to
   a. Release air upon closing the valve
   b. Relieve vacuum upon opening the valve
   c. Allow access for interior inspection
   d. Relieve excess water. pressure when closing the valve
   e. Remove water from the riser to prevent freezing

ii. A typical installation site for a compound meter is
   a. Any small commercial business
   b. A common single location with as many as 12 separate customers
   c. A large industrial user
   d. Any location that requires the electronic monitoring of peak flows
   e. A typical residential water flow meter

iii. A main break may cause low pressure in the distributions system, which in turn may result in
   a. Contamination of the system by backsiphonage
   b. "ice" formation in the pipes
   c. Increase in chlorine residual
   d. Water hammer

iv. Check valves are used to prevent
   a. Excessive pump pressure
   b. Priming
   c. Water from flowing in two directions
   d. Water hammer

v. The water table is defined as the
   a. Pumping water level in a well
   b. Upper surface of the groundwater
   c. Water level in a reservoir
   d. Bottom of the aquifer

vi. To protect stored water from contamination, a ground storage reservoir should

a. Be totally airtight

b. Have both the overflow pipe and vent screened

c. Have cathodic protection

d. Have its interior surface coated with an AWWA-approved paint system

   i. The peak capacity of water mains is often reduced by
      a. High pressure
      b. Looping
      c. Tuberculation
      d. Vacuum breakers

   ii. The least amount of head loss in a pipeline would be caused by a fully open

a. Angle valve

b. Check valve

c. Gate valve

d. Globe valve

   i. The variation in water demand during the course of a day is termed

a. Seasonal variation

b. Fire flow requirements

c. Emergency storage variation

d. The straight line equalization method

e. Diurnal variation

   i. The maximum momentary load placed on a water supply system is known as

a. Average daily flow

b. Average daily demand

c. Rated capacity

d. System float

e. Peak demand

   i. Elevated storage tanks are used primarily to

a. Eliminate the need for continuous pumping

b. Minimize variations in the system water pressures

c. Reduce auxiliary power requirements

d. Provide a considerable amount of water for storage

e. Protect against backflows

   i. A valve that automatically shuts off flow into an elevated storage tank when the water level in the tank reaches a preset level is termed $a(n)$

a. Gate valve

b. Air / vacuum relief valve

c. Wet-barrel hydrant

d. Altitude valve

e. Angle valve

   i. Because pipe materials come into contact with drinking water, they must conform with

a. Primary drinking water standards

b. Secondary drinking water standards

c. Surface water treatment rule

d. NSF - National Sanitation Foundation

d. ANSI/NSF Standard 61′

e. All of the above

   i. An example of a pipe material that is difficult to locate underground is

a. Mortar lined and coated steel b. Reinforced concrete cylinder

c. Ductile iron

d. Asbestos-cement

e. Steel

   i. Pipe with a " C " factor of 140 is regarded as having $a(n)$

a. Extremely smooth interior

b. Extremely rough interior

c. Extremely high corrosion resistance

d. Extremely low corrosion resistance

e. A purple color

  i. A lightweight type of pipe that has a very smooth interior, is essentially corrosion-free, and which is difficult to locate when buried is

a. Polyvinyl chloride : PVC

b. Cast iron

c. Ductile iron

d. Concrete cylinder

e. Steel

  i. An example of a pipe material that is relatively easy to locate underground is a. ABS

b. PVC

c. Reinforced concrete

d. Asbestos-cement

  i. Sleeve-type and "victaulic" couplings are the most common forms of a. Mechanical couplings

b. Welded joints

c. Asbestos-cement pipe fittings

d. PVC pipe fittings

e. Flanged joints

  i. If possible, a water main leak should be repaired under pressure to

a. Prevent contamination of the water line

b. Prevent flooding of basements

c. Save repair time

d. Use fewer materials

e. All of the above

  i. When is the best time to perform a distribution main flushing program?
    a. During night hours, to minimize traffic and other customer concerns
    b. During weekday day shift hours, to minimize overtime costs
    c. During Summer months, due to high system velocities
    d. During Spring months, prior to high system demands of Summer
    e. None of the above

ii. An system for the prevention of corrosion is called

a. Water hammer

b. Reverse osmosis

c. Diurnal variation

d. A foot valve

e. Cathodic protection

i. What category of meters is exemplified by propeller and turbine types?

a. Differential pressure

b. Positive displacement

c. Mass flow

d. Velocity

i. The hydraulic grade line in a pipeline is normally determined by

a. Reading pressure gauges

b. Checking for backflow

c. Opening fire hydrants on each loop of the system

d. Using a leak detector

e. A venturi meter

i. The slope of the hydraulic grade line is due to

a. Well elevations

b. Elevations of storage facilities

c. Pumping

d. Backflows

e. Friction loss

i. A normally buried valve located on a street water main and leading to a water service is known as a

a. Check valve

b. Gate valve

c. Corporation stop

d. Altitude valve

e. Butterfly valve

i. The risk of pipeline damage from water hammer can be reduced by

a. Installation of gate valves

b. Air release valves

c. Repair of defective pipes

d. Trimming pump impellers

e. Rapid closing of pump discharge valves

   i. A venturi is a device used to

a. Increase water flow

b. Decrease water flow

c. Regulate water flow d. Stop or start water flow

e. Measure water flow

   i. The most commonly used meter on small diameter domestic service is the

a. Venturi meter

b. Propeller meter

c. Orifice plate meter

d. Compound meter

e. Nutating disc meter

   i. The valve type most commonly used for isolation in a water distribution system is the

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b. Air relief valve

c. Globe valve

d. Ball valve

e. Butterfly valve

   i. The proper location for air relief valves is

a. At low points along a pipeline

b. At high points along a pipeline

c. At the bottom of surge tanks

d. At the mid-line of water storage reservoirs

e. At the springline of a pipeline

   i. When fully open, which of the following will have the highest friction loss?

a. Gate valve

b. Butterfly valve

c. Globe valve

d. Ball valve

e. All will have about the same friction loss.

   i. Which of the following is a device used to measure flow?

a. Baffle

b. Diversion box

c. Stop logs

d. Weir

e. None of the above

i. A compound meter is a device which

a. Is installed to allow automated meter reading

b. Can be installed to measure water use by as many as 12 separate customers

c. Provides accurate readings over a wide range of flows

d. Electronically records peak flows, as a demand meter does for electricity

e. Is a typical residential water flow meter

   i. Magnetic flow meters and ultrasonic flow meters are well suited to measure flow rates of water with a large concentration of suspended solids, because they have a. The best accuracy of any meters

b. No parts within the flow stream

c. Easily accessed cleanout ports

d. Simple recalibration procedures

e. All of the above

   i. A nutating disk is found in certain

a. Centrifugal pumps

b. Positive displacement pumps

c. Main line valves

d. Chemical feeders

e. Water meters

   i. The most common valve in a water distribution system is the

a. Gate valve

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c. Globe valve

d. Ball valve

e. Butterfly valve

   i. The drain hole in a fire hydrant is designed to

a. Release air upon closing the valve

b. Relieve vacuum upon opening the valve

c. Allow access for interior inspection

d. Relieve excess water pressure when closing the valve

e. Remove water from the riser to prevent freezing

   i. A typical installation site for a compound meter is

a. Any small commercial business

b. A common single location with as many as 12 separate customers

c. A large industrial user

d. Any location that requires the electronic monitoring of peak flows

e. A typical residential water flow meter

i. An example of a pressure-differential type water meter is a

a. Venturi meter

b. Propeller meter

c. Nutating disk meter

d. Magnetic flow meter

e. Utrasonic flow meter

i. When closing a hydrant, it should be

a. Closed rapidly to minimize water loss

b. Closed slowly to reduce surges

c. Closed using a standard valve key

d. Closed using a standard pipe wrench e. Closed at the street valve and left slightly open at the hydrant valve

i. Dry-barrel fire hydrants have their operating valves

a. In the base

b. In the head

c. Either of the above, depending on the manufacturer

d. In the street several feet away from the riser

e. None of the above

i. An example of a valve that has a 90 degree travel is a:

a. Butterfly valve

b. Plug valve

c. Ball valve

d. All of the above

e. None of the above

i. The valve type most commonly found on the discharge of a pump or well, and installed to prevent reverse flows is the

a. Gate valve

b. Check valve

c. Globe valve

d. Butterfly valve

e. Ball or Plug valve

i. Features that impact the CC " factor for measuring friction in pipelines include

a. Pipe length

b. Pipe type

c. Number of valves

d. Type of valves

e. All of the above

i. An abnormal flow condition caused by a difference in water pressures is known as:

a. Backflow

b. Reverse osmosis

c. Peak demand

d. Fire flow

e. Minimum daily requirement

i. "Backflow Device" is a term used to describe a device that

a. connects three inlet lines with one outlet line

b. lets air into valve vaults

c. prevents flow of potentially contaminated source into a drinking water supply

d. tests for oxygen deficiency in valve vaults

e. prevents backflow of water through an out-of-service pump

i. A cross-connection means

a. Four pipelines tied together b. A T-shaped tool

c. A connection between potable water and "unapproved" water supplies

d. A backflow caused by negative pressure

e. A connection between two or more pressure zones

i. Egress is normally required (per OSHA guidelines) for trenches of what minimum depth? a. 4-feet
b. 5 -feet
c. 6 -feet
d. 7-feet
e. 8-feet

ii. A backflow prevention device that can be used in any cross-connection situation is a

a. Pressure vacuum breaker

b. Single check valve

c. Double check valve

d. Reduced pressure zone device

e. Atmospheric vacuum breaker

i. A backflow prevention device that is designed for intermittent use in situations where there is no backpressure, such as toilet flush valves and lawn sprinkler systems is a

a. Pressure vacuum breaker

b. Single check valve

c. Double check valve

d. Reduced pressure zone device

e. Atmospheric vacuum breaker

i. A completely fail-safe means of backflow prevention is

a. Atmospheric vacuum breaker
b. Pressure vacuum breaker
c. Air gap
d. Check valve
e. Double check valve

i. Two hydraulic conditions can induce backflow. These are back-siphonage and

a. Peak flow
b. Diurnal flow
c. Faulty solenoid valves
d. Back pressure
e. Fire flow

i. When using the continuous feed method of disinfection, a new water main should be flushed, disinfected at 50mg/L, and held at above 25mg/L for at least
a. 6 hours
b. 12 hours
c. 24 hours
d. 36 hours
e. 48 hours

ii. To properly disinfect a water main after new construction, you should:
a. apply 50mg/l chlorine for 24 hours.
b. clean the pipe out' with a pig and then disinfect at 10mg/1 for 24 hours
c. use a 10% solution of calcium chloride
d don't use them main for one week

iii. From a sanitary standpoint. the pressure in a distribution system should never be allowed to fall to zero because:
a. low pressure allows bacteria to multiply
b. ground water may e:oter and back siphonage may occur
c. the chlorine residual will drop faster
d. the main may collapse

iv. The primary purpose of pressure-reducing valves between water system pressure zones is to
a. Minimize surge
b. Reduce downstream pressure
c. Control flows
d. Reduce upstream pressure

v. Because pipe materials come into contact with drinking water, they must conform with

a. Primary drinking water standards

b. Secondary drinking water standards

c. Surface water treatment rule

d. ANSI/NSF Standard 61

e. All of the above

i. An example of a: pipe material that is difficult to locate underground is

a. Mortar lined and coated steel

b. Reinforced concrete cylinder

c. Ductile iron

d. Asbestos-cement

e. Steel

i. A lightweight type of pipe that has a very smooth interior, is essentially corrosion-free, and which is difficult to locate when buried is:

a. Polyvinyl chloride

b. Cast iron

c. Ductile iron

d. Concrete cylinder

e. Steel 77. Sleeve-type and "victaulic" couplings are the most common forms of

a. Mechanical couplings

b. Welded joints

c. Asbestos-cement pipe fittings

d. PVC pipe fittings

e. Flanged joints

i. The tensile strength of a pipe is its ability to

a. Stretch or pull without breakage b. Resist internal pressure without breakage

c. Resist external pressure without breakage

d. Twist or bend without breakage

e. Resist heating without breakage

i. When is the best time to perform a distribution main flushing program?

a. During night hours, to minimize traffic and other customer concerns

b. During weekday day shift hours, to minimize overtime costs

c. During Summer months, due to high system velocities

d. During Spring months, prior to high system demands of Summer

e. None of the above

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iii. Features that impact the " K " factor for measuring friction in pipelines include a. Pipe length
b. Pipe type
c. Number of valves
d. Type of valves
e. All of the above

iv. A potable water supply discharges into an irrigation water storage tank. The 3-inch potable supply line should be terminated
a. Above the tank overflow by at least two pipe diameters
b. Above the tank outlet by at least two pipe diameters
c. Below the tank outlet by at least two pipe diameters
d. Level with the tank outlet
e. Level with the tank overflow

v. A backflow prevention device that is designed for intermittent use in situations where there is no backpressure, such as toilet flush valves and lawn sprinkler systems is a

a. Pressure vacuum breaker

b. Single check valve

c. Double check valve

d. Reduced pressure zone device

e. Atmospheric vacuum breaker

i. A completely fail-safe means of backflow prevention is

a. Atmospheric vacunm breaker

b. Pressure vacuum breaker C. Air gap d. Check valve e. Double check valve

i. Back-siphonage is defined as:

a. Back flow that occurs when a vacuum exists.

b. Increase in pressure.

c. Interconnection between the plumbing systems in the building and water supply.

d. Open end of a water supply through which water is discharged in the plumbing fixture.

i. A venturi tube increases the velocity and decreases the pressure as water flows through it, This type of tube is used to measure

the:

a. Amount of chlorine in the water.

b. Amount of turbidity in the water.

c. Rate of aeration.

d. Rate of water flowing through it.

ii. A venturi meter measures flow of a fluid in a pipe based upon the:

a. Difference in pressure between a constricted and a fill size portion of the pipe,

b. Electronic measurement

c. Velocity of the fluid past a given point.

d. Weight of the fluid

i. Valves are provided in a distribution system to

a. Detect any safety hazards.

b. Detect weak links in the system.

c. Isolate small areas for maintenance and emergency conditions.

d. Reduce costs of maintenance.

i. A connection that is made into a main that is under pressure is called a:

a. Cross connection

b. Dry Tap

c. Wet Tap

d. Valve Box

i. Because it permits flow in only one direction, which valve would help you determine the direction of the fluid flow?

a. Butterfly valve

b. Check Valve

c. Pressure valve

d. Gate valve

i. The size of water mains, pumping stations, and storage tanks is primarily determined by: a. Maximum day demand during a 24 hr. period during the previous year.

b. Population served

c. Per-capita water use

d. Fire protection requirement 98. Firefighting may cause low pressure in an area of the distribution system. This low pressure might lead to:

a. contamination of the system by back-siphonage

b. ice formation in the pipes

c. loss of chlorine residual

d. None of the above

i. The problem caused by dissolved carbon dioxide in the water of the distribution system is

b. Corrosion

c. Excessive encrustation

d. Tastes and odors

a. increased trihalomethanes (THMs)

i. The peak capacity of water mains is often reduced by

a. High pressure

b. Looping

c. Tuberculation

d. Vacuum breakers

i. To protect stored water from contamination, a ground storage reservoir should

a. Be totally airtight

b. Have both the overflow pipe and vent screened

c. Have cathodic protection

d. Have its interior surface coated with an AWWA-approved paint system

i. When using the $AWWA$ spray method for disinfecting the interior walls of water tanks, the minimum applied chlorine dose is

a. 5ppm

b. 50ppm

c. 10ppm

d. 200ppm

i. Water should be delivered with a minimum working pressure of:

a. 45psi

a. 100psi

b. 35psi

c. 50psi

d. 15psi

i. Thrust blocks are installed to

a. boost flexible joints.

b. boost water pressure.

c. minimize corrosion

d. prevent movement of pipes & joints.

i. Distribution system pressure (even during fire fighting demands) should not be allowed to drop below psi.
   a. 0
   b. 5
   c. 20
   d. 40

ii. Whenever possible the end of a distribution system should be to prevent taste and odor problens.
   a. inspected
   b. looped.
   c. plugged
   d. capped

iii. The three common types of plastic pipes are listed as PVC, PE, & PB. These names refer to the:
   a. Chemical resistance of the pipe
   b. Composition of the pipe
   c. Pressure for which the pipe is designed
   d. Types of appropriate application

iv. An invert of a pipe is located:
   a). According to the pipe manufacturers specifications
   b. At the inside bottom of the pipe
   c. At the inside cross section
   d. At the outside bottom of the pipe

v. An Altitude valve is a device used to:
   a. turn water flow off or on
   b. allow two or more pumps to alternate operation
   c. prevent backflow due to a cross connection
   d. regulate the water surface level in a water storage tank
   e. none of the above

8 Safety

8.1 Multiple Choice

i. What federal law is designed to protect the safety and health of operators? A. OSHA
B. FMLA
C. FLSA
D. ADEA

ii. What are the two most important safety concerns when entering a confined space? A. Corrosive chemicals and falls
B. Bad odors and claustrophobia
C. Extreme air temperatures and slippery surfaces
D. Oxygen deficiency and hazardous gases

iii. Which document provides a profile of hazardous substances? A. CERCLA
B. SARA
C. CFR
D. MSDS

iv. What is the purpose of a pump guard?
A. Allows operators to turn off pump in emergency situations
B. Notifies operators of excessive temperatures
c. Allows operators to pump against a closed discharge valve
D. Protects operators from rotating parts

v. Atmosphere is considered oxygen deficient when the oxygen level is below
A. 21.5%
B. 20%
C. 19.5%
D. 17%

vi. Employee hazards include
A. Noxious or toxic gases or vapors
B. Oxygen defficiency
C. Physical injuries
D. All of the above

vii. Before entering a permit-required confined space, you must:
A. Check the atmosphere with a calibrated gas detector.
B. Make notification that personnel are entering the space.
C. Lock out and tag out all equipment.
D. All of the above.

viii. When making a sulfuric acid dilution, the appropriate method is:
   A. Add the water to the acid.
   B. Add the acid to the water.
   C. Add both at the same time.
   D. None of the above.

ix. When manually lifting any object, be sure to
   A. Hold it at arm's length.
   B. Keep your back bent and hold it low.
   C. Keep it close to your body and use leg strength.
   D. Keep your knees locked and bend at the waist.

x. What is the proper slope of a ladder? A. Every 4 feet up the ladder is 1 foot out from the wall.
   B. Every 5 feet up the ladder is 1 foot out from the wall.
   C. Every 6 feet up the ladder is 1 foot out from the wall.
   D. Every 7 feet up the ladder is 1 foot out from the wall.

xi. When working on a chemical feed pump, what of the following is not required?
   A. Nitrile gloves.
   B. Safety glasses.
   C. Leather work gloves.
   D. Full face shield.

xii. When must the atmosphere of a confined space be tested?
   A. Only before a worker enters
   B. Never, if adequate ventilation exists
   C. Continuously
   D. Only if welding or painting is being performed

xiii. Some gases in a confined space can be:
   A. Colorless
   B. Odorless
   C. Deadly
   D. All of the above

xiv. Why should you contact other area companies with underground utilities before starting an underground repair job?
   a. To determine if there have been recent excavations in that location
   b. To ask these companies to mark the location of their utilities in the area of the repair job
   c. To see if they also have excavating to do in the area
   d. To see if they will help route traffic while you are doing the repair job

xv. The only acceptable breathing device to wear while handling

chlorine leaks is the
a. Activated carbon canister type
b. Potassium tetroxide canister type
c. Self-contained breathing apparatus
d. Oxygen supply apparatus

xvi. It is essential to ventilate a vault before entry in order to

a. Remove excessive moisture
b. Equalize temperature and pressure
c. Eliminate foul odors
d. Remove dangerous gasses

i. Permit-required confined space entry requires

a. Bright orange jackets, rubber boots, and gloves
b. Safety harness and a lifeline
c. Tool belts with flashlight attached
d. Utility belts with a full complement of tools

i. During a confined space entry, how often must the confined space
be monitored for hazardous atmospheres?
a. Continuously
b. Every five minutes
c. Before entry only
d. Before entry and then once per hour during entry

ii. Which of the following is the most likely to be a fuel involved in
a Class A fire? a. Butane
b. Magnesium
c. Electrical equipment
d. Gasoline
e. Paper and/or fabrics

iii. In an occupied trench where exits (i.e., ladders) are required,
what is the maximum allowed travel distance between an occu-
pant and the nearest exit?

a. 25 feet
b. 50 feet
c. 100 feet
d. At the discretion of the safety officer
e. None of the above

i. Standard first aid procedures direct that the first step to control
bleeding is to
a. Apply a tight tourniquet

b. Apply pressure directly to the wound

c. Let it bleed until natural clotting takes place

d. Wash wound and bandage

e. None of the above

ii. When excavating materials that will not stand in a vertical position, the most suitable form of shoring is

a. Air shores

b. Hydraulic shores

c. Screw jacks

d. Solid sheeting

e. Cleats

iii. A potable water supply discharges into an irrigation water storage tank. The 3-inch potable supply line should be terminated

a. Above the tank overflow by at least two pipe diameters

b. Above the tank outlet by at least two pipe diameters

c. Below the tank outlet by at least two pipe diameters

d. Level with the tank outlet

e. Level with the tank overflow

iv. Which of the following gases is toxic at the lowest concentration?

a. Carbon dioxide

b. Hydrogen sulfide

c. Methane

d. Nitrogen

e. Oxygen

v. Entry into an atmosphere with high concentrations of chlorine gas requires

a. A self-contained breathing apparatus

b. An approved and uncontaminated canister mask

c. Forced ventilation of the work area

d. Atmospheric testing with ammonia solution prior to entry

e. Rubber gloves and a full-face shield

vi. Shoring is normally required (per OSHA guidelines) for trenches of what minimum depth? a. 4-feet

b. 5-feet

c. 6-feet

d. 7-feet

e. 8-feet

vii. First aid for first-degree burns is to

a. Bandage tightly

b. Cover liberally with salve

c. Pack in ice

d. Submerge the burned area in cold water

e. All of the above

viii. What information must be on a warning tag attached to a locked-out switch?

a. Directions for removing the tag

c. Signature of the person who locked out the switch and who will remove it

d. Time to unlock the switch

e. None of the above

i. A confined space that contains a material that has the potential for engulfing an entrant is

a. A transition zone

b. A permit space

c. Prohibited by OSHA

d. Required to undergo atmospheric testing with ammonia solution prior to entry

e. S Required to use a complete "A" suit for personal protective equipment

i. What condition must exist for an area to be considered a confined space?
a. Limited or restricted means of entry or exit
b. Is large enough for a person to enter and perform work
c. Is not designated for continuous occupancy
d. All of the above
e. None of the above

ii. Which of the following is the most likely to be a fuel involved in a Class C fire?
a. Butane
b. Magnesium
c. Paper and/or fabrics
d. Gasoline
e. Electrical equipment

iii. Which of the following is the most likely to be a fuel involved in a Class B fire? a. Wood b. Magnesium c. Electrical equipment d. Gasoline e. Paper and/or fabrics

iv. The angle of repose is the angle of the slope of a

a. Sewer

b. Graded and/or cut ground elevation

c. Trench excavation

d. Unsupported loose soil

e. Filled and compacted ground elevation

i. At least 48 hours prior to conducting excavations in locations where other utilities may be present, whom should you notify?
   a. WARN
   b. USA
   c. AWWA
   d. DHS
   e. EPA

ii. Which of the following compounds emits a "rotten egg" odor?
   a. Hydrogen sulfide
   b. Chorine dioxide
   c. Chloramines
   d. Hydrochloric acid
   e. Hypochlorous acid

iii. Where is the best place to store a self -contained breathing apparatus (SCBA)? a. inside a cabinet in the chlorinator room b. in an unlocked cabinet outside the chlorinator room c. locked in a cabinet in the office d. locked in a cabinet just outside the chlorinator room

iv. Which of the following is a hazard when handling hydrofluosilicic acid? a. fire
   b. explosion
   c. corrosion
   d. inhalation

v. Which of the following chemical substances ii most likely to cause corrosion or deterioration of metal and concrete surfaces
   a. carbon dioxide
   b. ethanol
   c. methane
   d. hydrogen sulfide

vi. An employee ls caught in a room where ch1orine gas is leaking. He has no SCBA, he should

a. lay down on the floor and quickly crawl out of the room

b. walk out of the room quickly

c. pull shirt over mouth and face and quickly walk out of the room

d. keep mouth closed, head as high as possible, and quickly walk out of the room holding breath.

i. It is essential to ventilate a vault before entry in order to
   a. Rennove exçessive moisture
   b. Equalize temperature and pressure
   c. Eliminate foul odors
   d. Remove dangerous gasses

ii. A portable ladder must extend at least feet above the upper surface of an excavated trench.
   a. 1
   b. 3
   c. 4
   d. 4.5

iii. A trench must be shored if it is feet deep or more.
   a. 3
   b. 4
   c. 5
   d. 6

iv. When employees are working in a trench 5ft deep or more, an adequate means of exit, such as a ladder or steps, must be located no mote than ft away from them.
   a. 5
   b. 10
   c. 25
   d. 40

9   Math

10   Practice Problems - Fractions

i. Convert $22\frac{1}{4}$ into a fraction
ii. Express 10ft, 6 in into fraction
iii. Express 10ft, 6 in into decimal

11   Practice Problems - Decimals and Powers of Ten

i. Write the equivalent of $10,000,000$ as a power of ten
ii. Find the product of $3.4564 * 10^2$
iii. Find the product of $534.567 * 10^{-2}$
iv. Find the value of $\frac{165.93}{10^{-2}}$
v. Find the value of $0.023 * 10^4$

12   Solutions:

i. 10^7
ii. 345.64
iii. 5.34567
iv. 16,593
v. 230

13   Practice Problems - Rounding and Significant Digits

Round the following to the nearest hundredths (the second place after the decimal). A. 2.4568 B. 27.2534 C. 128.2111 D. 364.8762 E. 354.777777 F. 34.666666 G. 67.33333

Solution: A. 2.46 B. 27.25 C. 128.21 D. 364.88 E. 354.78 F. 34.67 G. 67.33

Round the following to the nearest tenths (the first place after the decimal). A. 2.4568 B. 27.2534 C. 128.2111 D. 364.8762 E. 354.777777 F. 34.666666 G. 67.33333 Solution: A. 2.5 B. 27.3 C. 128.2 D. 364.9 E. 354.8 F. 34.7 G. 67.3

Round the following answers off to the most significant digit.

	Problem	Accurate Answer
A.	$25.1 + 26.43 = 51.53$	
B.	$128.456 - 121.4 = 7.056$	
C.	$85 - 7.92432 = 77.07568$	
D.	$8.564 + 5 = 13.564$	

	Problem	Accurate Answer
A.	$26.34 \times 124.34567 = 3,275.26495$	
B.	$23.58 \times 34.251 = 807.63858$	
C.	$12,453/13.9 = 895.8992805755$	
D.	$12,457.92 \times 3 = 37,373.76$	

14   Practice Problems - Averages

i. Find the average of the following set of numbers:

0.2

0.2

0.1

0.3

0.2

0.4

0.6

0.1

0.3

i. The chemical used for each day during a week is given below. Based on these data, what was the average lb/ day chemical used during the week?

Monday	92lb/ day
Tuesday	93lb/ day
Wednesday	98lb/ day
Thursday	93lb/ day
Friday	89lb/ day
Saturday	93lb/ day
Sunday	97lb/ day

i. The average chemical use at a plant is 77lb/ day. If the chemical inventory is 2800lbs, how many days supply is this?

ii. A well pumped for 45 days. The beginning meter reading was 7,456,400 and 45 days later the same meter was $15,154,400$. What was the average flow in gallons per day?

15 Practice Problems - Percentage

i. 25% of the chlorine in a 30 -gallon vat has been used. How many gallons are remaining in the vat?

ii. The annual public works budget is $147, 450. If 75% of the budget should be spent by the end of September, how many dollars are to be spent? How many dollars will be remain- ing?

iii. A 75 pound container of calcium hypochlorite has a purity of 67%. What is the total weight of the calcium hypochlorite?

iv. 3/4 is the same as what percentage?

v. A 2% chlorine solution is what concentration in mg/L ?

vi. A water plant produces 84,000 gallons per day. 7,560 gallons are used to backwash the filter. What percentage of water is used to backwash?

vii. The average day winter demand of a community is 14,500 gallons. If the summer demand is estimated to be 72% greater than the winter, what is the estimated summer demand? Demand - When related to use, the amount of water used in a period of time. The term is in reference to the "demand" put onto the system to meet the need of customers.

viii. The master meter for a system shows a monthly total of 700,000 gallons. Of the total water, 600,000 gallons were used for billing. Another 30,000 gallons were used for flushing. On top of that, 15,000 gallons were used in a fire episode and an estimated 20,000 gallons were lost to a main break that was repaired that same day. What is the total unaccounted for water loss percentage for the month?

ix. Your water system takes 75 coliform tests per month. This month there were 6 positive samples. What is the percentage of samples which tested positive?

$$\text{Time} = \frac{\text{Total volume to be pumped}}{\text{Pump flow rate}}$$

$$\implies \frac{\left(0.785 * 110^2 * 25\right).\text{ft}^3 * \frac{7.48\text{gal}}{ft^3}}{\frac{1420\text{gal}}{\text{min}}} = 1,251 \text{ min}$$

16 Practice Problems - Ratio and Proportion

i. It takes 6 gallons of chlorine solution to obtain a proper residual when the flow is 45,000 gpd. How many gallons will it take when the flow is 62,000 gpd?

ii. A motor is rated at 41 amps average draw per leg at 30Hp. What is the actual Hp when the draw is 36amps ? C.

iii. If it takes 2 operators 4.5 days to clean an aeration basin, how long will it take three operators to do the same job?

iv. It takes 3 hours to clean 400 feet of collection system using a sewer ball. How long will it take to clean 250 feet?

v. It takes 14 cups of HTH to make a 12% solution, and each cup holds 300 grams. How many cups will it take to make a 5% solution?

vi. A bike travelling at 5 miles/hr completes a journey in 40 minutes. How long would the same journey take if the speed was increased to 8miles/hr ?

17 Solution

i. The gallons chlorine and flow are directly related.

Thus,

$$\frac{6}{45,000} = \frac{X}{62,000} \implies X = \frac{6*62,000}{45,000} = 8.3 \text{ gallons}$$

i. The amp draw and Hp are directly related.

This

$$\frac{30}{41} = \frac{X}{36} \implies X = \frac{30*36}{41} = 26.3\text{Hp}$$

i. The number of operators and the days to clean are inversely related.

Thus,

$$2*4.5 = 3*X \implies X = \frac{2*4.5}{3} = 3 \text{ days}$$

i. The hours to clean and the length of system cleaned are directly proportional.

Thus,

$$\frac{3}{400} = \frac{X}{250} \implies X = \frac{3*250}{400} = 1.9 \text{ hours}$$

i. The cups of HTH and percentage HTH solution are directly proportional.

Thus,

$$\frac{14}{12} = \frac{X}{5} \implies X = \frac{14 * 5}{12} = 5.8\text{cups}$$

i. The bike speed and time to complete the journey are inversely related.

Thus,

$$5 * 40 = 8 * X \implies X = \frac{5 * 40}{8} = 25 \text{ min}$$

18 Practice Problems - Area and Volume

i. A 60-foot diameter tank contains 422,000 gallons of water. Calculate the height of water in the storage tank.

ii. What is the volume of water in ft^3, of a sedimentation basin that is 22 feet long, and 15 feet wide, and filled to 10 feet?

iii. What is the volume in ft^3 of an elevated clear well that is 17.5 feet in diameter, and filled to 14 feet?

iv. What is the area of the top of a storage tank that is 75 feet in diameter?

v. What is the area of a wall 175ft. in length and 20ft. wide?

vi. You are tasked with filling an area with rock near some of your equipment. 1 Bag of rock covers 250 square feet. The area that needs rock cover is 400 feet in length and 30 feet wide. How many bags do you need to purchase?

vii. A circular clearwell is 150 feet in diameter and 40 feet tall. The Clearwell has an overflow at 35 feet. What is the maximum amount of water the clearwell can hold in Million gallons rounded to the nearest hundredth?

viii. A sedimentation basin is 400 feet length, 50 feet in width, and 15 feet deep. What is the volume expressed in cubic feet?

ix. A clearwell holds $314,000\text{ft}^3$ of water. It is 100ft in diameter. What is the height of the clearwell?

x. A treatment plant operator must fill a clearwell with $10,000\text{ft}^3$ of water in 90 minutes. What is the rate of flow expressed in GPM?

xi. A water tank has a capacity of 6MG. It is currently half full. It will take 6 hours to fill. What is the flow rate of the pump?

xii. A clearwell with the capacity of 2.5MG is being filled after a maintenance period. The flow rate is 2,500 GPM. The operator begins filling at 7AM. At what time will the clearwell be full?

xiii. A chemical feed pump with a 6-inch bore and a 6-inch stroke pumps 60 cycles per minute. Find the pumping rate in gpm.

xiv. Determine the flow capacity of a pump in gpm if the pump lowers the water level in a 6 -foot square wet well by 8 inches in 5 minutes.

xv. How much paint will it take for a single coat of the top and sidewalls of the storage tank that is 100-feet in diameter and 30-feet tall, if one gallon of paint covers 200 square feet? a. 86 gallons b. 96 gallons c. 106 gallons d. 116 gallons e. 126 gallons

xvi. Under like conditions, how much more water would an 8-inch pipe carry than a 4-inch pipe? a. 2 times b. 3 times c. 4 times d. not enough information given

19   Solution:

i. Volume = Surface area $*$ height $\implies$ height $= \frac{\text{Volume}}{\text{Surface area}}$

$$\implies \text{ height } = \frac{422,000\text{gat} * \frac{\text{ft}^{f\text{ft}^{\text{tt}}}}{7.48\text{gat}}}{0.785 * 60^2 \text{ft}^2} = 101\text{ft}$$

20   Practice Problems - Flow and Velocity

i. A rectangular channel 3ft. wide contains water 2ft. deep flowing at a velocity of 1.5fps. What is the flow rate in cfs?

ii. Flow in an 8-inch pipe is 500gpm. What is the average velocity in ft/sec ? (Assume pipe is flowing full)

iii. A pipeline is 18 " in diameter and flowing at a velocity of 125ft. per minute. What is the flow in gallons per minute?

iv. The velocity in a pipeline is 2ft./sec. and the flow is 3,000gpm. What is the diameter of the pipe in inches?

v. Find the flow in a 4-inch pipe when the velocity is 1.5 feet per second.

vi. A 42-inch diameter pipe transfers 35 cubic feet of water per second. Find the velocity in ft/sec.

vii. A plastic float is dropped into a channel and is found to travel 10 feet in 4.2 seconds. The channel is 2.4 feet wide and 1.8 feet deep. Calculate the flow rate of water in cfs.

viii. The flow velocity of a 6-inch diameter pipe is twice that of a 12-inch diameter pipe if both are carrying 50 gpm of water. True or false?

ix. What should the flow meter read in gpm if a 4-inch diameter main is to be flushed at a velocity of 4.6fps ?

x. The velocity through a channel is 4.18fps. If the channel is 4 feet wide by 2 feet deep by 10 feet long, what is the flow rate in gpm?

xi. What is the average flow velocity in ft/sec for a 12 -inch diameter main carrying a daily flow of 2.5mgd?

21 Solution:

i. Solution:

$Q = V * A \Longrightarrow Q = 1.5\frac{ft}{\sec} * (3 * 2)ft^2 = 9\frac{ft^3}{\sec}$

i. Solution:

$Q = V * A$

$$\Longrightarrow V = \frac{Q}{A} \Longrightarrow V\left(\frac{ft}{s}\right) = \frac{\frac{500 \text{ gatton}}{min} * \frac{ft^{\frac{f3}{ft}} * \frac{min}{60sec}}{7.48\text{gal}}}{0.785 * \left(\frac{8}{12}\right)^2 ft^{2t}} = 3.2\text{ft/s}$$

i. Solution:

The diameter of the pipe is 4 inches. Therefore, the radius is 2 inches. Convert the 2 inches

$$\frac{2}{12} = 0.6667\text{ft}$$
$$A = \pi \times r^2$$
$$A = \pi \times (0.167\text{ft})^2$$

to feet. $A = \pi \times 0.028\text{ft}^2$

$$A = 0.09\text{ft}^2$$
$$Q = V \times A$$
$$Q = 1.5\text{ft/sec} \times 0.09\text{ft}^2$$
$$Q = 0.14\text{ft/3}\sec(\text{cfs})$$

22 Practice Problems - Unit Conversions

Convert the following:

i. Convert 1000ft^3 to cu. yards

ii. Convert 10 gallons /min to ft^3/hr

iii. Convert $100,000ft^3$ to acre-ft.

iv. Find the flow in gpm when the total flow for the day is $65,000$gpd.

v. Find the flow in gpm when the flow is 1.3cfs.

vi. Find the flow in gpm when the flow is 0.25cfs.

vii. The flow rate through a filter is 4.25 MGD. What is this flow rate expressed as gpm?

viii. After calibrating a chemical feed pump, you've determined that the maximum feed rate is 178 mL/ minute. If this pump ran continuously, how many gallons will it pump in a full day?

ix. A plant produces 2,000 cubic foot of water per hour. How many gallons of water is produced in an 8-hour shift?

23 Solution

i. Solution:

i. Solution:

$\frac{10 \text{ gallems}}{\text{min}} * \frac{\text{ft}^3}{7.48 \text{ gallens}} * \frac{60 \text{ min}}{\text{hr}} = \frac{80.2\text{ft}^3}{\text{hr}}$

i. Solution:

$100,000ft^3 * \frac{\text{acre} - ft}{43,560 ft^2 - ft} = 2.3acre - ft$

Note: From the conversion table: acre $= 43,560ft^2$

Thus, acre-ft $= 43,560ft^2 -$ ft or $43,560$ft^3

i. Solution:

$\frac{65,000\text{gpd}}{1,440 \text{ min/ day}} = 45\text{gpm}$

i. Solution:

$1.3\frac{\text{cfs}}{1} \times \frac{448\text{gpm}}{1\text{cfs}} = 582\text{gpm}$

i. Solution:

$0.25\frac{\text{cfs}}{1} \times \frac{448\text{gpm}}{1\text{cfs}} = 112\text{gpm}$

i. Solution:

Flowrate, gpm $= \frac{\text{Flow rate, } gpd}{1440 \text{ min/ day}}$

Note: We are assuming that the filter operated uniformly over that 24 hour period.

Flowrate, gpm $= \frac{4.25\frac{MG}{dax}*1,000,000\frac{\text{gal}}{MG}}{1440\frac{\text{min}}{day}} = 2,951\text{gpm}$

i. Solution:

$\frac{2000\text{ft}^5}{h\text{hr}} * \frac{7.48 \text{ gallons}}{\text{ft}^6} * \frac{60\text{hr}}{\text{shift}} = \frac{119,680 \text{ gallons}}{\text{shift}}$

24 Practice Problems - Concentration

i. What is the concentration in mg/l of 4.5% solution of that substance.

ii. How many lbs of salt is needed to make 5 gallons of a $2,500$mg/l solution

25 Solution

i. $45,000$mg/l

ii. Applying pounds formula: lbs salt $= \frac{5}{1,000,000} * 2,500 * 8.34 = 0.14$lbs

26 Practice Problems - Density and Specific Gravity

i. What is the specific gravity of a 1ft^3 concrete block which weighs 145lbs ?

ii. What is the specific gravity of a chlorine solution if 1 (one) gallon weighs 10.2lbs ?

iii. How much does each gallon of zinc orthophosphate weigh (pounds) if it has a specific gravity of 1.46 ?

iv. How much does a 55 gallon drum of 25% caustic soda weigh (pounds) if the specific gravity is 1.28 ?

27 Practice Problems - Detention Time

i. A flocculation basin is 7ft deep, 15ft wide, and 30ft long. If the flow through the basin is 1.35MGD, what is the detention time in minutes?

ii. A tank has a diameter of 60 feet with an overflow depth at 44 feet. The current water level is 16 feet. Water is flowing into the tank at a rate of 250 gallons per minute. At this rate, how many days will it take to fill the tank to the overflow?

iii. How long will it take to fill a 50 gallon hypochlorite tank if the flow is 5gpm ?

iv. Find the detention time in a 45,000 gallon reservoir if the flow rate is 85gpm.

v. If the fuel consumption to the boiler is 35 gallons per day. How many days will the 500 gallon tank last.

vi. The sedimentation basin on a water plant contains 5,775 gallons. What is the detention time if the flow is 175gpm.

28   Solution

i. Solution:

$$DT = \frac{(30 * 15 * 7)\text{ft}^3 * 7.48\frac{\text{gal}}{\text{ft}^3}}{1,350,000\frac{\text{gal}}{\text{day}} * \frac{\text{day}}{1440 \text{ min}}} = 25 \text{ min}$$

i. Solution:

$$\text{Fill time} = \frac{\text{Volume}}{\text{Flow}} = \frac{0.785 * 60^2 * (44 - 16)f^3 * \frac{7.48 \text{ gallons}}{ft^3}}{250\frac{\text{gallons}}{\text{min}} * \frac{1440 \text{ min}}{day}} = 1.6 \text{ days}$$

29   Solution:

4

i. Solution:

5

$$DT = \frac{50\text{gal}}{5\text{gal/min}} = 10 \text{ min}$$

i. Solution:

$$DT = \frac{45,000\text{gal}}{85\text{gal/min}} = 529 \text{ min} \quad \text{or} \quad \frac{529 \text{ min}}{60 \text{ min/hr}} = 8.8\text{hrs}$$

i. Solution:

$$DT = \frac{500 \text{ gal}}{35\text{gal/ day}} = 14.3 \text{ days}$$

i. Solution:

$$DT = \frac{5,775\text{gal}}{175\text{gal/min}} = 33 \text{ min}$$

30   Practice Problems - Pounds Formula

i. A water treatment plant operates at the rate of 75 gallons per minute. They dose soda ash at 14mg/L. How many pounds of soda ash will they use in a day?

31 Practice Problems - Temperature Conversion

i. Convert 22°C into degree Fahrenheit.
ii. Convert 56°C into degree Celsius.

32 Practice Problems - Pressure-Force Relationship

i. Find the force on a 12-inch valve if the water pressure within the line is 60 psi. Express your answer in tons.

Force = Pressure × Area

$$\implies 60\frac{\text{lbs}}{\text{in}^2} * 0.785 * (12\text{in})^2 * \frac{1 \text{ ton}}{2000\text{lbs}} = 3.39 \text{ tons}$$

i. A 42-inch main line has a shut off valve. The same line has a 10-inch bypass line with another shut-off valve. Find the amount of force on each valve if the water pressure in the line is 80 psi. Express your answer in tons.

Force = Pressure × Area

Calculating the force from the 42 " line on the shutoff valve:
$\implies 80\frac{\text{lbs}}{\text{in}^2} * 0.785 * (42\text{in})^2 * \frac{1 \text{ ton}}{2000\text{lbs}} = 55 \text{ tons}$
Calculating the force from the 10 " line on the shutoff valve:

$$\implies 80\frac{\text{lbs}}{\text{in}^2} * 0.785 * (10\text{in})^2 * \frac{1 \text{ ton}}{2000\text{lbs}} = 3.14 \text{ tons}$$

i. A water tank is 15 feet deep and 30 feet in diameter. What is the force exerted on a 6-inch valve at the bottom of the tank?

$$\text{Force} = \text{Pressure} \times \text{Area}$$
$$\implies 15\text{ft} * \frac{0.433\text{psi}}{\text{ft}} * 0.785 * (6\text{in})^2 = 183\text{lbs}$$

33 Practice Problems - Wells

i. A well is drilled through an unconfined aquifer. The top of the aquifer is 80 feet below grade. After the well was in service for a year, the water level in the well stabilized at 110 feet below grade. What is the drawdown? DRAWDOWN = INITIDC − PUMPING = 80ft − 110ft = 30feet
ii. A well produces 300gpm. If the drawdown is 30 feet, find the specific yield.

$$\text{Specific Yield } = \frac{\text{Yield}}{\text{Drawdown}} = \frac{300\text{gpm}}{30\text{ft}} = 10\text{gpm/ft}$$

i. The specific yield for a well is 10gpm/ft. If the well produces 550gpm, what is the drawdown?

$$\text{Specific Yield } = \frac{\text{Yield}}{\text{Drawdown}} \implies 10\text{gpm/ft} = \frac{550\text{gpm}}{\text{Drawdown}}$$
$$\implies \text{ Drawdown } = \frac{550}{10} = 55\text{ft}$$

i. The pumped water level of a well is 400 feet below the surface. The well produces 350 gpm. If the aquifer level is 250 feet below the surface, what is the specific yield for the well?

34   Practice Problems - Pumping Head

i. Convert 45 psi to feet of head
ii. How long (in minutes) will it take to pump down 25 feet of water in a 110ft diameter cylindrical tank when using a 1420 gpm pump
iii. How long will it take (hrs) to fi

11 a 2 ac-ft pond if the pumping rate is 400 GPM?

i. If the pressure at a water main is 50psi, what would the static pressure (psi) be at a faucet on the top floor of a four story building? (Assuming 10ft. per story)
ii. A water tower has water pressure of 98psi at its base. What would be. the pressure at a hydrant three blocks away if there is a 65 -foot head loss in the pipe? a. 45psi b. 65psi c. 70psi d. 98psi

35   Solution:

i. Solution:

$45psi * \frac{ft\ \text{head}}{0.433psi} = 92.4$ feet

i. Solution:

Time to pump down $= \frac{\text{Volume}}{\text{Flow}} = \frac{0.785*110^2*25ft^5}{1420\frac{\text{gatton}}{\text{min}}*\frac{ft^36}{7.48\ \text{gatton}}} = 190$ minutes

i. Solution:

Time to fill (hours) $= \frac{\text{Volume}}{\text{Flow}} = \frac{2\ \text{Ac-ft} *\frac{325,851\text{gallons}}{4c-ft}}{400\frac{\text{galtons}}{\text{min}}*\frac{60\ \text{g min}}{hr}} = 27$ hours

i. Solution:

$50\text{psi} - 4 * 10\text{ft} * \frac{0.433\text{psift head}}{=} 32.7\text{psi}$

36 Practice Problems - Pumping Power Requirements

i. If a pump is operating at $2,200$gpm and 60 feet of head, what is the water horsepower? If the pump efficiency is 71%, what is the brake horsepower?

ii. The water horsepower of a pump is 10Hp and the brake horsepower output of the motor is 15.4Hp. What is the efficiency of the pump?

iii. The water horsepower of a pump is 25Hp and the brake horsepower output of the motor is 48Hp. What is the efficiency of the pump?

iv. The efficiency of a well pump is determined to be 75%. The efficiency of the motor is estimated at 94%. What is the efficiency of the well?

v. If a motor is 85% efficient and the output of the motor is determined to be 10BHp, what is the electrical horsepower requirement of the motor?

vi. The water horsepower of a well with a submersible pump has been calculated at 8.2WHp. The Output of the electric motor is measured as 10.3BHp. What is the efficiency of the pump?

vii. Water is being pumped from a reservoir to a storage tank on a hill. The elevation difference between water levels is 1200 feet. Find the pump size required to fill the tank at a rate of 120gpm. Express your answer in horsepower.

viii. A 25hp pump is used to dewater a lake. If the pump runs for 8 hours a day for 7 days a week, how much will it cost to run the pump for one week? Assume energy costs $0.07 per kilowatt hour.

ix. A pump station is used to lift water 50 feet above the pump station to a storage tank. The pump rate is 500gpm. If the pump has an efficiency of 85% and the motor has an effi- ciency of 90%, find each of the following: Water Horsepower, Brake Horsepower, Motor Horsepower, and Wire-to-Water Efficiency.

x. Find the brake horsepower for a pump given the following information: Total Dynamic Head = 75 feet, Pump Rate = 150gpm, Pump Efficiency = 90%, Motor Efficiency = 85%

xi. Water is being pumped from a reservoir to a storage tank on a hill. The elevation difference between water levels is 1200 feet. Find the pump size required to fill the tank at a rate of 120gpm. Express your answer in horsepower.

37   Solutions:

i. Solution:

water Hp = flow * head

$2,200 GPM * 60 ft * \frac{Hp}{3,960 GPM-ft} =$ Water $Hp = 33.3 Hp$

pump Hp = brake Hp* pump efficiency

brake Hp $= \frac{33.3}{0.71} =$ Brake Hp = 47Hp

i. Solution:

i. Solution:

i. Solution:

Well efficiency $= \eta_m * \eta_p \implies 0.94 \times 0.75 = 0.705 \times 100 = 71\%$

i. Solution:

i. Solution:

i. Solution:

water Hp = flow * head

Water Hp = 120gpm $* 1,200 ft * \frac{Hp}{3,960 gpm-ft} = 37Hp$

i. Solution:

$25Hp \frac{0.746 \text{ kW}}{Hp} * \frac{8hrs}{day} * \frac{7 \text{ days}}{month} * \frac{\$0.07}{kWh} = \frac{\$73.1}{week}$

i. Solution:

water Hp = flow * head

Water Hp = 500gpm $* 50 ft * \frac{Hp}{3,960 gpm-ft} = 6.3WHp$

Pump efficiency $= \frac{\text{water Hp}}{\text{brake Hp}} \implies$ brake Hp $= \frac{\text{pump Hp}}{\text{Pump efficiency}}$

brake $Hp = \frac{6.3}{0.85} = 7.4Hp$

Motor efficiency $= \frac{\text{brake Hp}}{\text{input Hp}} \implies$ input   Hp $= \frac{\text{brake Hp}}{\text{motor efficiency}} =$ $\frac{7.4}{0.9} = 8.2Hp$

Wire $-$ to $-$ water efficiency $= \eta_m * \eta_p \implies 0.9 \times 0.85 \times 100 = 77\%$

i. Solution:

water Hp = flow * head

150GPM * 75ft * $\frac{Hp}{3,960GPM-ft}$ = Water $Hp = 2.8Hp$

$$\frac{\kappa pp}{sq1}Zt0 \cdot \mathrm{I} = \downarrow \varepsilon \cdot 8 * \frac{1}{8m}0\varsigma Z * GDW\varsigma = \frac{\kappa pp}{sq1}$$

33443

Example 2: Calculate the lbs of chemical in 7,500 gallons of 4.5% active solution of that chemical.

Solution

Applying lbs formula:

lbschemical = $\frac{7500}{1,000,000}MG * 4.5 * 10,000 * 8.34 = 2,815$ lbs chemical

38 Practice Problems - Blending and Dilution

i. Ferric chloride is being added as a coagulant to the raw water entering a plant. Sampling shows that the concentration of ferric in the raw water is 25ppm. A quick check of the chemical metering pump shows that it is operating at a flow rate of 4.3gpm. If the flow through the water plant is 800gpm, what is the concentration of raw chemical in the dosing tank ?

ii. A water plant is fed by two different wells. The first well produces water at a rate of 600 gpm and contains arsenic at 0.5mg/L. The second well produces water at a rate of 350 gpm and contains arsenic at 12.5mg/L. What is the arsenic concentration of the blended water?

iii. Liquid polymer is delivered as an 8 percent solution. How many gallons of liquid polymer should be mixed in a tank to produce 150 gallons of 0.6 percent solution?

iv. There are two raw water lines feeding a water plant. One line carries a flow rate of 500 gpm with a TDS concentration of 1500mg/L. The second line has a flow rate of 6mgd with a a 250mg/L TDS concentration. What is the actual combined TDS concentration entering the plant?

39 Solutions:

i. Solution:

$$\mathrm{FeCl_3} \quad \mathrm{V_{FeCl_3}} = 4.3\mathrm{gpm}$$
$$\mathrm{C_{FeCl_3}} = ?$$

Water-

$$V_2 = 4.3 + 800 = 804.3 \text{gpm}$$
$$C_1 * V_1 = C_2 * V_2$$
$$C_{\text{FeCl}_3} * V_{\text{FeCl}_3} = C_2 * (V_{\text{FeCl}_3} + V_{\text{Water}})$$
$$C_{\text{FeCl}_3} * 4.3 = 25 * (804.3)$$
$$C_{\text{FeCl}_3} = \frac{25 * (804.3)}{4.3} = 4,676 \text{ppm or } 0.47\%$$

i. Solution:

$$C_1 * V_1 + C_2 * V_2+ = C_3 * V_3 = C_3 * (V_1 + V_2)$$

$$\implies C_{\text{Blend}} = \frac{C_{\text{Well 1}} * V_{\text{Well 1}} + C_{\text{Well 2}} * V_{\text{Well 2}}}{V_{\text{Well 1}} + V_{\text{Well 2}}} = \frac{0.5 * 600 + 12.5 * 350}{600 + 350} = 4.9 \text{mg/l}$$

i. Solution:

i. Solution:

$$C_1 * V_1 + C_2 * V_2+ = C_3 * V_3 = C_3 * (V_1 + V_2)$$
$$C_{\text{Line 1} TDS} * V_{\text{Line 1}} + C_{\text{Line 2} TDS} * V_{\text{line 2}} = C_{\text{Blend TDS}} * V_{\text{Blend}} = C_{\text{Blend}} TDS * (V_{\text{Line 1}} + V_{\text{Line 2}})$$

$$\implies C_{\text{Blend}} TDS = \frac{C_{\text{Line 1} TDS} * V_{\text{Line 1 TDS}} + C_{\text{Line 2} TDS} * V_{\text{Line 2}}}{V_{\text{Line 1}} + V_{\text{Line 2}}}$$

$$\implies \frac{1500 * \left(\frac{500 \text{gal}}{\text{min}} * \frac{MG}{1,000,000 \text{gal}} * \frac{1440 \text{ min}}{day}\right) + 6 * 250}{\left(\frac{500 \text{gal}}{\text{min}} * \frac{MG}{1,000,000 \text{gal}} * \frac{1440 \text{ min}}{day}\right) + 6} = 384 \text{mg/l}$$

40 Practice Problems - Sedimentation

i. A circular clarifier has a diameter of 80ft. If the flow to the clarifier is 1800gpm, what is the surface overflow rate in gpm/ft

ii. A sedimentation basin 70ft by 25ft receives a flow of 1000gpm. What is the surface overflow rate in gpm/ft2?

iii. A circular clarifier receives a flow of 3.55MGD. If the diameter of the weir is 90ft, what is the weir loading rate in gpm/ft ?

41   Solution

i. Surface overflow rate $= \frac{\text{Flow, gpm}}{\text{Clarifier surface area, ft}^2} = \frac{1{,}800\text{gpm}}{(0.785*80^2)\text{ft}^2} = 0.36\text{gpm/ft}^2$

ii. Surface overflow rate $= \frac{\text{Flow, gpm}}{\text{Clarifier surface area, ft}^2} = \frac{1{,}000\text{gpm}}{(70\text{ft}*25\text{ft})^{\text{ft}^2}} = 0.6\text{gpm/ft}^2$

iii. Weir overflow rate $= \frac{\text{Flow, gpm}}{\text{Weir length } ft}$

$$\implies \frac{\frac{3.55\text{MG}}{\text{day}} * \frac{1{,}000{,}000\text{gal}}{\text{MG}} * \frac{\text{day}}{1440 \text{ min}}}{(3.14*90)\text{ft}} = 2{,}465\text{gpm/ft}$$

Note: The concentration and volume (or flow) units need to be the same. Thus, the gpm flow rate of Line 1 was converted to math the MGD flow rate unit of Line 2.

42   Practice Problems - Wells

i. A well yields 2,840 gallons in exactly 20 minutes. What is the well yield in gpm? a. 140gpm b. 142gpm c. 145gpm d. 150gpm

ii. A well is producing 1.25MGD. Its static water level was 35ft bgs, and its current pumping water level is 115ft bgs. What is the specific capacity of this well? a.   0.016gpm/ftb. 4.7gpm/ftc.   10.9gpm/ft d.   15.6gpm/ft e.   100gpm/ft

iii. Before pumping, the water level in a well is 15ft. down. During pumping, the water level is 45ft. down. The draw-down is: (a) 30ft. (b) 60ft. (c) 45ft. (d) 15ft.

iv. A well produces 365gpm with a drawdown of 22.5ft. What is the specific yield in gallons per minute per foot? a. 16.2 b. 22.5 c 32.4 d. 86.5

v. . A well is located in an aquifer with a water table elevation 20 feet below the ground surface. After operating for three hQ!Jrs, the water level in the well stabilizes at 50 feet below the ground surface. The pumping water level is: a. 20 feet b. 30 feet c. 50 feet d. 70 feet e. 100 feet

vi. Calculate drawdown, in feet, using the following data:

-The water level in a well is 20 feet below the ground surface when the pump is not in operation,

-The water level is 35 feet below the ground surface when the pump is in operation.

A. 15 feet B. 20 feet c. 35 feet D. 55 feet

i. Calculate the well yield in gpm, given a drawdown of 14.1ft and a specific yield of 31 gpm/ft. a. 2.2gpm b. 7.3gpm c. 45.1gpm ∴. d. 440gpm

ii. A well is producing 1.25MGD. Its static water level was 35ft and its current pumping water level is 115ft. What is the specific capacity of this well?

- a. 0.016gpm/ft b. 4.7gpm/ft C. 10.9gpm/ft d. 15.6gpm/ft e. 100gpm/ft

i. Determine the drawdown from a well measuring a static water level of 120 feet and a pumping water level of 205 feet? a. 105ft b. 320 feet c. 85 feet d. 310 feet

ii. Before pumping, the static water level in a well is 15 feet. During pumping, the water level drops to 45 feet. What is the drawdown? a. 15ft b. 30ft c. 45ft d. 60ft e. 90ft

iii. The specific capacity for a well is 10gpm-ft. If the well produces 550 gallons per minute, what is the drawdown?

iv. The distance between the ground surface to the water level in a well when the pump is not operating is 98ft. Distance from the ground surface to the water in the well when the pump is operating is 116 feet. Calculate the drawdown in the well under these conditions.

v. What is the specific capacity in gpm/feet a well that is pumping 495gpm and has a static level of 55 feet and a pumping level of 110 feet?

vi. During a test for well yield, a well produced 760 gallons per minute. The drawdown for the test is 22 feet What is the specific capacity in gallons per min-ft/?

vii. The pumped water level of a well is 400 feet below the surface. The well produces 250 gpm. If the aquifer level 50 feet below the surface, what is the specific capacity for the well

43 Practice Problems - Filtration

i. At an average flow of $4,000$gpm, how long of a filter run in hours would be required to produce 25MG of filtered water?

ii. A filter is 40ft long by 20ft wide. During a test of flow rate, the influent valve to the filter is closed for 6 minutes. The water level drop during this period is 16 inches. What is the filtration rate for the filter in gpm/ft^2 ?

iii. A water plant has three filters. Each filter is 12 feet wide by 12 feet long. Find the hydraulic loading rate in gpm/sf when all three filters are on-line and the raw water enters the plant at 9.5mgd.

iv. A sand filter will be backwashed at a rate of 8gpm/sf. If the filter is 10 feet wide by 15 feet long, what will the filter backwash rise rate be in inches per minute?

v. A series of filters must be backwashed. Each filter is 20 feet square. If the goal is to achieve a filter backwash rise rate of 30 inches per minute, what should the backwash rate be in gpm/sf ?

vi. A water plant has 3 filters. The plant is currently treating 5mgd. If each filter is 12 feet wide by 20 feet long, what is the minimum number of filters that should be placed into service to keep the hydraulic loading rate below 20gpm/sf ?

vii. Find the yield for a filter in lbs/hr/sf given the following information: Filter operates for 12 hours of each day and captures 95% of the influent solids. The solids load to the filter is 200 pounds per day. The filter is 40 feet square.

viii. Coagulated raw water contains 120mg/L of total suspended solids. The water plant produces 2.0mgd and has two sand filters that are 20 feet wide by 20 feet long. If the filters operate 22 hours of each day and capture 99% of the coagulated solids, what is the filter yield in lbs/hr/sf? What is the filter yield total in pounds per day?

ix. A series of filters discharge into a combined effluent trough. The trough is 5 feet wide by 80 feet long. A weir runs the full length of the trough. If the water plant capacity is 2mgd, what is the weir overflow rate in gpd/sf ?

44 Solution

i. Flow rate (gpm) $= \frac{\text{Total flow (gal)}}{\text{Filter run time (min)}}$

$\implies$ Filter run time (min) $= \frac{\text{Total flow (gal)}}{\text{Flow rate (gpm)}}$

$\implies$ Filter run time $(hr) = 25MG * \frac{1,000,000\text{gal}}{MG} * \frac{\text{min}}{4,000\text{gal}} * 60\frac{\text{hr}}{\text{min}} = 104\text{hrs}$

i. The volume of the water dropped after the inlet valve was closed would be the filter flow rate. Since the dimensions to calculate are in feet and inches, the volume needs to be converted from ft^3 to gallons

$$\text{Filtration rate, gpm/ft}^2 = \frac{\left(40\text{ft} * 20\text{ft} * 16\ \bar{h} * \frac{ft}{12i\hbar}\right)\text{ft}^3 * 7.48\frac{\text{gal}}{\text{ft}}}{40\text{ft} * 20\text{feet}} = 1.7\text{gpm/ft}^2$$