

1. Your license renews
 - a) before January 1
 - b) after July 30 in even numbered years
 - c) after October 1 in odd numbered years
 - d) before June 30 in even numbered years
2. A Class II water treatment operator needs hours of continuing education to renew her/his license.
 - a) 6
 - b) 12
 - c) 18
 - d) 24
3. In water treatment, a Class I system is determined to be different than a Class III system by
 - a) population served
 - b) number of service connections
 - *c) amount of water treated a day
 - d) amount of water in storage facilities
4. The primary duty of a water treatment operator is to
 - *a) protect the public health
 - b) perform assigned duties
 - c) obey the mayor or water board
 - d) get promoted as often as possible

1. 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
2. When underground water is under pressure greater than atmospheric pressure and could rise above the its confining space and above the ground level is referred to as a(n)
 - a. aquifer
 - b. anaerobic condition
 - c. *artesian effect
 - d. drawdown
 - e. pressure gradient
3. The gradual flow or movement of water into and through the pores of the soil is called
 - a. *percolation
 - b. run-off
 - c. precipitation
 - d. impermeable flow
 - e. evapotranspiration
4. Water rights which are acquired by diverting water and putting it to use in accordance with specified procedures is referred to as
 - a. artesian wells
 - b. potable water
 - c. *prescriptive water
 - d. safe yield water
 - e. palatable water
5. Water that has been used to carry solids away from a home or office into a treatment facility is referred to as
 - a. *wastewater or sewage
 - b. potable
 - c. seawater intrusion injection water
 - d. riparian water
6. The water right to put it to beneficial use of the surface water adjacent to your land is called water.
 - a. wastewater
 - b. *riparian
 - c. filter ripening
 - d. infiltration
 - e. run-off
7. The difference between static level and pumping level in a well is called:
 - a. *drawdown.

- b. cone of depression
 - c. zone of saturation
 - d. radius of influence
8. 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
9. 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
10. 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
11. 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
12. 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
13. 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
14. 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
15. 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
16. 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
17. An aquifer under pressure is often termed
- (a) Unconfined
 - (b) Pacific
 - (c) Artesian
 - (d) Alluvial
 - (e) Elevated
18. 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
19. 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
20. 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

21. 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
22. 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
23. 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
24. 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
25. 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%
26. 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
27. 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
28. 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
29. 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
30. 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
31. 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
32. Which source of water has the greatest natural protection from bacterial contamination?
- (a) Shallow well
 - (b) Deep well
 - (c) Surface water
 - (d) Spring
33. 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

34. 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
35. 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
36. 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
37. 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
38. The freezing point of water is
- (a) 0°F
 - (b) 32°C
 - (c) 32°F
 - (d) 0°C
 - (e) 100°F
39. 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
40. The movement of water on the surface of the earth is called
- (a) Percolation

- (b) Evaporation
 - (c) Evapotranspiration
 - (d) Runoff
 - (e) Infiltration
41. 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
42. 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
43. Water that is safe to drink is called _____ water.
- (a) Potable
 - (b) Palatable
 - (c) Good
 - (d) Clear
44. 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
45. What is the middle layer of a stratified lake called?
- (a) Thermocline
 - (b) Benthic Zone
 - (c) Epilimnion
 - (d) Hypolimnion
46. What is the conversion of liquid water to gaseous water known as?
- (a) Advection
 - (b) Condensation
 - (c) Precipitation
 - (d) Evaporation
47. Water weighs
- (a) 7.48lbs/gal
 - (b) 8.34lbs/gal
 - (c) 62.4lbs/ft³
 - (d) Both B. and C.

48. What is the static level of an unconfined aquifer also known as?
- (a) Drawdown
 - (b) Water Table
 - (c) Pumping Water Level
 - (d) Aquitard
49. A water bearing geologic formation that accumulates water due to its porousness
- (a) Aquifer
 - (b) Lake
 - (c) Aquiclude
 - (d) Well
50. What kind of stream flows continuously throughout the year?
- (a) Ephemeral
 - (b) Perennial
 - (c) Intermittent
 - (d) Stratified
51. The surface to atmosphere movement of water is known as
- (a) Precipitation
 - (b) Percolation
 - (c) Stratification
 - (d) Evapotranspiration
52. 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
53. What is the middle layer of a stratified lake known as?
- (a) Hypolimnion
 - (b) Benthic Zone
 - (c) Thermocline
 - (d) Epilimnion
54. The amount of water that can be pulled from a aquifer without depleting
- (a) Drawdown
 - (b) Safe yield
 - (c) Overdraft
 - (d) Subsidence
55. 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

56. A primary source of volatile organic chemical (VOC) contamination of water supplies is
- Agricultural pesticides
 - Industrial solvents
 - Acid rain
 - Agricultural fertilizers
57. The term "surface runoff" refers to
- Rainwater that soaks into the ground
 - Rain that returns to the atmosphere from the earth's surface
 - Surface water that overflows the banks of rivers
 - Water that flows into rivers after a rainfall
58. A disease that can be transferred by water is
- Gonorrhea
 - Malaria
 - Mumps
 - Typhoid
59. To prevent the entry of surface contamination into a well is the purpose of
- The well casing
 - The water table
 - The louvers or slots
 - Well development
 - The annular grout seal
60. Potable water may be defined as
- Water high in organic content
 - Any water that occasionally may be polluted from another source
 - Any water that, according to recognized standards, is safe for consumption
 - Water that indicates a septic condition
 - Water that has been transported from outside the service area
61. An operating well will drain the water from a volume of soil around the well during pumping. This volume is referred to as the
- Pumping water level
 - Radius of influence
 - Drawdown
 - Cone of depression
 - Recharge zone
62. A well screen must be installed in
- deep wells
 - consolidated materials
 - shallow wells
 - unconsolidated materials
63. A well is acidified in order to

- a. disinfect
 - b. increase yield
 - c. remove objectionable gases
 - d. remove disinfection by-products
64. 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
65. 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.
66. A well is acidized in order to
- a. Disinfect the water
 - b. Increase yield
 - c. Remove objectionable gasses
 - d. Remove disinfection by-products
67. 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
68. 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
69. 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
70. 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.
71. 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".
72. 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.
73. Movement of water through the ground is called:
- a) Hydraulic subsidence
 - b) Runoff
 - c. Percolation
 - d. Infiltration
74. 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
75. 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.
76. 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
77. 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
78. 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
79. The amount of water in a water-bearing formation depends on the
- a. Depth of the well
 - b. Size of the pump
 - c. Thickness and permeability of the formation
 - d. Type of well casing
80. An artesian aquifer could occur in a
- a. Confined aquifer
 - b. Unconfined aquifer
 - c. Water table aquifer a
 - d. Shale formation
81. A well screen must be installed for which of the following
- a. All deep wells
 - b. Only shallow wells
 - c. Consolidated materials d
 - d. Unconsolidated materials

1. Hard water contains an abundance of
 - a. sodium
 - b. iron
 - c. lead
 - d. *calcium carbonate
2. A specific class of bacteria that only inhabit the intestines of warm-blooded animals is referred to as?
 - a. Eutrophic
 - b. Grazing
 - c. Salmonella
 - d. *Fecal coliform
 - e. pathogenic
3. Water with a pH of 8.0 is considered to be
 - a. acidic
 - b. *basic or alkaline
 - c. neutral
 - d. undrinkable
4. Over which water quality indicator do operators have the greatest control?
 - a. alkalinity
 - b. pH
 - c. temperature
 - d. *turbidity
5. Which piece of laboratory equipment is used to titrate a chemical reagent?
 - a. graduated cylinder
 - b. *burette
 - c. pipet
 - d. Buchner funnel
6. Which pH range is generally accepted as most palatable (drinkable)?
 - a. *6.5 to 8.5
 - b. 4.5 to 6.5
 - c. 8.5 to 9.5
 - d. 9.5 and above
 - e. all of the above
7. Which of the following conditions is favorable for the rapid growth of algal?
 - a. *moderate to high dissolved oxygen and nutrients
 - b. high pH and water hardness
 - c. low temperatures and low dissolved oxygen
 - d. high alkalinity and water hardness
8. Which of the following is the name given for a turbidity meter that has reflected or scattered light off suspended particles as a measurement?

- a. HACH colorimeter
 - b. spectrophotometer
 - c. Wheaton bridge
 - d. *Nephelometer
9. Water hardness is the measure of the concentrations of and dissolved in the water sample.
- a. iron, manganese
 - b. nitrates, nitrites
 - c. sulfates, bicarbonates
 - d. *calcium & magnesium carbonates
 - e. ferric chlorides and polymers
10. The electrical potential required to transfer electrons from one compound or element to another is commonly referred to as
- a. *oxidation-reduction potential (ORP)
 - b. voltage potential (OHM/P)
 - c. resistance-impedance potential
 - d. microMho differential
11. Water has physical, chemical, and biological characteristics. Which of the following is a physical characteristic?
- a. Coliform
 - b. *Turbidity
 - c. Hardness
 - d. All the above
12. Tastes and odors in surface water are most often caused by:
- a. clays
 - b. hardness
 - c. *algae
 - d. coliform bacteria
13. Which of the following elements cause hardness in water?
- a. sodium and potassium
 - b. *calcium and magnesium
 - c. iron and manganese
 - d. turbidity and suspended solids
14. When measuring for free chlorine residual, which method is the quickest and simplest?
- *a. DPD color comparater
 - b. Orthotolidine method
 - c. Amperometric titration
 - d. 1, 2 nitrotoluene di-amine method
15. Which water quality parameter requires a grab sample because it cannot be collected as a composite sample?
- a. pH

- b. Iron
 - c. Nitrate
 - d. Zinc
16. If a water sample is not analyzed immediately for chlorine residual, it is acceptable if it is analyzed within
- a. 10 minutes.
 - *b. 15 minutes.
 - c. 20 minutes.
 - d. 30 minutes.
17. The volume of a sample for coliform compliance is
- *a. 100 mL.
 - b. 200 mL.
 - c. 300 mL.
 - d. 0 ; there is no volume compliance for coliforms.
18. Which of the following is an indicator organism?
- a. Giardia
 - b. Cryptosporidium
 - c. Hepatitis
 - *d. E. Coli
19. 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
20. What is the term for water samples collected at regular intervals and combined in equal volume with each other?
- a. Time grab samples
 - b. Time flow samples
 - c. Proportional time composite samples
21. 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
22. 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

23. The quantity of oxygen. that can remain dissolved in water is related to
- *a. Temperature
 - b. pH
 - c. Turbidity
 - d. Alkalinity
24. 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°C
 - *d. 24 and 48 hours at 35°C
25. A major source of error when obtaining water quality information is improper:
- *a. Sampling
 - b. Preservation
 - c. Tests of samples
 - d. Reporting of data
26. 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
27. The type of organisms that can cause disease are said to be microorganisms.
- a. Bad
 - *b. Pathogenic
 - c. Undesirable
 - d. Sick
28. 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
29. 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
30. 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
- 31. Turbidity is measured as:
 - a. mg/L
 - b. mL
 - c. gpm
 - d. NTU
- 32. Giardia and cryptosporidium are a type of:
 - a. Mineral
 - b. Organism
 - c. Color
 - d. Bird
- 33. Chronic contaminants are those that can cause sickness after:
 - a. Prolonged exposure
 - b. Low levels or low exposure
- 34. 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
- 35. 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
- 36. 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
- 37. Samples taken for routine bacteriological testing should be preserved by:
 - a. Freezing
 - b. Boiling
 - c. DPD preservative
 - d. Refrigeration
- 38. 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
39. 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
40. 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
41. 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
42. ___ is a measure of the capacity of water to neutralize acids.
- a. Concentration
 - b. Alkalinity
 - c. pH
 - d. Conductivity
43. The DPD method is used to determine the of a water sample.
- a. Dissolved oxygen content
 - b. Conductivity
 - c. pH
 - d. Free chlorine residual
44. What color does N,N-diethyl-p-phenylenediamine (DPD) turn in the presence of chlorine?
- a. Brown
 - b. Green
 - c. Blue
 - d. Pink
45. 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
46. 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
47. 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
48. What is the second step in the multiple tube fermentation test?
- a. Presumptive test
 - b. Negative test
 - c. Completed
 - d. Confirmed
49. What is the removal and deactivation requirement for Giardia?
- a. 2log
 - b. 3log
 - c. 4log
 - d. There is no requirement
50. The multiple barrier approach to water treatment includes removal through which method?
- a. Filtration
 - b. Coagulation
 - c. Disinfection
 - d. a and c
51. A pH reading of 7 is considered
- a. Slightly acidic
 - b. Acidic
 - c. Basic
 - d. Neutral
52. EDTA titration is used to determine the of a water sample.
- a. Hardness
 - b. Conductivity
 - c. Alkalinity
 - d. Free chlorine residual
53. 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
54. What is the ingredient used during the second multiple tube fermentation test?

- a. Colilert
 - b. MMO/MUG
 - c. Brilliant Green Bile
 - d. Chlorine
55. 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
56. Black stains on plumbing fixtures might be attributed to
- a. calcium.
 - b. copper.
 - c. magnesium.
 - d. manganese.
57. 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. presumptive, preliminary, and completed tests.
58. 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
59. pH is a measure of :
- a. conductivity
 - b. water's ability to neutralize acid
 - c. hydrogen ion activity
 - d. dissolved solids
60. Sodium Thiosulfate is used to
- a. Buffer chlorine solutions
 - b. Neutralize chlorine residuals
 - c. Detect chlorine leaks
 - d. Sterilize sample bottles
61. 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
- 62. A primary health risk associated with microorganisms in drinking water is
 - a. Cancer
 - b. Acute gastrointestinal diseases
 - c. Birth defects
 - d. Nervous system disorders
- 63. 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
- 64. Hardness in water is caused by
 - a. Dissolved minerals
 - b. High pH.
 - c. Low turbidity
 - d. Alkalinity
- 65. 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
- 66. 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
- 67. 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
- 68. 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
- 69. Trihalomethanes are classified as
 - a. Metals
 - b. Inorganic constituents
 - c. Secondary drinking water standards
 - d. Radiological contaminants
 - e. Volatile organic compounds
- 70. 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
- 71. 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
- 72. 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
- 73. 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
- 74. The standard indicator of potential fecal contamination of a water supply is
 - a. Cryptosporidium
 - b. pH
 - c. Alkalinity
 - d. Hardness
 - e. Coliform Presence - Absence
- 75. 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
76. 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
77. 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
78. 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
79. 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
80. 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
81. Cathodic protection refers to protection against
- a. contamination
 - b. corrosion

- c. hardness
 - d. alkalinity
82. An operator uses to test for residual chlorine
- a. DPD
 - b. Cresol red
 - c. Methyl orange
 - d. Sulfuric acid
83. 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
84. 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
85. Which of the following can cause tastes and odors in a water supply?
- a. Dissolved zinc
 - b. Algae
 - c. High pH
 - d. Low pH
86. 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
87. 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
88. Cathodic protection means protection against
- a. contamination
 - b. corrosion

- c. hardness
 - d. infiltration
89. 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
90. Under no circumstances should a composite sample be collected for which type of analysis?
- *a. Bacteriological
 - b. Total dissolved solids
 - c. Alkalinity
 - d. Turbidity
91. The number of monthly distribution system chlorine residual samples required is
- a. based on water withdrawal permit limit.
 - b. based on system size.
 - *c. based on population.
 - d. different for each state.
92. Which is (are) the ideal indicator for pathogens?
- a. Salmonella species
 - *b. Coliform group bacteria
 - c. Gram-negative cocci
 - d. Gram-negative coccobacilli
93. When one substance is dissolved in another and will not settle out, which is the product called?
- a. An emulsion
 - b. A compound
 - c. A suspension
 - *d. A solution
94. Acids, bases, and salts lacking carbon are
- a. ketones.
 - b. aldehydes.
 - c. organic compounds.
 - *d. inorganic compounds.
95. Which type of sample should always be collected for determining the presence of coliform bacteria?
- a. Time composite.
 - *b. Grab sample.
 - c. Proportional.

- d. Composite.
96. Samples to be tested for coliforms can be refrigerated for up to hours before analysis, but should be done as soon as possible.
- a. 4
 - b. 6
 - *c. 8
 - d. 12
97. When a water sample is acidified, the final pH of the water must be
- *a. <2.0.
 - b. < 2.5.
 - c. < 3.0.
 - d. < 3.5.
98. Which chemical is used to remove residual chlorine from water?
- *a. $\text{Na}_2 \text{S}_2\text{O}_3$
 - b. Na_2SiO_3
 - c. Na_2SiF_6
 - d. NaOCl
99. When a sample is collected, which causes its quality to begin to change?
- a. CO_2
 - b. Dissolved gases
 - *c. Biological activity
 - d. pH
100. Water that is to be analyzed for inorganic metals should be acidified with
- a. dilute hydrochloric acid.
 - b. concentrated hydrochloric acid.
 - c. dilute nitric acid.
 - *d. concentrated nitric acid.
101. A solution used to determine the concentration of another solution is called a
- a. saturated solution.
 - *b. standardized solution.
 - c. concentrated solution.
 - d. dilute solution.
102. Which method would you use to concentrate and retrieve low numbers of bacteria from a large quantity of water?
- a. Colilert
 - b. Colisure
 - *c. Membrane filtration
 - d. MPN (Most Probable Number)
103. A typical coliform colony in the membrane filter method has the following characteristics:
- a. Blue with lustrous surface sheen

- *b. Pink to dark red with green metallic surface sheen
 - c. Pink or yellow with lustrous to metallic surface sheen depending on species
 - d. Yellow with silver metallic to lustrous surface sheen
104. In the presumptive phase of the Most Probable Number test, how long does it take for the coliforms to produce gas?
- a. 12 to 24 hours
 - *b. 24 to 48 hours
 - c. 24 to 36 hours
 - d. 36 to 48 hours
105. Chemical analysis for synthetic organic compounds should not be collected in containers made of
- a. polytetrafluoroethylene.
 - b. stainless steel.
 - *c. polypropylene.
 - d. borosilicate.
106. How much acid per 100 mL should be used to preserve a sample for later hardness analyses?
- a. 0.1 mL
 - b. 0.2 mL
 - *c. 0.5 mL
 - d. 1.0 mL
107. Conductivity measurements can assist the laboratory analyst in
- a. measuring the electrical strength, which is directly proportional to the number of free electrons.
 - b. estimating the concentration of calcium carbonate.
 - c. evaluating variations in the concentration of suspended particles.
 - *d. determining the degree of mineralization of the water.
108. Water that is to be analyzed for inorganic metals should be filtered for before
- a. dissolved metals; analyses
 - b. suspended metals; analyses
 - *c. dissolved metals; preserving
 - d. suspended metals; preserving
109. In routine water quality sampling, which one of the following is an early warning sign that conditions are becoming more conducive to sulfate-reducing bacteria?
- a. Increase in ferrous iron
 - b. Increase in ferric iron
 - *c. Dramatic decline in dissolved oxygen
 - d. Increase in sulfides
110. pH, by definition is
- a) the ability of particles to stick together

- b) the ability to cause color to turn insoluble
 - c) causes a water molecule to bring in a third hydrogen atom
 - *d) the hydrogen ion concentration in water
111. One method of determining if your finished water has the likelihood to be corrosive is
- a) Van der Waals formula
 - b) Zeta potential
 - *c) Langeliers Saturation Index
 - d) Hydrological Cycles
112. The Langeliers Saturation Index provides an indication of
- a) the solubility of iron and manganese
 - b) the pH necessary to settle out color
 - c) the rate at which particles will settle
 - *d) the likelihood that your source water is corrosive
113. The most common operational complaint received by a water operator is
- a) water rates are too high
 - *b) taste and odor
 - c) your uniforms aren't stylish enough
 - d) improper treatment techniques
114. The two main substances that cause water hardness are
- a) benzene and cadmium
 - b) manganese and calcium
 - c) calcium and copper
 - *d) magnesium and calcium
115. Heterotrophic Plate Counts measure
- a) all pathogens in the sample
 - *b) all bacteria in the sample
 - c) all giardia lamblia in the sample
 - d) percent of sludge in the sample
116. Total Coliform samples have a hold time.
- a) 12 hour
 - b) 24 hour
 - *c) 30 hour
 - d) 36 hour
117. Extremely soft water can cause problems with pipes and fittings because it is
- *a) corrosive
 - b) scale forming
 - c) full of suspended solids
 - d) toxic
118. Which, surface water or groundwater, usually contain a higher level of pathogens?
- *a) surface water

- b) groundwater
 - c) both are equal
 - d) neither
119. High nitrate levels in the water can cause
- a) rickets
 - b) cholera
 - *c) blue baby syndrome
 - d) dysentery
120. Hard water can cause problems. Which of these is NOT a problem caused by hard water?
- a) scale formation in pipes
 - *b) toxic substances occurring because of corrosion
 - c) white scale on laundry fixtures, sinks, cooking utensil, etc.
 - d) buildup on water heater heating elements
121. Sources of taste and odor issues include
- *a) raw water
 - b) distribution systems
 - c) consumer plumbing
 - d) all of the above
122. Algae has a profound effect on our surface waters. During the day algae and at night it
- a) produces carbon dioxide, produces oxygen
 - b) secretes sludge, produces toxins
 - *c) produces oxygen, produces carbon dioxide
 - d) sleeps soundly, parties hardy
123. Which type of bottle should be used and how should it be cleaned for taste and odor sample
- a. Plastic cleaned with detergent and rinsed with de-ionized water
 - b. New glass bottles only
 - c. Glass bottle cleaned with detergent and rinsed with distilled water C
 - d. New glass or plastic bottles only rinsed with de-ionized water
124. Which of the following is a strong acid
- *a. pH=2
 - b. pH=4
 - c. pH=5
 - d. pH=13
125. Which is the correct order (on the average) from smallest to largest for the microorganisms below?
- a. Giardia cysts, bacteria, viruses
 - *b. Viruses, bacteria, Giardia cysts
 - c. Bacteria, Giardia cysts, viruses
 - d. Giardia cysts, viruses, bacteria

126. Which radioactive nuclide is a gas?
- a. Radium
 - b. Uranium
 - *c. Radon
 - d. Thorium
127. Which type of adverse effects does the secondary contaminant color have?
- *a. Unappealing appearance and indication that dissolved organics may be present
 - b. Added total dissolved solids and scale, indication of contamination, and tastes
 - c. Taste, scale, corrosion, and hardness
 - d. Undesirable taste and appearance
128. Precursors to the formation of trihalomethanes (THMs) would most likely come from which source?
- a. Domestic and commercial activities
 - b. Wastewater treatment plants and industrial waters
 - *c. Humic materials
 - d. Reactions that occur within the treatment plant
129. Which gas occurs mainly in groundwater, is heavier than air, and is odoriferous?
- *a. Hydrogen sulfide
 - b. Carbon dioxide
 - c. Radon
 - d. Methane
130. Which adverse effects does the secondary contaminant iron have?
- a. Unappealing to drink, undesirable taste, and possible indication of corrosion
 - *b. Discolored laundry brown and changed taste of water, coffee, tea, and other beverages
 - c. Undesirable metallic taste and possible indication of corrosion
 - d. Added total dissolved solids and scale, indication of sewage contamination, and tastes
131. Which piece of laboratory equipment is used to titrate a chemical reagent?
- a. graduated cylinder
 - *b. burette
 - c. pipet
 - d. Buchner funnel
132. Which of the following is the name given for a turbidity meter that has reflected or scattered light off suspended particles as a measurement?
- a. HACH colorimeter
 - b. spectrophotometer
 - c. Wheaton bridge
 - d. *Nephelometer
133. Hard water contains an abundance of
- a. sodium
 - b. iron

- c. lead
 - *d. calcium carbonate
134. Which species causes typhoid?
- *a. Salmonella
 - b. Shigella
 - c. Klebsiella
 - d. Pseudomonas
135. In humans, Salmonella will cause
- a. hemochromatosis.
 - b. cholera.
 - *c. gastroenteritis.
 - d. dysentery.
136. The freezing point of water is _____.
- a. 0°F
 - *b. 32°C
 - c. 32°F
 - d. 100°C
137. An unknown material 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
138. The electrical potential required to transfer electrons from one compound or element to another is commonly referred to as
- a. *oxidation-reduction potential (ORP)
 - b. voltage potential (OHM/P)
 - c. resistance-impedance potential
 - d. microMho differential
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 - c. pipet
 - d. Buchner funnel

141. What is the grain per gallon (gpg) hardness of water that has a total hardness of 228mg/L ?
- *a. 14
 - c. 18
 - e. 133.3
 - b. 3898.8
 - d. 39
142. Water hardness is the measure of the concentrations of and dissolved in the water sample.
- a. iron , manganese
 - b. nitrates, nitrites
 - c. sulfates, bicarbonates
 - d. *calcium & magnesium carbonates
 - e. ferric chlorides and polymers
143. A specific class of bacteria that only inhibit the intestines of warm-blooded animals is referred to as?
- a. Eutrophic
 - b. Pathogenic
 - c. Salmonella
 - d. *Fecal coliform
144. When sampling for bacteria in a distribution system, the bacteria sample bottle is prepared with which chemical inside the bottle before it is sterilized?
- a. copper sulfate
 - b. chlorine tablets
 - c. *sodium thiosulfate
 - d. hydrochloric acid
145. Hard water contains an abundance of
- a. sodium
 - b. iron
 - c. lead
 - d. *calcium carbonate
146. Microorganisms from smallest to largest are as follows:
- a. Viruses, protozoans, and bacteria
 - b. Bacteria, viruses, and protozoans
 - *c. Viruses, bacteria, and protozoans
 - d. Protozoans, bacteria, and viruses
147. What is the term for water samples collected at regular intervals and combined in equal volume with each other?
- a. Time grab samples
 - b. Time flow samples
 - *c. Proportional time composite samples

- d. Proportional flow composite samples
148. Which of the following conditions would increase turbidity?
- a. decrease in pH
 - b. increase in alkalinity
 - c. increase in phosphate concentration
 - *d. increase in organic matter
149. Water that is to be analyzed for inorganic metals should be acidified with
- a. dilute hydrochloric acid.
 - b. concentrated hydrochloric acid.
 - c. dilute nitric acid.
 - *d. concentrated nitric acid.
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152. A typical coliform colony in the membrane filter method has the following characteristics:
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 - d. Yellow with silver metallic to lustrous surface sheen
153. In the presumptive phase of the Most Probable Number test, how long does it take for the coliforms to produce gas?
- a. 12 to 24 hours
 - *b. 24 to 48 hours
 - c. 24 to 36 hours
 - d. 36 to 48 hours
154. Which gas is radioactive, occurs in many groundwater supplies, and is colorless and odorless?
- a. Neon
 - b. Argon
 - c. Boron
 - *d. Radon
155. How often should the Langelier Index of the raw and treated water be calculated?

- a. Every 8 hours
 - b. Every 12 hours
 - *c. Every day
 - d. Every week
156. Which type of hardness is considered permanent hardness?
- a. Carbonate hardness
 - *b. Noncarbonated hardness
 - c. Calcium hardness
 - d. Magnesium hardness
157. Which organisms are prokaryotes and release odorous compounds such as geosmin and 2-methylisoborneol?
- a. Methylomonas
 - b. Chlorobium
 - c. Clostridium
 - *d. Cyanobacteria
158. Which is the most common radionuclide in water?
- *a. Radium
 - b. Uranium
 - c. Radon
 - d. Thorium
159. The polarity of water causes the hydrogen part of one water molecule to be weakly bonded to the oxygen of another water molecule. This bonding is called
- a. ionic.
 - b. covalent.
 - c. van der Waals.
 - *d. hydrogen bonding.
160. The process whereby water moves with the air currents in the atmosphere is called
- a. transpiration.
 - b. evaporation.
 - c. interception.
 - *d. advection.
161. The most common forms of manganese found in nature are
- a. sulfides, inosilicates, and native metal.
 - b. sulfides and phosphates.
 - *c. oxides, carbonates, and hydroxides.
 - d. phyllosilicates, tectosilicates, and inosilicates.
162. Which has the USEPA chosen to suggest assaying water for as indicators for the inactivation of viruses?
- a. Total coliforms
 - b. Fecal coliforms

- c. E-coli
 - *d. Coliphages
163. When ingested Giardia cysts mature and multiply, which problem do they cause?
- *a. Interfere with nutrient absorption
 - b. Destroy the lining of the stomach
 - c. Secrete a toxin, which causes diarrhea
 - d. Kill millions of cells in the large intestine, which causes diarrhea
164. Consistency is maintained by providing certified laboratories with a known concentration of a contaminant. Who oversees the analytical results of the samples provided to the certified laboratories?
- *a. USEPA and state primacy programs
 - b. Primacy agency for each state
 - c. American Chemical Society
 - d. US Department of Public Health
165. Which type of adverse effect does the secondary contaminant zinc have?
- a. Unappealing taste and possible indication of contamination
 - b. Added total dissolved solids and stained laundry
 - c. A laxative effect and undesirable metallic taste
 - *d. Undesirable taste and a milky appearance
166. Which statement is true concerning dissolved oxygen?
- a. Dissolved oxygen will increase the absorption of carbon dioxide
 - b. High dissolved oxygen has adverse health effects
 - c. Most consumers do not prefer high levels of dissolved oxygen in the water
 - *d. Dissolved oxygen may oxidize iron and manganese
167. Zebra mussels multiply and spread so fast because
- a. the female produces over 250,000 eggs in a single season.
 - b. the larvae are free swimming for 2 or 3 months before attaching themselves.
 - *c. they commonly adhere to boats so they move around and disperse eggs.
 - d. they can live out of water for as long as 3 months.
168. Which is the unit of gamma radiation?
- a. Muon
 - b. Neutrino
 - c. X-ray
 - *d. Photon
169. Which of the following causes lung cancer?
- a. Uranium
 - b. Radium
 - *c. Radon
 - d. Thorium
170. Which genera of cyanobacteria primarily release neurotoxins?

- a. Nodularia
 - b. Microcystis
 - *c. Anabaena
 - d. Cylindrospermopsis
171. If artificial radionuclides are present in the environment, which element is most likely to be found?
- a. Potassium 20
 - b. Carbon 14
 - c. Argon 40
 - *d. Tritium
172. Beta radiation consists of $\alpha(n)$
- *a. electron.
 - b. neutron.
 - c. proton.
 - d. muon.
173. Which naturally occurring radionuclide is most prevalent in drinking water?
- a. Gamma
 - *b. Alpha
 - c. Beta
 - d. Muson
174. Enteric protozoans
- a. usually have four stages in their life cycles.
 - b. are easy to culture.
 - *c. have cysts that can penetrate filters.
 - d. can be found in very high densities in most lakes.
175. Which is the size range of *Cryptosporidium*?
- *a. 4 to $6\mu\text{m}$
 - b. 6 to $8\mu\text{m}$
 - c. 10 to $12\mu\text{m}$
 - d. 12 to $18\mu\text{m}$
176. Prolonged *Entamoeba histolytica* disease can cause amoebic abscesses which usually occur in the
- *a. liver.
 - b. urinary tract.
 - c. small intestine.
 - d. kidney.
177. The quantity of dissolved oxygen in water is a function of
- a. pH, alkalinity temperature and total dissolved solids
 - b. Temperature and alkalinity
 - c. pH and temperature

*d. Temperature, pressure and salinity

1. Primary drinking water standards are set to protect the public from illnesses as a direct result in drinking water that exceeds maximum set levels. Secondary standards were set to alert the public to
 - a. the incidences of local cancer numbers
 - b. dissolved solids in water
 - c. immediate health concerns
 - d. radiological conditions concerning drinking water
 - e. *aesthetic issues with drinking water
2. A positive fecal coliform test must be reported to the primacy agency within
 - a. 8 hours.
 - b. 12 hours.
 - c. 24 hours.
 - d. 48 hours.
3. Which agency sets legal limits on the concentration levels of harmful contaminants in potable water distributed to customers?
 - a. National Primary Drinking Water Regulations
 - b. United States Environmental Protection Agency
 - c. United States Public Health Service
 - d. Occupational Health and Safety Organization
4. Which may be substituted for the analysis of residual disinfectant concentration, when total coliforms are also sampled at the same sampling point?
 - a. Heterotrophic plate count (HPC)
 - b. Fecal coliforms
 - c. Giardia lamblia
 - d. Combined chlorine
5. What does the acronym MCL stand for?
 - a. Minimum contaminant level
 - b. Micron contaminant level
 - c. Maximum contaminant level
 - d. Milligrams counted last
6. How long do sanitary surveys have to be retained for records?
 - a. 3 years
 - b. 5 years
 - c. 7 years
 - d. 10 years
7. The most severe water system violation that requires the fastest public notification
 - a. Tier I
 - b. Tier II
 - c. Tier III
 - d. Tier IV
8. 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.
8. 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
9. Regulations based on the aesthetic quality of drinking water
- a. Primary Standards
 - b. Secondary Standards
 - c. Microbiological Standards
 - d. Radiological Standards
10. The lowest reportable limit for a water sample
- a. 0.5mg/l
 - b. Zero
 - c. Public health goal
 - d. Detection Level for reporting
11. Primary Standards are based on
- a. Color and Taste
 - b. Aesthetic quality
 - c. Public Health
 - d. Odor
12. A disease causing microorganism
- a. Pathogen
 - b. Colilert
 - c. Pathological
 - d. Turbidity
13. According to Surface Water Treatment Rule, what is the combined inactivation and removal for Giardia?
- a. 1.0log s
 - b. 2.0log s
 - c. 3.0log s
 - d. 4.0 Logs
14. 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%
- 15. 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
- 16. 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
- 17. 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
- 18. Records on turbidity analyses should be kept for a minimum of
 - a. 5 years
 - b. 7 years
 - c. 10 years
 - d. 25 years
- 19. Records on bacteriological analyses should be kept for a minimum of
 - a. 5 years
 - b. 7 years
 - c. 10 years
 - d. 25 years
- 20. Difference 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.
- 21. 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
22. 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 .
23. What US agency establishes drinking water standards?
- a. AWWA
 - b. USEPA
 - c. NIOSH
 - d. NSF
24. 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
25. According to the Lead and Copper Rule. the action for the 90th percentile lead level is:
- a. 0.005mg/l
 - b. 0.015mg/l
 - c. 0.030mg/l
 - d. 0.050mg/l
26. 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
27. 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
28. 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 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
29. 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
30. 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
31. Trihalomethanes are classified as:
- a. Metals
 - b. Inorganic constituents
 - c. Secondary drinking water standards
 - d. Radiological contaminants
 - e. Volatile organic compounds
32. 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
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 - c. Small and medium public water systems (serving > 25 and < 3,300 people)
 - d. All public water systems
34. 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
35. 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
36. The difference between Tier 1 and Tier 2 violations is
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- 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
38. All of the following diseases may be transmitted by contaminated water, except for:
- a. Cryptosporidiosis
 - b. Giardiasis
 - c. Cholera
 - d. Typhoid
 - e. Tuberculosis
39. 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
40. 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
41. 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

42. Final determination of vulnerability is made by
- Private contractor/consultants
 - The primacy agency
 - The water supplier
 - All of the above
43. The regulation that establishes standards for microbiological quality in drinking water is a.
- The Disinfection By-Product Rule
 - Secondary Drinking Water Standards
 - The Total Coliform Rule
 - The Lead and Copper Rule
 - Maximum Contaminant Level
44. Primary and secondary drinking water standards are normally established with a
- Maximum contaminant level
 - Minimum contaminant level
 - Public health goal
 - Maximum contaminant level goal
 - Minimum contaminant level goal
45. The presence of coliform bacteria in a distribution system
- Is positive proof that pathogenic organisms are present
 - Indicates that chlorine demand has increased dramatically
 - Indicates that pathogenic organisms may be present also
 - Requires the use of brilliant green bile as a secondary disinfectant
 - Has no particular significance
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 - The size of the water system
 - Previous maximum contaminant level (MCL) violations
 - All of the above

49. According to the Lead and Copper Rule, the action for the 90th percentile lead level is:
- a. 0.005mg/l
 - b. 0.015mg/l
 - c. 0.030mg/l
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 - b. Daily
 - c. Weekly.
 - d. Monthly
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 - 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
54. BARF is an acronym for
- a) Boil Advisory Reference Form
 - *b) Bacteriological Analysis Report Forms
 - c) Biological Activity Reactive Format
 - d) vomit
55. Which of these does NOT have a primary MCL?
- a) nitrate
 - b) fluoride
 - *c) manganese
 - d) copper
56. MCLG is an acronym for
- a) Most Common Lucky Guess

- b) Minimum Colloidal Level Goals
 - c) Maximum Chlorine Level Gallons
 - *d) Maximum Contaminant Level Goals
57. The LT2ESWTR has decreed that we test our source water for the presence of
- a) algae
 - b) pharmaceuticals
 - *c) cryptosporidium
 - d) nitrate
58. Combined filter effluent must be less than NTU in 95% of all measurements (collected every four hours) for each month.
- a) 1.0NTU
 - b) 2.0NTU
 - c) 3.0NTU
 - *d) 0.3NTU
59. If you get a positive coliform sample what must be done?
- a) retake the original sample
 - *b) retake the original sample plus one sample within five upstream service connections and one sample within five downstream service connections.
 - c) retake the original sample, one from the water plant, and one from any service connection close to the original sample site.
 - d) since no fecal coliform was detected, no more sampling needs to take place.
60. All systems in Kentucky must carry at least ppm chlorine residual everywhere in their system.
- *a) 0.2
 - b) 2.0
 - c) 4.0
 - d) there is no minimum
61. For a community water system, a sanitary survey is required to be conducted _____
- a. Every five years
 - b. Every two years
 - *c. Every three years
 - d. Every 10 years
62. Primary drinking water standards are set to protect the public from illnesses as a direct result in drinking water that exceeds maximum set levels. Secondary standards were set to alert the public to
- a. the incidences of local cancer numbers
 - b. dissolved solids in water
 - c. immediate health concerns
 - d. radiological conditions concerning drinking water
 - e. *aesthetic issues with drinking water

63. What is the reason for keeping adequate, reliable records in a treatment plant?
- *a. to record the plant's effectiveness and because of requirements by regulatory agencies
 - b. to maintain records for cold cases
 - c. in case the IRS wishes to check files for due diligence
 - d. because of homeland security issues and files being available to the public
64. Which of the following substances pose an immediate health threat whenever standards are exceeded?
- a. Benzene and mercury
 - *b. Coliform and nitrate
 - c. Mercury and coliform
 - d. Lead and nitrate

1. What is the purpose of coagulation and flocculation?
 - a. control corrosion
 - b. to kill disease causing organisms
 - c. to remove leaves, sticks, and fish debris
 - d. *to remove particulate impurities and suspended matter
2. How are filter production (capacity) rates measured?
 - a. Mgd/sq.ft.
 - b. *Gpm/sq.ft.
 - c. Gpm
 - d. Mgd
3. Why should a filter be drained if it is going to be out-of-service for a prolonged period?
 - a. to allow the media to dry out
 - b. to save water
 - c. to prevent the filter from floating on groundwater levels
 - d. *to avoid algal growth
4. Which of the following are commonly used coagulation chemicals?
 - a. hypochlorites and free chlorine
 - b. sodium and potassium chlorides
 - c. *alum and polymers
 - d. bleach and HTH
5. How can an operator tell if a filter is NOT completely cleaned after backwashing?
 - a. *the initial headloss is on the high side
 - b. the backwash rate was too slow
 - c. mudballs are NOT present
 - d. backwashing pumping rate is too low
6. Flocculation is defined as
 - a. *the gathering of fine particles after coagulation by gentle mixing
 - b. clumps of bacteria
 - c. the capacity of water to neutralize acids
 - d. a high molecular weight of compounds that have negative charges
7. A multi-barrier water filtration plant that contains a flash mix, a coagulation/flocculation zone, sedimentation, filtration and a clear well is considered to be a
 - a. community special treatment plant
 - b. direct filtration plant
 - c. reverse osmosis plant
 - d. *conventional filtration plant
 - e. traditional plant
8. The filtration unit process usually
 - a. is located at the beginning of a filtration plant
 - b. *follows the coagulation/flocculation/sedimentation processes

- c. is located after the clear well area
 - d. is located on the plant effluent line after the clearwell
9. Filters are generally backwashed when the loss-of-head indicator registers a certain set value, such as 6-ft, or upon a certain time, say 48-hours, or upon a rise in
- a. alkalinity
 - b. a jar-test result
 - c. *turbidity
 - d. temperature
10. What is a method of reducing hardness?
- a. *Softening
 - b. Hardening
 - c. Lightning
 - d. Flashing
11. The solid that adsorbs a contaminant is called the:
- a. *Adsorbent
 - b. Adsorbate
 - c. Sorbet
 - d. Rock
12. The adsorption process is used to remove:
- a. *Organics or inorganics
 - b. Bugs or salts
 - c. Organisms or dirt
 - d. Color or particles
13. Describe two primary methods used to control taste and odor?
- a. *Oxidation and adsorption
 - b. Filtration and sedimentation
 - c. Mixing and coagulation
 - d. Sedimentation and clarification
14. What is the recommended loading rate for copper sulfate for algae control at an alkalinity greater than 50mg/L ?
- a. 0.9lb of copper sulfate per acre of surface area
 - b. 1.9lb of copper sulfate per acre of surface area
 - c. 2-4 lb of copper sulfate per acre of surface area
 - d. .4lb of copper sulfate per acre of surface area
15. The basic goal for water treatment is to
- a. Protect public health
 - b. Make it clear
 - c. Make it taste good
 - d. Get stuff out
16. Greensand can be operated in either regeneration or regeneration modes.

- a. Continuous or intermittent
 - b. Fast or slow
 - c. Hot or cold
 - d. Constant or unusual
17. 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
18. GAC contactors are used to reduce the amount of contaminants in water.
- a. Inorganic
 - b. Turbidity
 - c. Particle
 - d. Organic
19. List the five types of surface water filtration systems.
- a. Bag filtration, cartridge filtration, fine filtration, coarse filtration, media filtration
 - b. Conventional treatment, direct filtration, slow sand filtration, diatomaceous earth filtration, membrane filtration
 - c. Turbidity filtration, color filtration, bag filtration, fine filtration, media filtration
 - d. None of the above
20. Describe two primary methods used to control taste and odor?
- a. Oxidation and adsorption
 - b. Filtration and sedimentation
 - c. Mixing and coagulation
 - d. Sedimentation and clarification
21. The adsorption process is used to remove:
- a. Organics or inorganics
 - b. Bugs or salts
 - c. Organisms or dirt
 - d. Color or particles
22. The solid that adsorbs a contaminant is called the:
- a. Adsorbent
 - b. Adsorbate
 - c. Sorbet
 - d. Rock
23. What is a method of reducing hardness?
- a. Softening
 - b. Hardening
 - c. Lightning
 - d. Flashing

24. Bag and cartridge filters are used to remove which two pathogenic microorganisms?
- Viruses and giardia
 - Giardia and cryptosporidium
 - Viruses and bacteria
 - None of the above
25. The process of cleaning a filter by pumping water up through the filter media is called the filter.
- Backwashing
 - Rewashing
 - Purging
 - Lifting
26. In a typical water treatment plant, alum would be added into the mixer.
- Speed
 - Large
 - Slow
 - Flash
27. When comparing conventional treatment with direct filtration, what process unit is in the conventional treatment plant that is not in the direct filtration plant?
- Filter
 - Clarifier
 - Mixer
 - Detention
28. List the basic processes, in the proper order, for a conventional treatment plant.
- Coagulation, flocculation, sedimentation, filtration
 - Flocculation, coagulation, sedimentation, filtration
 - Filtration, coagulation, flocculation, sedimentation
 - Coagulation, sedimentation, flocculation, filtration
31. The four most common oxidants include:
- Chlorine, potassium permanganate, ozone, chlorine dioxide
 - Chlorides, soap, air, coagulants
 - Air, chemicals, sodium, chloride
 - Flocculants, coagulants, sediments, granules
29. 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.
- Different
 - Differential
 - High
 - Low
30. What type of polymer is used to improve the efficiency of the sedimentation process?

- a. Cationic
 - b. Nonionic
 - c. Anionic
 - d. All of the above
31. A(n)_ polymer is commonly used as a coagulant.
- a. Anionic
 - b. Cationic
 - c. Nonionic
 - d. Ionic
32. A(n)... polymer is used to enhance flocculation.
- a. Anionic
 - b. Cationic
 - c. Nonionic
 - d. Ionic
33. $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ is the chemical formula for:
- a. Alum
 - b. Iron
 - c. Manganese
 - d. Lead
34. Particles that are less than $1\mu\text{m}$ in size and will not settle easily and are called:
- a. Light particles
 - b. Colloidal particles
 - c. Colored particles
 - d. Flat particles
35. The sedimentation portion of water treatment is also called a(n):
- a. Clarifier
 - b. Filter
 - c. Adsorber
 - d. Water treater
36. Slowly agitating coagulated materials is the process of:
- a. Flocculation
 - b. Coagulation
 - c. Sedimentation
 - d. Filtration
37. The process of decreasing the stability of colloids in water is called:
- a. Flocculation
 - b. Coagulation
 - c. Sedimentation
 - d. Clarification
38. The chemical oxidation process in water treatment is typically used to aid in the removal

of :

- a. Organic contaminants
 - b. Inorganic contaminants
 - c. Large contaminants
 - d. None of the above
39. Flocculation, sedimentation, filtration, and adsorption are processes.
- a. Physical
 - b. Chemical
 - c. Biological
 - d. Mechanical
40. Oxidation, coagulation, and disinfection are
- a. Physical
 - b. Chemical
 - c. Biological
 - d. Mechanical
41. A precipitate can be formed after which one of the following processes:
- a. Oxidation
 - b. Flocculation
 - c. Filtration
 - d. Adsorption
42. Water that is safe to drink is called water.
- a. Potable
 - b. Palatable
 - c. Good
 - d. Clear
43. The type of organisms that can cause disease are said to be microorganisms.
- a. Bad
 - b. Pathogenic
 - c. Undesirable
 - d. Sick
44. The basic goal for water treatment is to
- a. Protect public health
 - b. Make it clear
 - c. Make it taste good
 - d. Get stuff out
45. Four types of aesthetic contaminants in water include the following:
- a. Odor, turbidity, color, hydrogen sulfide gas
 - b. Pathogens, microorganisms, arsenic, disinfection by-products
46. What does mg/L stand for?
- a. Microorganisms/Liter

- b. Milligrams/Loser
 - c. Milligrams/Liter
 - d. None of the above
47. Disinfection by-products are a product of:
- a. Filtration
 - b. Disinfection
 - c. Sedimentation
 - d. Adsorption
48. Acute contaminants are those that can cause sickness after:
- a. Prolonged exposure
 - b. Low levels or low exposure
49. Chronic contaminants are those that can cause sickness after:
- a. Prolonged exposure
 - b. Low levels or low exposure
50. TTHMs and HAA5s can affect:
- a. Health
 - b. Aesthetics
 - c. Color
 - d. Odor
51. Oxidation, coagulation, and disinfection are processes.
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- a. Mineral
 - b. Organism
 - c. Color
 - d. Bird
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- d. Water treater

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- a. Light particles
- b. Colloidal particles
- c. Colored particles
- d. Flat particles

60. One micrometer is also equal to:

- a. 0.1 mm
- b. 0.0001 mm
- c. 0.001 mm
- d. 1 m

61. Particles less than $0.45\mu\text{m}$ in size are considered to be:

- a. Dissolved
- b. Really little
- c. Colored particles
- d. Flat particles

62. Turbidity is measured as:

- a. Mg/L
- b. mL
- c. gpm
- d. NTU

63. $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ is the chemical formula for:
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 - Lead
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 - Cationic
 - Nonionic
 - Ionic
65. A(n)_polymer is used to enhance flocculation.
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 - Cationic
 - Nonionic
 - Ionic
66. The concentration of a chemical added to the water is measured in:
- mL
 - mg
 - mg/L
 - Liters
67. The quantity of chlorine remaining after primary disinfection is called a residual.
- Chlorine
 - Permanganate
 - Hot
 - Cold
68. Primary disinfectants are used to microorganisms.
- Hurt
 - Inactivate
 - Burn up
 - Evaporate
69. Secondary disinfectants are used to provide a in the distribution system.
- Color
 - Chemical
 - Smell
 - Residual
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 - Lifting
77. Bag and cartridge filters are used to remove which two pathogenic microorganisms?
- Viruses and giardia
 - Giardia and cryptosporidium
 - Viruses and bacteria
 - None of the above
78. List the four types of membrane filtration processes commonly used in water treatment.
- MF, UF, NF, and RO

- b. MNF, UOF, NOF, and ROO
 - c. CFM, FM, FN, and OR
 - d. None of the above
79. What is a method of reducing hardness?
- a. Softening
 - b. Hardening
 - c. Lightning
 - d. Flashing
80. Adsorption of a substance involves its accumulation onto the surface of a:
- a. Solid
 - b. Rock
 - c. Pellet
 - d. Snow ball
81. The solid that adsorbs a contaminant is called the:
- a. Adsorbent
 - b. Adsorbate
 - c. Sorbet
 - d. Rock
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84. List the five types of surface water filtration systems.
- a. Bag filtration, cartridge filtration, fine filtration, coarse filtration, media filtration
 - b. Conventional treatment, direct filtration, slow sand filtration, diatomaceous earth filtration, membrane filtration
 - c. Turbidity filtration, color filtration, bag filtration, fine filtration, media filtration
 - d. None of the above
85. GAC contactors are used to reduce the amount of contaminants in water.
- a. Inorganic
 - b. Turbidity
 - c. Particle
 - d. Organic
86. Greensand can be operated in either regeneration or regeneration modes.

- a. Continuous or intermittent
 - b. Fast or slow
 - c. Hot or cold
 - d. Constant or unusual
87. What is the cause of taste and odor problems in raw surface water?
- a. Copper sulfate
 - b. Blue-green algae
 - c. Oxygen
 - d. Lake turnover
88. What chemical reduces blue-green algae growth?
- a. Chlorine
 - b. Caustic Soda
 - c. Copper Sulfate
 - d. Alum
89. 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
90. The optimal coagulant dose is determined by a
- a. Chlorine Test
 - b. Flocculation test
 - c. Jar Test
 - d. Coagulation test
91. The most common primary coagulant is
- a. Alum
 - b. Cationic polymer
 - c. Fluoride
 - d. Anionic polymer
92. Bacteria and Viruses belong to a particle size known as
- a. Suspended
 - b. Dissolved
 - c. Strained
 - d. Colloidal
93. The purpose of coagulation is to
- a. Increase filter run times
 - b. Increase sludge
 - c. Increase particle size
 - d. Destabilize colloidal particles
94. The purpose of flocculation

- a. Destabilize colloidal particles
 - b. Increase particle size
 - c. Decrease sludge
 - d. Decrease filter run times
95. Primary coagulant aids used in treatment process are
- a. Poly-aluminum chloride
 - b. Aluminum sulfate
 - c. Ferric chloride
 - d. All of the Above
96. How do water agencies monitor the effectiveness of their filtration process?
- a. Alkalinity
 - b. Conductivity
 - c. Turbidity
 - d. pH
97. Flocculation is used to enhance
- a. Number of particle collisions to increase floc
 - b. Charge neutralization
 - c. Dispersion of chemicals in water
 - d. Settling speed of floc
98. If there is a problem with floc formation, what would you consider changing?
- a. Adjust coagulant dose
 - b. Stay the course
 - c. Adjust mixing intensity
 - d. Both A&C
99. Which step in the treatment process is the shortest?
- a. Filtration
 - b. Sedimentation
 - c. Flocculation
 - d. Coagulation
100. To lower the pH for enhanced coagulation the operator will add
- a. Chlorine
 - b. Sulfuric acid
 - c. Lime
 - d. Caustic Soda
101. The flocculation process lasts how long?
- a. Seconds
 - b. 5-10 minutes
 - c. 15-45 minutes
 - d. Over an hour
102. The function of a flocculation basin is to

- a. Settle colloidal particles
 - b. Destabilize colloidal particles
 - c. Mix chemicals
 - d. Allow suspended particles to grow
103. The treatment process that involves coagulation, flocculation, sedimentation, and filtration is known as
- a. Direct filtration
 - b. Slow sand Filtration
 - c. Conventional treatment
 - d. Pressure filtration
104. Sedimentation produces waste known as
- a. Backwash water
 - b. Sludge
 - c. Waste water
 - d. Mud
105. What kind of process is the sedimentation step?
- a. Physical
 - b. Chemical
 - c. Biological
 - d. Direct
106. The weirs at the effluent of a sedimentation basin are also called
- a. Effluent weirs
 - b. Baffling
 - c. Launderers
 - d. Spokes
107. Sedimentation is used in water treatment plants to
- a. Settle pathogenic material
 - b. Destabilize particles
 - c. Disinfect water
 - d. Reduce loading on Filters
108. Scouring is a term that describes conditions in a sedimentation tank which
- a. Could impact the rest of treatment process
 - b. Higher flow rates in the sludge zone
 - c. Re-suspends settle sludge
 - d. All of the above
109. The four zones in a Sedimentation basin include
- a. Inlet, sedimentation, sludge, outlet
 - b. Inlet, filter, waste, outlet
 - c. Inlet, top, bottom, outlet
 - d. Surface, sedimentation, sludge, outlet

110. The removal and inactivation requirement for Giardia is?
- a. 99.9%
 - b. 99.99%
 - c. 99.00%
 - d. 90%
111. Short circuiting in a sedimentation basin could be caused by
- a. Surface wind
 - b. Ineffective weir placement, or weirs covered in algae
 - c. Poor baffling in sedimentation inlet zone
 - d. All of the Above
112. How much solids should be removed during sedimentation?
- a. 95% or more
 - b. 80 – 95%
 - c. 70 – 80%
 - d. 60 – 70%
113. The type of basin that includes coagulation and flocculation is
- a. Rectangular
 - b. Triangular
 - c. Up-Flow
 - d. None of the above
114. Recarbonation basins are used to stabilize water after
- a. Filtration
 - b. Disinfection
 - c. Softening
 - d. Coagulation
115. Which of the following is an effective way for removing iron water?
- a. adding baffles
 - b. adding sodium chloride
 - c. aeration and filtration
 - d. flash mixing
116. How can iron bacteria be controlled in a water distribution system?
- a. by aeration
 - b. filtration
 - c. chlorination
 - d. precipitation
117. Which of the following is a hazard when handling hydrofluosilicic acid?
- a. fire
 - b. explosion
 - c. corrosion
 - d. inhalation
118. Trihalomethane may be partially removed from water by:

- a. fluoridation
 - b. chlorination
 - c. oxidation
 - d. ultraviolet radiation
119. Which of the following forms of iron is most soluble in water?
- a. Ferric (Fe^{+3})
 - b. Ferric hydroxide [$\text{Fe}(\text{OH}_3)$]
 - c) Ferrous (Fe^{+2})
 - d. Ferrous oxide (FeO)
120. 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
121. A zeolite softening unit will replace calcium and magnesium ions with ions.
- a. Fluoride
 - b. Iron
 - c. Sodium
 - d. Sulfur
122. One use of polyphosphates is to:
- a. Control algae
 - b. Improve taste
 - c. Sequester iron and manganese
 - d. Kill bacteria
124. 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
123. Which of the following chemicals will most likely keep iron in suspension?
- a. Chlorine
 - b. Fluoride
 - c. Polyphosphate
 - d. Lime inhibitor
124. 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

125. 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
- Coagulation
 - Sedimentation
 - Filtration
 - Disinfection
126. The problem caused by dissolved carbon dioxide in the water of the distribution system is
- increased Trihalomethanes
 - Corrosion
 - Excessive encrustation
 - Tastes and odors
127. The presence of the coliform group of bacteria in water indicates
- Contamination
 - Inadequate disinfection
 - Improper sampling
 - Taste and odor problems
128. The granular filtration process is designed to reduce
- Calcium and magnesium sulfates
 - True color
 - Total dissolved solids
 - Turbidity
129. The presence of the coliform group of bacteria in water indicates
- Contamination
 - Inadequate disinfection
 - Improper sampling
 - Taste and odor problems
130. Aeration in water treatment plants is used to
- Lower the pH
 - Reduce concentrations of dissolved gasses
 - Reduce turbidity
 - Stabilize chlorine residuals
131. What can the operator do if iron fouling appears to be a problem in an ion exchange softener?
- Decrease the strength of the brine used in the regeneration stage
 - Increase backwash flow rates
 - Increase duration of backwash stage
 - Increase duration of service stage
132. At what pH would a chlorinated water have the highest concentration of hypochlorous acid?

- a. 5
 - b. 7
 - c. 9
 - d. 11
133. One use of polyphosphates is to
- a. Control algae
 - b. Improve taste
 - c. Sequester iron and manganese
 - d. Kill bacteria
134. 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
135. 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
136. 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
137. A zeolite softening unit will replace calcium and magnesium ions with ions.
- a. Fluoride
 - b. Iron
 - c. Sodium
 - d. Sulfur
138. 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
139. A method used to soften water is
- a. Aeration
 - b. Sedimentation
 - c. Ion exchange
 - d. Adsorption

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- Decrease the strength of the brine used in the regeneration stage
 - Increase backwash flow rates
 - Increase duration of backwash stage
 - Increase duration of service stage
147. Trihalomethane may be partially removed from water by:
- fluoridation

- b. chlorination
 - c. oxidation
 - d. ultraviolet radiation
148. Temporary cloudiness in a freshly drawn sample of tap water may be caused by:
- a. air
 - b. chlorine
 - c. hardness
 - d. silica
149. 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
150. A zeolite softening unit will replace calcium and magnesium ions with ions.
- a. Fluoride
 - b. Iron
 - c. Sodium
 - d. Sulfur
151. What happens when lime is fed to water for corrosion control? a. Alkalinity is decreased
- b. CO_2 does not change
 - c. Turbidity is decreased
 - d. pH is increased
152. Which two chemicals are used to remove turbidity?
- a. Soda Ash and lime
 - b. Copper sulphate and caustic soda
 - c. Alum and lime
153. Which of the following is considered to be a coagulant aid?
- a. Lime
 - b. Polymer
 - c. Bentonite
 - d. All of the above
154. Alum precipitates as
- a. Aluminum carbonate
 - b. Aluminum sulphate
 - c. Aluminum hydroxide
155. Turbidity removal with alum is best accomplished at what pH ?
- a. 3.5
 - b. 5.0
 - c. 6.5

156. Which of the following will not lower the pH ?
- Alum
 - Carbonic acid
 - Ferric chloride
 - Sodium carbonate
157. Liquid fluoride is delivered as:
- Sodium Fluoride
 - Hydrofluorosilicic acid
 - Sodium Silicofluoride
 - Hydrofluoric acid
158. An upflow clarifier will have which of the following processes?
- Coagulation
 - Flocculation
 - Sedimentation
 - All of the above
159. Sludge that rises to the surface of a sedimentation basin is caused by:
- Not removing sludge often enough
 - Removing sludge too often
 - pH is too low
 - Surface loading rate is too low
160. Pin floc leaving a sedimentation basin may indicate a problem with:
- Coagulation
 - Flocculation
 - Sedimentation
 - Disinfection
161. What is the backwash rate for a rapid sand filter?
- 2 gpm/sq.ft.
 - 15gpm/sq.ft.
 - 20gpm/sq.ft.
 - 25gpm/sq.ft.
162. What is the maximum run time for a gravity filter?
- 8 hours
 - 20 hours
 - 48 hours
 - 100 hours
163. During backwash, the filter bed should expand:
- 5 – 10%
 - 15 – 20%
 - 30 – 50%
 - 60 – 80%

164. If the backwash time is too short, what may result?
- a. Too much freeboard
 - b. Mudballs
 - c. Loss of filter media
 - d. Filter breakthrough
165. If the filtration rate is too high, what may result?
- a. Filter breakthrough
 - b. Mudballs
 - c. Reduction in operating costs
 - d. Lower headloss
166. Solids removed from a filter are most commonly removed by what method?
- a. Adsorption
 - b. Straining
 - c. Deactivation
 - d. Flocculation
167. What is a typical filtration rate for slow sand filters?
- a. 2.0-6.0 GPM/sq. ft.
 - b. 6.0-10.0 GPM/sq. ft.
 - c. 1.0 – 2.0GPM/sq. ft.
 - *d. 0.5 – 0.10GPM/sq. ft.
168. In a typical conventional treatment plant, the finished water turbidity for an individual filter should be less than
- a. 1.0 NTUs
 - *b. 0.3 NTUs
 - c. 5.0NTUs
 - d. 3.0 NTUs
169. A filter running under normal conditions will see head loss in a filter
- a. Remain constant
 - b. Increase slowly
 - c. Rapidly increase
 - d. Decrease slowly
170. A filter must be washed if this condition is met
- a. Head Loss
 - b. Turbidity break through
 - c. Maximum Filter run time
 - d. All of the Above
171. Filter performance is measured by the removal of
- a. Oxygen
 - b. Head loss
 - c. Turbidity

- d. Chlorine
- 172. What is the biologically active layer of a slow sand filter called?
 - a. Mixed Media
 - b. Dual Media
 - c. Sludge Layer
 - d. Schmutzdecke
- 173. The pressure drop in a filter is called
 - a. Turbidity breakthrough
 - b. Head Loss
 - c. Filtration
 - d. Backwash
- 174. What is the most common reason for putting a filter into the wash cycle?
 - a. Head loss
 - b. Filter run time
 - c. Turbidity breakthrough
 - d. Water level decrease
- 175. Formation of mud balls and excessive boiling during a wash is an indicator of
 - a. Proper backwash rate
 - b. Too low backwash rate
 - c. Excessive backwash rate
 - d. Improper chemical dose
- 176. Important processes which occur during filtration are
 - a. Sedimentation
 - b. Adsorption
 - c. Straining
 - d. All of the Above
- 177. Typical filtration rates for a conventional treatment plant are
 - a. 0.2-0.6 GPM/sq.ft.
 - b. 2.0-10.0 GPM/sq.ft.
 - c. 10.0-20.0 GPM/sq.ft.
 - d. 200-400 GPM/sq.ft.
- 178. Detention time in flocculation basins are usually designed to provide for
 - a. 5 to 15 minutes.
 - *b. 15 to 45 minutes.
 - c. 45 to 60 minutes.
 - d. 60 to 90 minutes.
- 179. Alum works best in a pH range of
 - a. less than 4.0.
 - b. 4.0 to 5.5 .
 - *c. 5.8 to 8.5 .

- d. Greater than 9.0.
- 180. Which statement is true concerning colloidal particles?
 - *a. Colloidal particles are so small that gravity has little effect on them
 - b. The zeta potential between colloidal particles is balanced by covalent bonding
 - c. Electrical phenomenon of colloidal particles predominate and control their behavior
 - d. The surface area of colloidal particles is very small compared to their mass
- 181. Which natural electrical force keeps colloidal particles apart in water treatment?
 - a. van der Waals forces
 - b. Ionic forces
 - *c. Zeta potential
 - d. Quantum forces
- 182. The zeta potential measures the number of excess all particulate matter.
 - *a. electrons
 - b. ions
 - c. cations
 - d. protons

0.1 Sample Questions for Level II, Answers on Page 157

- TII-1 Low temperature water can be compensated for when using alum by
 - a. increasing the pH.
 - b. decreasing the pH.
 - *c. increasing the alum dosage.
 - d. decreasing the alum dosage.
- TII-2 Which is the optimal pH range for the removal of particulate matter, when using alum as a coagulant?
 - a. 4.5 to 5.7
 - b. 5.8 to 6.5
 - *c. 6.5 to 7.2
 - d. 7.3 to 8.1
- TII-3 Which forces will pull particles together once they have been destabilized in the coagulation-flocculation process?
 - *a. van der Waals forces
 - b. Zeta potential
 - c. Ionic forces
 - d. Quantum forces
- TII-4 Which is a common mistake that operators make in regards to flocculation units?
 - a. Excessive flocculation time
 - b. Lack of food-grade NSF-approved grease on the flocculator bearings
 - *c. Keeping the mixing energy the same in all flocculation units

- d. Too short a flocculation time
- THI-5 Ferric sulfate has which advantage over aluminum sulfate (alum)?
 - a. Less staining characteristics
 - b. Less cost
 - *c. More dense floc
 - d. Not as corrosive

0.2 Sample Questions for Level III, Answers on Page 157

- THI-1 How much alkalinity as CaCO_3 will dry-basis alum consume?
 - *a. 0.5 mg/l
 - b. 0.8 mg/l
 - c. 1.2 mg/l
 - d. 1.5 mg/l
- THI-2 Natural zeolites that have become exhausted with use are regenerated by immersing them in a strong solution of which chemical?
 - *a. NaCl
 - b. NaOH
 - c. HCl
 - d. H_2SO_4
- THI-3 The zeta potential on a particular sample of water is -2 . The degree of coagulation is best described as
 - a. poor.
 - b. fair.
 - *c. excellent.
 - d. maximum.
- THI-4 Which is a disadvantage of using static mixers?
 - a. They do not provide good mixing
 - b. They are not economical
 - *c. They increase head loss
 - d. They require too much maintenance
- THI-5 Which is the usual effective pH range of iron salt coagulants?
 - *a. 3.5 to 9.0
 - b. 6.5 to 8.8
 - c. 3.0 to 9.5
 - d. 4.2 to 9.0

0.3 Sample Questions for Level IV, Answers on Page 158

- TIV-1 Which is the minimum recommended number of flocculation basins?
 - a. 2

*b. 3

c. 4

d. 5

TIV-2 Which type of polymer(s) is (are) sometimes formulated with regulated substances from the following list?

a. Polyethylene

b. Divinylbenzene

c. Polypropylene and polyethylene

*d. Nonionic and anionic polymers

TIV-3 Which is the most probable solution if rotifers are visible in the finished water?

a. Superchlorinate the water plant

*b. Optimize coagulation, flocculation, and filtration

c. Use aeration followed by lime softening before the settling process

d. Use oxygen deprivation

TIV-4 The best addition for water that is highly colored due to organic matter would be

a. the addition of lime.

b. lime addition with increase in the coagulant being used.

c. a small increase in a nonionic polymer.

*d. the addition of an acid to lower pH before coagulation.

TIV-5 If the activation process of silica is not carefully controlled,

a. the silica could splash due to high heat of reactants.

*b. it could inhibit floc formation.

c. it could corrode and destroy the metal and rubber in the flocculators.

d. it could deposit silica on the flocculators and the gears, bringing it eventually to a grinding halt.

0.4 Monitor, Evaluate, & Adjust Treatment Processes-Clarification and Sedimentation

0.5 Sample Questions for Level I, Answers on Page 158

TI1 In solid-contact basins with fairly constant water quality parameters, how often should the solids concentration be determined?

a. At least once per week

b. At least every other day

c. At least once per month

*d. At least twice per day

TI2 The definition of decant is

a. to draw off a liquid layer from a vessel of any size without disturbing any layer(s) above or below.

b. to draw off the sediment at the bottom of a vessel of any size without disturbing the

overlying liquid layer(s).

c. to remove the precipitate at the bottom of any size vessel.

*d. to draw off the liquid from a vessel of any size without stirring up bottom sediment.

TI3 How often should sedimentation basins with mechanical sludge removal equipment be drained and inspected?

a. Twice a year

*b. Once a year

c. Every other year

d. Every three years

TI4 Which is the most important reason to reduce turbidity?

a. To reduce taste and odor problems

*b. To remove pathogens

c. To reduce corrosion

d. To determine the efficiency of coagulation and filtration

0.6 Sample Questions for Level II, Answers on Page 159

TII-1 If enteric disease-causing protozoans have been found in the effluent of a water plant, which is the most probable solution?

a. Where possible, use powdered activated carbon (PAC) throughout water plant; backwashing filters will remove the PAC

b. Use PAC only in the sedimentation basin; backwashing the filters will remove the PAC

*c. Use multibarrier approach—coagulation, flocculation, sedimentation, and filtration

d. Superchlorinate the water plant

TII-2 Which is the major cause of short circuiting in a sedimentation basin?

a. Open basins that are subject to algal growths and thick slime growths on the side of the basin

b. Basins without a wind break

*c. Poor inlet baffling

d. Density currents

TII-3 Conventional sedimentation has a removal of *Cryptosporidium* oocysts.

*a. less than 0.5-log

b. 0.5-log

c. 1.0-log

d. 2.0-log

TII-4 In solids-contact basins, the weir loading normally should not exceed weir length.

a. 1 gpm/ft

b. 2 gpm/ft

c. 5 gpm/ft

*d. 10 gpm/ft

TII-5 Dissolved-air flotation is particularly good for removing

- a. sulfides.
- b. inorganics.
- c. manganese and iron.
- *d. algae.

0.7 Sample Questions for Level III, Answers on Page 159

TIII-1 Which determines whether or not colloidal-sized particles in suspension repel each other, stay in suspension, or agglomerate and eventually settle?

- a. Number of collisions
- b. Flow and temperature of the water
- c. Types of chemical bonding
- *d. Magnitude of the charges

TIII-2 If the sludge in a sedimentation basin becomes too thick, which could happen?

- a. Gases from decomposition will rise through the settled sludge accelerating normal floc settling
- b. Abundant trihalomethanes and haloacetic acids will form
- *c. Solids can become resuspended or taste and odors can develop
- d. The sludge will compact at the bottom of the basin making it very difficult to remove

TIII-3 In basins using tube and plate settlers, which parameter must be much better than conventional treatment basins?

- a. Metals must be oxidized before reaching the tubes and plates
- b. Floc rate must be 2 to 3 times slower than conventional basins
- c. Floc rate must be 3 to 4 times faster than conventional basins
- *d. Floc must have good settling characteristics

TIII-4 Which type of sedimentation basins have the flow of water admitted at an angle?

- a. Rectangular settling basins
- b. Square settling basins
- c. Center-feed settling basins
- *d. Spiral-flow basins

TIII-5 At which minimum angle must self-cleaning tube settlers be placed?

- *a. 50 degrees
- b. 60 degrees
- c. 65 degrees
- d. 70 degrees

0.8 Sample Questions for Level IV, Answers on Page 160

TIV-1 If nematodes are interfering with the disinfectant, which is the most probable solution?

- *a. Optimize the settling process

- b. Use chloramines
- c. Decrease detention time of finished water in clearwell and tanks
- d. Use oxygen deprivation

TIV-2 At which angle should the parallel inclined plates be installed when using the shallow-depth sedimentation method?

- a. 35°
- *b. 45°
- c. 50°
- d. 60°

TIV-3 Why do solids-contact basins have much shorter detention times than conventional treatment basins?

- a. Because chemical reactions take place throughout the basin
- b. Because the settling zone water moves upward, while at the same time the mixing zone moves upward
- c. Because the gentle upward flow of the water throughout the basin is conducive for producing larger settleable floc
- *d. Because of the recycled materials from the sludge blanket, the chemical reactions occur more quickly and completely in the mixing area

TIV-4 The pulsating energy in a pulsator clarifier helps to

- *a. maintain a uniform sludge blanket layer.
- b. mix the coagulants with the raw water.
- c. mix the coagulant aids with the primary coagulant and water to help in flocculation.
- d. raise the sludge blanket over the weir for wasting.

TIV-5 Pulsator clarifiers are used to treat water that is

- a. low in temperature, usually $< 10^{\circ}\text{C}$.
- *b. high in color and low in turbidity.
- c. low in color and high in turbidity.
- d. high in organic acids.

0.9 Monitor, Evaluate, & Adjust Treatment Processes-Filtration

0.10 Sample Questions for Level I, Answers on Page 160

TI1 Which is the filtration flow rate through a manganese greensand pressure filter?

- a. 1 to 2gpm/ft²
- *b. 2 to 3gpm/ft²
- c. 3 to 5gpm/ft²
- d. 5 to 8gpm/ft²

TI2 When a filter is ripening,

- a. it is in need of a backwash.
- b. turbidity is just starting to break through.

- *c. it is becoming more efficient in particle removal.
 - d. it is beginning to grow algae in the filter bed, walls, and troughs.
- TI3 Virgin greensand can be regenerated by soaking the filter bed for several hours in a solution of chlorine containing
- a. 50mg/LCl₂.
 - b. 75mg/LCl₂.
 - *c. 100mg/LCl₂.
 - d. 200mg/LCl₂.
- TI4 Which role does the action of straining of suspended particles play during filtration?
- *a. Minor
 - b. Fair
 - c. Good
 - d. Major
- TI5 The turbidity of settled water before it is applied to the filters (post sedimentation process) should always be kept below
- *a. 1 to 2ntu.
 - b. 2 to 4ntu.
 - c. 5 ntu.
 - d. 8 to 10ntu.

0.11 Sample Questions for Level II, Answers on Page 160

- TII-1 Which is the best process for the removal of turbidity?
- a. Anion exchange
 - *b. Coagulation, flocculation, sedimentation, and filtration
 - c. Chemical oxidation
 - d. Granular activated carbon
- TII-2 If filter run times between backwashes are long, for example one week, because high quality (low turbidity) water is being applied to the filters, which problem could still arise?
- a. Mudball formation
 - b. Air binding and formation of mudballs
 - c. Extended backwashing due to media becoming too compacted
 - *d. Floc breakthrough
- TII-3 Gravel displacement in a filter bed from backwash rates with too high of a velocity could eventually cause
- a. compaction of the filter media.
 - b. loss of media into the backwash troughs.
 - *c. a sand boil.
 - d. bed shrinkage.
- TII-4 Virgin greensand

- a. does not require regeneration.
- *b. requires regeneration with potassium permanganate - 1 hour soak with 60 grams KMnO_4
- c. requires regeneration with manganese dioxide - 2 hour soak with 25% by weight solution of MnO_2
- d. requires regeneration with manganese hydroxide - 4 hour soak with 200 grams Mn(OH)_2

TIII-5 Which conventional treatment step is eliminated by direct filtration?

- a. Oxidation
- b. Aeration
- c. Flocculation
- *d. Sedimentation

0.12 Sample Questions for Level III, Answers on Page 161

TIII-1 If crustaceans have clogged the water treatment plant's filters, which is the most probable solution?

- a. Shut down the filters and physically remove them
- b. Shut down one filter at a time and drain; once the crustaceans have died, physically remove them and then repeat process on the other filters
- c. Backwash filters using a very high concentration of ozone in the water
- *d. Use a disinfectant that targets the specific organisms in question

TIII-2 Which organism can escape coagulation and thus pass through a granular filter?

- a. Giardia
- b. Entamoeba
- *c. Cryptosporidium
- d. Naegleria

TIII-3 Reverse osmosis membranes will compact faster with

- a. higher iron content.
- b. higher chlorine contact.
- *c. higher pressure.
- d. higher pH.

TIII-4 Which would immediately occur if newly installed manganese greensand was not skimmed of the fines after backwashing and stratification steps were completed?

- a. Uneven flow through the bed
- b. Cracks would develop in the bed
- c. Mudball formation
- *d. Shorter filter runs

TIII-5 When a filter is operated at normal flow rates, its ability to trap flocculated particles in suspension is a function of

- a. effective size multiplied by uniformity coefficient.

- b. effective size multiplied by uniformity coefficient divided by media size.
- *c. media depth and media size.
- d. media depth and uniformity coefficient.

0.13 Sample Questions for Level IV, Answers on Page 161

- TIV-1 Which is the best solution if iron bacteria are causing corrosion problems in the filters?
- a. Protect the metal parts of the filters by adding zinc orthophosphate
 - b. Optimize the settling process
 - *c. Superchlorinate
 - d. Add lime at 50 mg/L to one filter at a time
- TIV-2 A conventional water treatment plant with dual media filters has very cold water in the winter and warm water in the summer. Which should the operator do to compensate for this temperature change?
- a. Use more coagulants in the summer per million gallons
 - *b. Sustain the same bed expansion without media loss by reducing or increasing backwash flow rate
 - c. Increase summer bed expansion and increase winter backwash flow rates
 - d. Increase bed expansion in the winter compared to summer in order to remove turbidity
- TIV-3 How are reverse osmosis membranes cleaned once they become fouled?
- a. They are soaked in high purity industrial soap for at least 24 hours
 - *b. They are cleaned with an acid wash
 - c. They are cleaned with an acid, then with an industrial soap for 24 hours
 - d. They are cleaned first with a high purity industrial soap and then soaked in an acid solution for 3 days
- TIV-4 Which membrane process is used to treat brackish water or seawater?
- a. Microfiltration
 - b. Nanofiltration
 - *c. Reverse osmosis
 - d. Ultrafiltration
- TIV-5 The amount of reject water from a reverse osmosis unit is dependent on the number of stages in which the membranes are configured and the
- *a. feed pressure.
 - b. amount of cations.
 - c. amount of cations and anions.
 - d. pH of the water.

0.14 Monitor, Evaluate, and Adjust Treatment Processes-Residuals Disposal

0.15 Sample Questions, General, Answers on Page 162

- TG-1 In the precipitative softening plant, which percentage of solids sludge is produced?
- a. 1%
 - *b. 5%
 - c. 10%
 - d. 30%
- TG-2 Which sludge disposal method is most economical for lime-soda ash softening plants?
- a. Disposal into the sewage system
 - b. Sand drying beds
 - *c. Lagoons
 - d. Landfill the sludge
- TG-3 Current regulations require water treatment wastes to be monitored
- *a. daily.
 - b. weekly.
 - c. monthly.
 - d. quarterly.
- TG-4 Which process is used to concentrate sludge?
- a. Sand bed
 - b. Solar lagoon
 - *c. Thickener
 - d. Centrifuge
- TG-5 Which process is used to dewater sludge?
- a. Wash water basin
 - c. Thickener
 - *b. Sand bed
 - c. Thickener
 - d. Reclamation basin

0.16 Sample Questions for Level III, Answers on Page 162

- TIII-1 Which is the total concentration of dissolved solids in the wastewater from the regeneration of ion exchange units?
- a. 10,000 to 20,000mg/l
 - b. 20,000 to 30,000 mg/l
 - *c. 35,000 to 45,000 mg/l
 - d. 45,000 to 60,000 mg/l
- TIII-2 Which is the usual range of percent sludge solids, if the sludge is allowed to accumulate and compact at the bottom of a sedimentation basin?
- *a. 2-4 %

- b. 4-7 %
- c. 7-12 %
- d. 12-15 %

TIII-3 Which should be determined first before an in-ground sedimentation tank is drained?

- a. The solids content
- b. The hazardous metals content
- c. Sludge volume and volume of process area to make sure it will be large enough
- *d. Water table level

TIII-4 Which sludge dewatering process is best for alum sludges (which are difficult to dewater) when the cakes are very dry, filtrate is clear, and solids capture is very high?

- a. Centrifuge
- b. Vacuum filters
- *c. Filter press
- d. Belt filter press

TIII-5 Which sludge dewatering process requires a precoat of diatomaceous earth and its use has declined due to other newer methods?

- a. Centrifuge
- *b. Vacuum filters
- c. Filter press
- d. Belt filter press

TIII-6 Which precipitates can foul a cation exchange resin?

- a. Sodium chloride and potassium chloride
- b. Chlorate and borate
- c. Sulfates
- *d. Iron and manganese

TIII-7 Which process works best for sequestering manganese?

- a. Sodium silicate alone
- b. Sodium silicate and chlorine
- c. Polyphosphates alone
- *d. Polyphosphates and chlorine

TIII-8 When should polyphosphates used for sequestration of iron and manganese from a well be injected into the process?

- a. Right after disinfection
- b. Immediately after aeration to remove unwanted gases
- c. Right after clarification
- *d. Right after the water leaves the well

TIII-9 Recarbonation is

- *a. adding CO₂ to the water.
- b. adding bicarbonate to the water.
- c. adding acid to precipitate the excess lime.

d. adding caustic soda.

TIII-10 In the ion-exchange softening process, once the resin can no longer soften water it must be

a. renewed.

b. re-catalyzed.

*c. regenerated.

d. recharged.

0.17 Sample Questions for Level II, Answers on Page 164

TII-1 Ion exchange processes can typically be used for direct groundwater treatment as long as turbidity and levels are not excessive.

a. calcium carbonate

*b. iron

c. carbon dioxide

d. sodium sulfate

TII-2 Softened water has a high pH and a high concentration of CaCO_3 . Therefore, stabilization is essential in order to prevent the CaCO_3 from precipitating out

a. in household plumbing.

b. in the clear well.

c. in the distribution system.

*d. on the filters.

TII-3 Which is the best type of salt to use in the regeneration of ion exchange softener resin?

a. Fine-grained salt

b. Block salt

c. Block or road salt

*d. Rock salt or pellet-type salt

TII-4 Powdered activated carbon is primarily used to control

a. disinfectant by-products.

*b. organic compounds responsible for tastes and odors.

c. synthetic organic chemicals.

d. humic and fulvic acids.

TII-5 Ion exchange will remove

*a. all hardness.

b. all hardness down to 7.4 mg/l, as CaCO_3 .

c. all hardness down to 17.2 mg/l, as CaCO_3 .

d. all hardness down to about 25.0 mg/l, as CaCO_3 .

0.18 Sample Questions for Level III, Answers on Page 164

TIII-1 It is impossible to produce waters with a hardness of less than ____ when using the lime-soda ash process.

- a. 9 mg/l
- b. 17 mg/l
- *c. 25 mg/l
- d. 50 mg/l

TIII-2 When added to water for softening purposes, soda ash will do which of the following?

- *a. Disinfect the water and kill the vast majority of protozoans, viruses, bacteria, and other multicellular organisms
- b. Raise the pH of water to between 8.0 and 9.8 pH units
- c. Add CO₂ to the water
- d. Add calcium alkalinity to the water

TIII-3 Magnetic ion exchange resin has been developed to remove

- *a. total organic carbon.
- b. chlorides.
- c. iron and magnesium.
- d. sulfates and sulfides.

TIII-4 Approximately how much carbon is lost during the reactivation process for granular activated carbon?

- *a. 5 %
- b. 7 %
- c. 10 %
- d. 15 %

TIII-5 Which is the most advantageous application point for powdered activated carbon?

- *a. Raw water intake
- b. After coagulation
- c. After oxidation with chlorine
- d. In the filters

0.19 Sample Questions for Level IV, Answers on Page 165

TIV-1 Which is the most effective method for removing tastes and odors?

- a. Coagulation, sedimentation, and filtration
- *b. Granular activated carbon
- c. Anion exchange
- d. Lime softening

TIV-2 Backwashing rate procedures should be reassessed to determine the cause of granular activated carbon loss if the loss per year exceeds

- *a. 2 inches.
- b. 4 inches.
- c. 6 inches.
- d. 8 inches.

TIV-3 Which is the most efficient process for the removal of nitrite and nitrate?

- a. Powdered activated carbon
- b. Granular activated carbon
- *c. Anion exchange
- d. Cation exchange

TIV-4 Which is the main problem if particle agglomeration is occurring in a filter for iron and manganese removal at the interface of the coal layer and the layer below?

- a. Oxidant is too weak
- b. Coagulant dosage is excessive
- c. Coal layer is too fine
- *d. Coal layer is too coarse

TIV-5 Which is the most effective method for the removal of disinfection by-products?

- a. Reverse osmosis
- b. Lime softening
- c. Ultrafiltration
- *d. Granular activated carbon

1. are used to cause particles to become destabilized and begin to clump together.

- a) coagulant aids
- b) nonsettable solids
- c) zeta particles
- *d) primary coagulants

2. The purpose of stabilization is

- a) to prevent floc from rising in the basin
- b) to prevent sludge from entering the filters
- *c) to prevent corrosion or excessive scale from entering the distribution system
- d) to prevent excessive turbidity at the top of the filters

3. Core sampling is a viable way to check the condition of your

- a) raw water
- b) coagulation process
- c) finished water
- *d) filters

4. In solid contact units, the three main operational fundamentals are

- a) sedimentation, slurry, & suspended solids
- b) mixing, clarifying, & filtration
- *c) chemical dosage, recirculation rate, & sludge control
- d) weighing agents, alkalinity & pac

5. Particle counters can be used in place of _____ in the treatment process to obtain better control.

- a) flash mixers
- b) variable drives

- c) filter coring
 - *d) turbidimeters
6. In their soluble or reduced state, iron and manganese are
 - a) alkalinity enhancers
 - *b) colorless
 - c) negatively charged
 - d) won't dissolve in water
 7. The maximum filtration rate allowable, without special permission, for dual and mixed media filters is
 - a) 2gal/min/sqft
 - *b) 5gal/min/sqft
 - c) there is no maximum
 - d) 9gal/min/sqft
 8. During the coagulation/flocculation process, particulate impurities can be divided into two classifications.
 - a) primary coagulants and coagulant aids
 - *b) settleable and nonsettleable solids
 - c) hydraulic and mechanical
 - d) paddlewheel and walking beam
 9. In conventional rectangular sedimentation basins, 50% of the sludge should settle out in the of the basin.
 - *a) first third
 - b) last half
 - c) very beginning
 - d) tail end
 10. Generally, the more uniform the media, the the rate of headloss.
 - *a) slower
 - b) same
 - c) smaller
 - d) larger
 11. polymers are positively charged.
 - a) nonionic
 - b) anionic
 - *c) cationic
 - d) platonic
 12. The Van der Waals principle refers to
 - *a) oppositely charged particles attract
 - b) the settling rate of suspended solids
 - c) the benefits of early oxidation of raw water
 - d) the backwash rates of multi media filters

13. The time necessary to perform the coagulation, flocculation, and settling processes in treatment are correctly listed in what order, starting with coagulation?
- a) days, weeks, months
 - b) hours, minutes, seconds
 - c) weeks, months, years
 - *d) seconds, minutes, hours
14. Overdosing of potassium permanganate will likely cause
- a) an extremely high pH
 - *b) pink water
 - c) taste and odor
 - d) inadequate settling
15. Which of the following is most likely to be used as a primary coagulant?
- a) brine
 - b) ammonious hydroxide
 - *c) ferric sulfate
 - d) sodium thiosulfate
16. Desirable media characteristics include
- a) permeability
 - b) solubility in water
 - c) full of impurities
 - *d) hard and durable
17. The two types of removal mechanisms for gravity filters are
- a) redundant and repetitive
 - *b) mechanical and adsorption
 - c) coagulation and flocculation
 - d) regeneration and renewal
18. Fluoride is added to water to
- a) create a nuisance
 - *b) aid in the development of teeth and bones
 - c) so there is something that has both a primary and secondary MCL
 - d) aid in the protective coating of pipes
19. The best pH level for coagulation usually falls in the range of
- a) 4-6
 - *b) 5 – 7
 - c) 7 – 9
 - d) 1 – 3
20. The mixing of coagulant chemicals and raw water is called
- a) flocculation
 - b) aeration
 - c) reverse osmosis

- *d) flash mixing
- 21. Sedimentation basins have zones.
 - a) five
 - *b) four
 - c) three
 - d) two
- 22. A jumbled mass or collection of floc, solids, and filter media that could grow into a larger mass and reduce filter efficiency is
 - a) turbidity mass
 - b) tuberculation
 - *c) a mudball
 - d) a media crack
- 23. When backwashing filters, bed expansion should be between
 - *a) 15 – 30% percent.
 - b) 10 – 20%
 - c) 20 – 40%
 - d) 30 – 50%
- 24. The two main softening methods used by treatment facilities are
 - a) reverse osmosis and oxidation
 - b) distillation and disinfection
 - c) ultraviolet radiation and electrodialysis
 - *d) ion-exchange and lime-soda ash
- 25. The effective way to combat taste and odor problems is
 - a) aeration and tube settlers
 - b) settling out by particle counting
 - *c) prevent them from occurring
 - d) coagulation and flocculation
- 26. If a filter exceeds NTU at any time the system must arrange for the State to conduct a Comprehensive Performance Evaluation within thirty days.
 - *a) 2.0NTU
 - b) 3.0NTU
 - c) 5.0NTU
 - d) 10.0NTU
- 27. Most water treatment facilities will run more effectively if
 - a) the mayor lends a hand
 - *b) it runs 24hrs a day
 - c) it runs 12hrs on and 12hrs off
 - d) it runs 16 hours a day
- 28. Turbidity is used as a process control measurement because
 - a) everyone has a turbidimeter around

- b) the results are foolproof
 - *c) the number of pathogens increase as turbidity increases
 - d) turbidity removal is an extremely easy task
29. Solids contact units (clarifiers) generally demand a higher level of operator knowledge and skill than conventional treatment techniques and processes.
- a) true
 - b) false
30. Filtration actually particulates.
- a) destroys
 - *b) stores
 - c) dissolves
 - d) suspends
31. is a concentrated accumulation of chemicals and contaminants and pollutants that we attempt to remove from raw water.
- a) pathogens
 - *b) sludge
 - c) coagulants
 - d) fluoride
32. Iron and manganese removal can be accomplished by
- a) oxidation with chlorine followed by filtration
 - b) oxidation by aeration followed by filtration
 - c) oxidation by potassium permanganate followed by filtration
 - *d) all of the above
33. Short circuiting refers to
- a) pumps running backwards which stops treatment
 - b) a movie made in the 80 's
 - c) inadequate voltage applied water treated by electrodialysis
 - *d) uneven flows which result in decreased treatment efficiency
34. Solids removed from a filter are most commonly removed by what method?
- a. Adsorption
 - b. Straining
 - c. Deactivation
 - d. Flocculation
35. What is a typical filtration rate for slow sand filters?
- a. 2.0-6.0 GPM/sq. ft
 - b. 6.0-10.0 GPM/sq. ft
 - c. 1.0-2.0 GPM/sq. ft
 - d. 0.5-0.10 GPM/sq. ft
36. In a typical conventional treatment plant, the finished water turbidity for an individual filter should be less than _____.

- a. 1.0 NTUs
 - b. 0.3 NTUs
 - c. 5.0 NTUs
 - d. 3.0 NTUs
37. A filter running under normal conditions will see head loss in a filter _____.
- a. Remain constant
 - b. Increase slowly
 - c. Rapidly increase
 - d. Decrease slowly
38. A filter must be washed if this condition is met:
- a. Head loss
 - b. Turbidity breakthrough
 - c. Maximum filter run time
 - d. All of the above
39. Filter performance is measured by the removal of _____.
- a. Oxygen
 - b. Head loss
 - c. Turbidity
 - d. Chlorine
40. What is the biologically active layer of a slow sand filter called?
- a. Mixed media
 - b. Dual media
 - c. Sludge layer
 - d. Schmutzdecke
41. The pressure drop in a filter is called _____.
- a. Turbidity breakthrough
 - b. Head Loss
 - c. Filtration
 - d. Backwash
42. What is the most common reason for putting a filter into the wash cycle?
- a. Head loss
 - b. Filter run time
 - c. Turbidity breakthrough
 - d. Water level decrease
43. Formation of mud balls and excessive boiling during a wash is an indicator of _____.
- a. Proper backwash rate
 - b. Too low backwash rate
 - c. Excessive backwash rate
 - d. Improper chemical dose
44. Important processes which occur during filtration are _____.

- a. Sedimentation
 - b. Adsorption
 - c. Straining
 - d. All of the above
45. Typical filtration rates for a conventional treatment plant are _____.
- a. 0.2-0.6 GPM/sq.ft
 - b. 2.0-10.0 GPM/sq.ft
 - c. 10.0-20.0 GPM/sq.ft
 - d. 200-400 GPM/sq.ft
46. Which will occur if dry alum and quicklime are mixed together
- a. Create tremendous heat and hydrogen gas will be released
 - b. Dust may be released which may cause an explosion
 - c. A coagulated gel will form a
 - d. Nothing as they are neutral towards each other
47. X. The quantity of dissolved oxygen in water is a function of
- a. Ph alkalinity temperature and total dissolved solids
 - b. Temperature and alkalinity
 - c. Ph and temperature d
 - d. Temperature pressure and salinity
48. When chlorine has destroyed all reducing compounds any chlorine remaining will react with
- a. Nitrite and form chloramines
 - b. Nitrates and form chloramines
 - c. Ammonia and form chloramines
 - d. Organics and form aromatics
49. When used with alum which chemical improves coagulation
- a. Ferric chloride
 - b. Ferric sulfate
 - c. Sodium aluminate
 - d. Aluminum sulfate
50. In the ion exchange softening process once the resin can no longer soften water it must be
- a. Renewed
 - b. Re-catalyzed
 - c. Regenerated
 - d. Recharged
51. Low values for which characteristic may require the addition of lime caustic soda or sodium bicarbonate
- a. Turbidity
 - b. Water temperature
 - c. pH

- d. Alkalinity
- 52. Ion exchange process can typically be used for direct groundwater treatment as long as turbidity and _____ levels are not excessive
 - a. Calcium carbonate
 - b. Iron
 - c. Carbon dioxide
 - d. Sodium sulfate
- 53. Which statement is true concerning colloidal particles
 - a. Colloidal particles are so small that gravity has little effect on them
 - b. The zeta potential between colloidal is balanced by covalent bonding
 - c. Electrical phenomenon of colloidal particles predominate and control their behavior a
 - d. The surface area of colloidal particles is very small compared to theirs mass
- 54. The zeta potential measures the number of excess found on the surface of all particulate matter
 - a. Electrons
 - b. Ions
 - c. Cations
 - d. Protons
- 55. Which natural electrical force keeps colloidal particles apart in water treatment
 - a. Van der waals force
 - b. Ionic forces
 - c. Zeta potential
 - d. Quantum forces
- 56. Which forces will pull particles together once they have destabilized in the coagulation flocculation process
 - a. Van der waals forces
 - b. Zeta potential
 - c. Ionic forces
 - d. Quantum forces
- 57. Ferric sulfate has which advantage over aluminum sulfate (alum)
 - a. Less staining characteristics
 - b. Less cost
 - c. More dense floc
 - d. Not as corrosive
- 58. Which is the major cause of short circuiting in a sedimentation basin
 - a. Open basins that are subject to algal growths and thick slime growths
 - b. Basins without a wind break
 - *c. Poor inlet baffling
 - d. Density currents
- 59. Algae blooms may be responsible for which of the following problems

- a. An increased in chlorine demand
 - b. Elevated disinfection by products
 - c. Filter clogging
 - *d. All of the above
60. Strategies for taste and odor treatment generally fall under two broad categories
- a. Oxidation and chlorination
 - b. Aeration and degasification
 - *c. Removal and destruction
 - d. Sedimentation and adsorption
61. A problem in filters that occurs when suspended solids pass through the filter media is called
- a. Head loss
 - *b. Breakthrough
 - c. Turbidity
 - d. Air binding
62. What is a typical filtration rate for slow sand filters?
- a. 2.0-6.0 GPM/sq. ft
 - b. 6.0-10.0 GPM/sq. ft
 - c. 1.0-2.0 GPM/sq. ft
 - d. 0.5-0.10 GPM/sq. ft
63. The branch of science which deals with water or fluids at rest or in motion is
- a. conductivity
 - b. geology
 - c. oceanography
 - *d. hydraulics
64. What is the ratio of lime to copper sulfate for controlling algae growth on basin walls?
- *a. 1 part lime to 1 part copper sulfate
 - b. 1 part lime to 2 parts copper sulfate
 - c. 1 part lime to 3 parts copper sulfate
 - d. 2 parts lime to 3 parts copper sulfate
65. Copper sulfate is used in surface water reservoirs to control
- a. Emergent weeds
 - *b. Algae
 - c. Mosquito larvae
 - d. Snails
66. Which of the following best defines adsorption?
- a. Assimilation of one substance into the body of another by molecular or chemical action
 - *b. Adhesion of a gas, liquid, or dissolved substance onto the surface or interface zone of another substance
 - c. Converting small particles of suspended solids into larger particles by the use of chemicals

- d. Chemical complexing of metallic cations with certain inorganic compounds
67. About how much alkalinity is required for each milligram per liter of alum added to raw water?
- *a. 0.5mg/L
 - b. 1.0mg/L
 - c. 1.5 mg/L
 - d. 2.0 mg/L
68. A water treatment plant's flocculation-coagulation and sedimentation processes should be checked if which of the following changes?
- *a. Turbidity
 - b. Chlorine feed rate
 - c. Fluoride feed rate
 - d. Total trihalomethanes
69. Which of the following is an example of a weighting agent?
- a. Polyelectrolytes
 - *b. Bentonite clay
 - c. Calcium carbonate
 - d. Sodium bicarbonate
70. Algae can shorten filter runs by
- *a. Clogging the filters
 - b. Increasing chlorine demand
 - c. Lowering the pH
 - d. Increasing turbidity
71. Coagulation is a chemical and physical reaction that converts
- a. Settleable solids into nonsettleable solids
 - *b. Nonsettleable solids into settleable solids
 - c. Dissolved solids into settleable solids
 - d. Dissolved solids into a precipitate
72. Water, deposition in metal piping will increase if
- a. The pH is above 7.0 and has low dissolved oxygen levels
 - b. The alkalinity is high and water temperature is low
 - c. Total dissolved solids are high and the pH is below 7.0
 - *d. The pH and alkalinity increase
73. The filtration unit process usually
- a. is located at the beginning of a filtration plant
 - *b. follows the coagulation/flocculation/sedimentation processes
 - c. is located after the clear well area
74. Filters are generally backwashed when the loss-of-head indicator registers a certain set value, such as 6-ft, or upon a certain time, say 48-hours, or upon a rise in
- a. alkalinity

- b. a jar-test result
 - *c. turbidity
 - d. temperature
75. Which is the safe dosage for most species of fish when using copper sulfate to control algae in a body of water?
- a. 0.3 mg/l
 - *b. 0.5 mg/l
 - c. 0.8 mg/l
 - d. 1.0 mg/l
76. Manganese greensand filters can be regenerated by using
- a. a surface wash and an air-water backwash.
 - b. brine water during backwashing.
 - *c. potassium permanganate solution during backwashing.
 - d. first a brine solution during the first backwashing cycle followed by potassium permanganate solution for the second backwash cycle.
77. Which material is manganese greensand and which is the coating?
- a. Quartz sand coated with manganese hydroxide $[\text{Mn}(\text{OH})_2]$
 - b. Garnet sand coated with manganese dioxide $[\text{MnO}_2]$
 - c. Ilmenite sand coated with manganese hydroxide
 - *d. Glauconite sand coated with manganese dioxide
78. Which is the layer of solids and biological growth that forms on the top of a slow sand filter?
- a. Biosolids film
 - b. Bio-carbonated scale layer
 - *c. Schmutzdecke
 - d. Saprophytic layer
79. Below are four membrane technologies. Which is the correct sequence from larger to smaller pore sizes?
- a. Microfiltration, reverse osmosis, ultrafiltration, and nanofiltration
 - *b. Microfiltration, ultrafiltration, nanofiltration, and reverse osmosis
 - c. Reverse osmosis, ultrafiltration, microfiltration, and nanofiltration
 - d. Ultrafiltration, microfiltration, reverse osmosis, and nanofiltration
80. Which filter media material is given an abrasive number?
- a. Garnet
 - *b. Activated carbon
 - c. Sand
 - d. Greensand
81. Direct filtration is used to treat raw water that has average turbidities
- a. below 10NTU.
 - *b. up to 25NTU.

- c. 40 to 50NTU.
 - d. above 50NTU.
82. Diatomaceous earth filters
- a. have a relatively high installation cost.
 - b. have relatively high operating costs.
 - *c. are used only for water with low turbidity.
 - d. produce very little backwash sludge.
83. A multi-barrier water filtration plant that contains a flash mix, a coagulation/flocculation zone, sedimentation, filtration and a clear well is considered to be a
- a. community special treatment plant
 - b. direct filtration plant
 - c. reverse osmosis plant
 - d. *conventional filtration plant
 - e. traditional plant
84. Baffling inside a storage facility may be needed to prevent "hot spots" and
- *a. straight through flows
 - b. long contact times with disinfectants
 - c. high chlorine residuals throughout the facility
 - d. high temperatures throughout the storage facility
85. Which chemical, when it contacts moisture, will produce a cake that is both difficult and hazardous to handle?
- a. Quicklime
 - b. Calcium oxide
 - c. Calcium hydroxide
 - *d. Soda ash
- item Which of the following conditions is favorable for the rapid growth of algal?
- *a. *moderate to high dissolved oxygen and nutrients
 - b. high pH and water hardness
 - c. low temperatures and low dissolved oxygen
 - d. high alkalinity and water hardness
86. Flocculation is defined as
- *a. the gathering of fine particles after coagulation by gentle mixing
 - b. clumps of bacteria
 - c. the capacity of water to neutralize acids
 - d. a high molecular weight of compounds that have negative charges
87. When handling fluoride chemicals, personnel should wear a respirator or mask approved by
- a. OSHA
 - b. MSA
 - c. EPA

*d. NIOSH

88. are used to cause particles to become destabilized and begin to clump together.
- a) coagulant aids
 - b) nonsettable solids
 - c) zeta particles
 - *d) primary coagulants
89. Which of the following are commonly used coagulation chemicals?
- a. hypochlorites and free chlorine
 - b. sodium and potassium chlorides
 - c. *alum and polymers
 - d. bleach and HTH
90. Chlorine gas is _____ times heavier than breathing air
- a. 2.5
 - b. 20
 - c. 60
 - d. 460
91. Filters are generally backwashed when the loss-of-head indicator registers a certain set value, such as 6-ft, or upon a certain time, say 48-hours, or upon a rise in
- a. alkalinity
 - b. a jar-test result
 - c. *turbidity
 - d. temperature
92. Why should a filter be drained if it is going to be out-of-service for a prolonged period?
- a. to allow the media to dry out
 - b. to save water
 - c. to prevent the filter from floating on groundwater levels
 - d. *to avoid algal growth
93. The proper concentration for fluoride in drinking water is determined by:
- *a. average annual air temperature
 - b. average annual water temperature
 - c. average alkalinity
 - d. average iron concentration
94. 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.
- a. Different
 - *b. Differential
 - c. High
 - d. Low
95. List the basic processes, in the proper order, for a conventional treatment plant.

- *a. Coagulation, flocculation, sedimentation, filtration
 - b. Flocculation, coagulation, sedimentation, filtration
 - c. Filtration, coagulation, flocculation, sedimentation
 - d. Coagulation, sedimentation, flocculation, filtration
96. The four most common oxidants include:
- *a. Chlorine, potassium permanganate, ozone, chlorine dioxide
 - b. Chlorides, soap, air, coagulants
 - c. Air, chemicals, sodium, chloride
 - d. Flocculants, coagulants, sediments, granules
97. When comparing conventional treatment with direct filtration, what process unit, _____ is in the conventional treatment plant that is not in the direct filtration plant?
- a. Filter
 - b. Clarifier
 - c. Mixer
 - d. Detention
98. How thick should the layer of sodium fluoride crystals be maintained in a saturator tank for flows of less than 100 gpm?
- *a. 6 inches
 - b. 10 inches
 - c. 1 foot
 - d. 2 feet
99. How much alkalinity as CaCO_3 will dry-basis alum consume?
- *a. 0.5 mg/l
 - b. 0.8 mg/l
 - c. 1.2 mg/l
 - d. 1.5 mg/l
100. Natural zeolites that have become exhausted with use are regenerated by immersing them in a strong solution of which chemical?
- *a. NaCl
 - b. NaOH
 - c. HCl
 - d. H_2SO_4
101. The zeta potential on a particular sample of water is -2 . The degree of coagulation is best described as
- a. poor.
 - b. fair.
 - *c. excellent.
 - d. maximum.
102. Which is a disadvantage of using static mixers?
- a. They do not provide good mixing

- b. They are not economical
 - *c. They increase head loss
 - d. They require too much maintenance
103. Which is the usual effective pH range of iron salt coagulants?
- *a. 3.5 to 9.0
 - b. 6.5 to 8.8
 - c. 3.0 to 9.5
 - d. 4.2 to 9.0
104. Which determines whether or not colloidal-sized particles in suspension repel each other, stay in suspension, or agglomerate and eventually settle?
- a. Number of collisions
 - b. Flow and temperature of the water
 - c. Types of chemical bonding
 - *d. Magnitude of the charges
105. If the sludge in a sedimentation basin becomes too thick, which could happen?
- a. Gases from decomposition will rise through the settled sludge accelerating normal floc settling
 - b. Abundant trihalomethanes and haloacetic acids will form
 - *c. Solids can become resuspended or taste and odors can develop
 - d. The sludge will compact at the bottom of the basin making it very difficult to remove
106. In basins using tube and plate settlers, which parameter must be much better than conventional treatment basins?
- a. Metals must be oxidized before reaching the tubes and plates
 - b. Floc rate must be 2 to 3 times slower than conventional basins
 - c. Floc rate must be 3 to 4 times faster than conventional basins
 - *d. Floc must have good settling characteristics
107. Which type of sedimentation basins have the flow of water admitted at an angle?
- a. Rectangular settling basins
 - b. Square settling basins
 - c. Center-feed settling basins
 - *d. Spiral-flow basins
108. At which minimum angle must self-cleaning tube settlers be placed?
- *a. 50 degrees
 - b. 60 degrees
 - c. 65 degrees
 - d. 70 degrees
109. If crustaceans have clogged the water treatment plant's filters, which is the most probable solution?
- a. Shut down the filters and physically remove them
 - b. Shut down one filter at a time and drain; once the crustaceans have died, physically

remove them and then repeat process on the other filters

c. Backwash filters using a very high concentration of ozone in the water

*d. Use a disinfectant that targets the specific organisms in question

110. Which organism can escape coagulation and thus pass through a granular filter?

a. Giardia

b. Entamoeba

*c. Cryptosporidium

d. Naegleria

111. Reverse osmosis membranes will compact faster with

a. higher iron content.

b. higher chlorine contact.

*c. higher pressure.

d. higher pH.

112. Which would immediately occur if newly installed manganese greensand was not skimmed of the fines after backwashing and stratification steps were completed?

a. Uneven flow through the bed

b. Cracks would develop in the bed

c. Mudball formation

*d. Shorter filter runs

113. When a filter is operated at normal flow rates, its ability to trap flocculated particles in suspension is a function of

a. effective size multiplied by uniformity coefficient.

b. effective size multiplied by uniformity coefficient divided by media size.

*c. media depth and media size.

d. media depth and uniformity coefficient.

114. Which is the total concentration of dissolved solids in the wastewater from the regeneration of ion exchange units?

a. 10,000 to 20,000 mg/l

b. 20,000 to 30,000 mg/l

*c. 35,000 to 45,000 mg/l

d. 45,000 to 60,000 mg/l

115. Which is the usual range of percent sludge solids, if the sludge is allowed to accumulate and compact at the bottom of a sedimentation basin?

*a. 2-4 %

b. 4-7 %

c. 7-12 %

d. 12-15 %

116. Which should be determined first before an in-ground sedimentation tank is drained?

a. The solids content

b. The hazardous metals content

- c. Sludge volume and volume of process area to make sure it will be large enough
 - *d. Water table level
117. Which sludge dewatering process is best for alum sludges (which are difficult to dewater) when the cakes are very dry, filtrate is clear, and solids capture is very high?
- a. Centrifuge
 - b. Vacuum filters
 - *c. Filter press
 - d. Belt filter press
118. Which sludge dewatering process requires a precoat of diatomaceous earth and its use has declined due to other newer methods?
- a. Centrifuge
 - *b. Vacuum filters
 - c. Filter press
 - d. Belt filter press
119. It is impossible to produce waters with a hardness of less than _____ when using the lime-soda ash process.
- a. 9 mg/l
 - b. 17 mg/l
 - *c. 25 mg/l
 - d. 50 mg/l
120. When added to water for softening purposes, soda ash will do which of the following?
- *a. Disinfect the water and kill the vast majority of protozoans, viruses, bacteria, and other multicellular organisms
 - b. Raise the pH of water to between 8.0 and 9.8 pH units
 - c. Add CO₂ to the water
 - d. Add calcium alkalinity to the water
121. Magnetic ion exchange resin has been developed to remove
- *a. total organic carbon.
 - b. chlorides.
 - c. iron and magnesium.
 - d. sulfates and sulfides.
122. Approximately how much carbon is lost during the reactivation process for granular activated carbon?
- *a. 5 %
 - b. 7 %
 - c. 10 %
 - d. 15 %
123. Which is the most advantageous application point for powdered activated carbon?
- *a. Raw water intake
 - b. After coagulation

- c. After oxidation with chlorine
 - d. In the filters
124. To obtain the best and most lasting control of algae, which is the optimum alkalinity range of the water being treated when using copper sulfate for algae control?
- *a. <50 mg/l
 - b. 50-75 mg/l
 - c. 76-100 mg/l
 - d. >101 mg/l
125. Trout can be killed if the copper sulfate application exceeds what dosage level?
- a. 0.08 mg/l
 - b. 0.10 mg/l
 - c. 0.12 mg/l
 - *d. 0.14 mg/l
126. The copper sulfate dose for controlling algae in lakes is predominately based on a lake's
- a. temperature.
 - b. pH.
 - c. turbidity.
 - *d. alkalinity.
127. Which is the typical filtration rate for high-rate filters?
- a. 0.5 to 2.0gpm/ft²
 - *b. 3.0 to 12.0gpm/ft²
 - c. 15.0 to 20.0gpm/ft²
 - d. > 25.0gpm/ft²
128. Particle counters use the principle of light
- a. scattering.
 - b. reflection.
 - c. refraction.
 - *d. blockage.
129. The pressure-reducing and shutoff valve on a vaporizer will shut off when there is a/an
- *a. loss of electrical power.
 - b. high water level.
 - c. high water temperature.
 - d. over-pressurization of the vaporization system.
130. How much time does it usually take to slake lime in the detention-time lime slaker?
- *a. 20 to 30 minutes
 - b. 30 to 45 minutes
 - c. 45 to 60 minutes
 - d. 60 to 75 minutes
131. At which temperature should the slaking process be maintained?
- a. 120Deg. F

- b. 135Deg. F
 - c. 150Deg. F
 - *d. 160Deg. F or higher
132. Which would be the most probable solution to control algae in the source water if the algae were clogging the filters at the water plant?
- a. Use activated carbon
 - b. Decrease oxygen levels
 - c. Backwash filters more frequently
 - *d. Control nutrients
133. A diatom is a type of
- a. bacterium.
 - *b. algae.
 - c. virus.
 - d. protozoan.
134. Over which water quality indicator do operators have the greatest control?
- a. alkalinity
 - b. pH
 - c. temperature
 - d. *turbidity
135. Which method would be the most effective treatment for zebra mussels at the inlet?
- a. Continuous dosing of chloramines at 0.5 to 1.0 mg/l
 - b. Continuous dosing of chlorine at 0.5 to 1.0 mg/l
 - c. Shock dosages of potassium permanganate at 1.0 to 2.0 mg/l for at least 15 minutes
 - *d. Shock treatment using chlorine at a dosage of 10.0 mg/l for 30 minutes
136. The bulk of synthetic organic compounds (SOCs) are
- a. solvents.
 - b. PAHs, PCBs, and polynuclear aromatic hydrocarbons.
 - *c. pesticides.
 - d. volatiles.
137. Which one of the following would be best to use for controlling algae in large water bodies?
- a. Hydrogen peroxide
 - b. Granular activated carbon
 - *c. Powdered activated carbon
 - d. Magnesium sulfate
138. For operational corrosion control, the total alkalinity concentration should be measured every
- *a. 8 hours.
 - b. 12 hours.
 - c. 4 hours.

- d. Week.
139. When manganese greensand filters are run in the continuous regeneration mode [continuous regeneration of the $\text{MnO}_2(s)$ surfaces], the free chlorine residual in the filter effluent should be kept at
- *a. 0.50 mg/l.
 - b. 1.00 mg/l.
 - c. 1.20 mg/l.
 - d. 1.75 mg/l.
140. The chemical that is used most for raising pH is:
- a. Calgon
 - *b. Lime
 - c. Alum
 - d. Calcium chloride
141. Proper coagulant dosage can be determined by:
- *a. Performing jar test
 - b. The break-point chlorination
 - c. Performing total solids tests
 - d. Observing the pilot filter
142. Which will occur if dry alum and quicklime are mixed together
- a. Create tremendous heat and hydrogen gas will be released
 - b. Dust may be released which may cause an explosion
 - c. A coagulated gel will form a
 - d. Nothing as they are neutral towards each other
143. Which device collects the settled water as it leaves the sedimentation basins
- a. Effluent weir
 - b. Effluent flow box
 - c. Effluent baffle
 - *d. Effluent launder
144. List three water treatment coagulant chemicals
- a. Turbidity, alkalinity, temperature
 - *b. Alum, ferric chloride, polymers
 - c. Chlorine, potassium permanganate, ozone
 - d. Water, pH, alum
145. Low values for which water characteristic usually cause poor coagulation flocculation and settling characteristics
- a. Water temperature
 - b. Turbidity
 - c. Alkalinity
 - d. pH

1. Chlorine gas is times heavier than breathing air
 - a. 2.5
 - b. 20
 - c. 60
 - d. 460
2. A commonly used method to test for chlorine residual in water is called the method.
 - a. HTH
 - b. THM
 - c. VOC
 - d. DPD
3. When chlorine gas is added to water the pH goes down due to
 - a. chlorine gas producing caustic substances
 - b. two base materials that form
 - c. *two acids that form
 - d. caustic soda being formed in the water
4. Disinfection by-products are a product of:
 - a. Filtration
 - b. Disinfection
 - c. Sedimentation
 - d. Adsorption
5. Chloramine is most effective as a disinfectant.
 - a. Primary
 - b. Secondary
 - c. Third
 - d. First
6. 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
7. 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
8. 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

9. Secondary disinfectants are used to provide a in the distribution system.
 - a. Color
 - b. Chemical
 - c. Smell
 - d. Residual
10. Primary disinfectants are used to microorganisms.
 - a. Hurt
 - b. Inactivate
 - c. Burn up
 - d. Evaporate
11. The quantity of chlorine remaining after primary disinfection is called a residual.
 - a. Chlorine
 - b. Permaganate
 - c. Hot
 - d. Cold
12. 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
13. 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
14. A__ residual of chlorine is required throughout the system.
 - a. Large
 - b. High
 - c. Trace
 - d. Hot
15. 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
16. 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
- 17. 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
- 18. Free chlorine can only be obtained after point chlorination has been achieved.
 - a. Breakpoint
 - b. Fastpoint
 - c. Softpoint
 - d. Onpoint
- 19. 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
- 20. Chloramine is most affective as a disinfectant.
 - a. Primary
 - b. Secondary
 - c. Third
 - d. First
- 21. TTHMs and HAA5s can affect:
 - a. Health
 - b. Aesthetics
 - c. Color
 - d. Odor
- 22. The multiple barrier treatment approach includes
 - a. Sterilization and filtration
 - b. Disinfection and filtration
 - c. Disinfection and sterilization
 - d. Infection and filtration
- 23. 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
- 24. What is the disinfectant byproduct caused by ozonation?
 - a. Trihalomethanes
 - b. Bromate
 - c. Chlorite

- d. No DBP formation
- 25. Haloacetic Acids are also known as
 - a. TTHM
 - b. HOCL
 - c. Chlorite
 - d. HAA5
- 26. What is the MCL for trihalomethanes?
 - a. .10mg/L
 - b. .06mg/L
 - c. .08mg/L
 - d. .12mg/L
- 27. What is the MCL for Haloacetic Acids?
 - a. 100ppb
 - b. 60ppb
 - c. 80ppb
 - d. 120ppb
- 28. What is the MCL for bromate?
 - a. .010mg/L
 - b. .020mg/L
 - c. .030mg/L
 - d. .040mg/L
- 29. 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
- 30. When Chlorine reacts with natural organic matter in water it can create
 - a. Disinfectant by-products
 - b. Coliform bacteria
 - c. Chloroform
 - d. Calcium
- 31. What are trihalomethanes classified as
 - a. Salts
 - b. Inorganic compounds
 - c. Volatile organic compounds
 - d. Radio
- 32. What disinfectant is used for emergency purposes and not utilized in the water treatment industry?
 - a. Chlorine
 - b. Iodine

- c. Ozone
 - d. Chlorine Dioxide
33. 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
34. The active ingredient in household bleach is
- a. Calcium hypochlorite
 - b. Calcium hydroxide
 - c. Sodium hypochlorite
 - d. Sodium hydroxide
35. Cryptosporidium is not resistant to this chemical
- a. Ozone
 - b. Chlorine Dioxide
 - c. Chlorine
 - d. Both A&B
36. 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
37. 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
38. The form of Chlorine which is 100% available chlorine is?
- a. Sodium Hypochlorite
 - b. Calcium Hypochlorite
 - c. Calcium Hydroxide
 - d. Gaseous Chlorine
39. 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

40. What is the approximate pH range of sodium hypochlorite?
- 4-5
 - 6-7
 - 9 – 11
 - 12 – 14
41. What is the typical concentration of sodium hypochlorite utilized in water treatment?
- 5%
 - 65%
 - 100%
 - 12.5%
42. Chlorine demand refers to
- Chlorine in the system for a given time
 - The difference between chlorine applied and chlorine residual-usually caused by inorganics, organics, bacteria, algae, ammonia, etc.
 - Chlorine needed to produce a higher pH
 - None of the above
43. What is the most effective chlorine disinfectant?
- Dichloramine
 - Trichloramine
 - Hypochlorite Ion
 - Hypochlorous acid
44. What can form when chlorine reacts with natural organic matter in source water?
- Disinfectant by-products
 - Sulfur
 - Algae
 - Coliform bacteria
45. What kind of solution is used to check for a gas chlorine leak?
- Sodium hydroxide
 - Ozone
 - Ammonia
 - Calcium hypochlorite
46. Chlorine is
- Heavier than air
 - Lighter than air
 - Brown in color
 - not harmful to your health
47. Chlorine demand may vary due to
- Chlorine demand always stays the same
 - Temperature
 - pH

- d. Both B and C
- 48. 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
- 49. What is the target chlorine:ammonia ratio?
 - a. 2 : 1
 - b. 3 : 1
 - c. 4 : 1
 - d. 5 : 1
- 50. What is the MCL for Nitrates?
 - a. 1ppm
 - b. 10ppm
 - c. 5ppm
 - d. None of the above
- 51. What is the molecular weight of Chlorine?
 - a. 70
 - b. 14
 - c. 65
 - d. 20
- 52. What disinfectant has the longest lasting residual?
 - a. Ozone
 - b. Chlorine
 - c. Chloramine
 - d. Chlorine Dioxide
- 53. 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
- 54. What are THMs classified as?
 - a. Turbidity
 - b. Radiological
 - c. Volatile Organic Chemicals
 - d. Salts
- 55. 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

56. How many times stronger is Chlorine compared to monochloramine?
- 250 times
 - 20 times
 - 1500 times
 - 5 times
57. What chemicals are formed when chlorine is mixed with water?
- Hydrogen sulfide and ammonia
 - DPD and carbon dioxide
 - Sodium hypochlorite and calcium hypochlorite
 - Hypochlorous acid and hydrochloric acid
58. Chlorine residual is measured in the field using the
- Electroconductivity method
 - EDTA titrimetric method
 - Ortho-tolidine colorimetric method
 - DPD colorimetric method
 - Differential pH method
59. In nitrification, bacteria consume excess ammonia in the water and produce
- Chloramines
 - Free chlorine
 - Urine
 - Nitrite
 - Sodium thiosulfate
60. Which of the following is a form of free chlorine?
- Nitrite
 - Hypochlorous acid
 - Monochloramine
 - Hydrochloric acid
 - Trichloramine
61. 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?
- Zero
 - One
 - Two
 - Three
 - Four
62. What is the chlorine dosage that must be applied when disinfecting a pipeline using the slug method?
- 300mg/L
 - 100mg/L
 - 50mg/L

- d. 25mg/L
 - e. 6mg/L
63. Which of the following is a form of combined chlorine?
- a. Hypochlorite ion
 - b. Hypochlorous acid
 - c. Monochloramine
 - d. Hydrochloric acid
 - e. Free ammonia
64. 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
65. 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
66. Of the following, which is the most effective disinfectant?
- a. Hypochlorite ion
 - b. Hypochlorous acid
 - c. Monochloramine
 - d. Dichloramine
 - e. Trichloramine
67. 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
68. 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

69. Residual chlorine refers to
- The amount of chlorine in the chlorinated water after several minutes
 - The chlorine needed to disinfect the water supply
 - The chlorine needed to produce floc in the water
 - The sludge in the bottom of the chlorine solution tank
 - None of the above
70. While handling sodium hypochlorite, proper safety precautions include:
- Avoiding situations that could splash hypochlorite solution.
 - Using a face shield and/or goggles to avoid eye contact.
 - Minimizing skin contact with rubber gloves and/or protective clothing
 - All of the above
 - None of the above are necessary
71. The fusible plug that is in all chlorine containers
- Is not necessary
 - May be used as a tap for the chlorine source
 - Should be removed after the cylinders are empty
 - Should never be removed or tampered with
 - Should be removed prior to withdrawing chlorine from the container
72. Sodium hypochlorite is a
- Compound purchased in liquid solution used for disinfection
 - Dry neutralizing powder for treating chlorine burns
 - Gas delivered in 100-pound, 150-pound, or one-ton containers
 - Salt that is formed when hydrochloric acid is neutralized with caustic soda
 - None of the above
73. The chlorine demand abruptly jumps in your source water. This may indicate that
- The water source has been contaminated
 - Flow rates in the distribution system have increased
 - The hypochlorite solution used for disinfection has deteriorated
 - The hypochlorite solution tank is empty
 - The hypochlorite ion has a higher concentration than hypochlorous acid
74. The chemical compound typically found in chlorination tablets and granules is
- Sodium hypochlorite
 - Sodium hydroxide
 - Sodium chloride
 - Calcium hypochlorite
 - Calcium hydroxide
75. The maximum rate of withdrawal of gas from a 150-pound chlorine cylinder in 24-hours is
- 20 pounds
 - 40 pounds
 - 100 pounds
 - 150 pounds
 - None of the above
76. 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
77. 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
78. 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
79. 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
80. 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
81. 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
82. 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
83. Killing of pathogenic organisms in water treatment is called
- a. Disinfection
 - b. Oxidation
 - c. Pasteurization
 - d. Sterilization
84. Chlorine reacts with nitrogenous compounds to form
- a. Ammonia nitrate
 - b. Free chlorine
 - c. Chlorinated hydrocarbons
 - *d. Chloramines
85. 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
86. 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
87. 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
88. 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
89. 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

90. Breakpoint chlorination is achieved when
- Free ammonia can be tasted in the water
 - No chlorine residual is detected
 - The strong chlorine tasted at the plant did not persist in the distribution system
 - When chlorine dosage is increased, a corresponding increase in residual is detected
91. Because chlorine residual is related to the pH of the water, it may be said that
- A higher pH requires a higher chlorine residual
 - A higher pH requires a lower chlorine residual
 - A lower pH requires a higher chlorine residual
 - pH has no effect on chlorine residual
92. As long as the temperature is steady, the pressure indicator on a chlorine cylinder will until all the chlorine has been gasified
- Remain steady
 - Decrease slowly
 - Decrease rapidly
 - Increase slightly
93. When fresh, the typical concentration of sodium hypochlorite solution is
- 1.25%
 - 6.5%
 - 12.5%
 - 65%
 - variable, depending on the manufacturer
94. Chlorine in a dry form is called:
- hypochlorite
 - hypochlorous
 - hydrochlorite
 - hydroxide
95. Which of the following procedures is done when preparing to disconnect a chlorine cylinder?
- close the cylinder valve first to allow time for the chlorine to be drawn off
 - loosen the line to the tank and then shut off the valve to the chlorine cylinder
 - shut off the water supply and allow sufficient time for the chlorine to be drawn off
 - turn the chlorinator feed rate valve off then turn the valve on the chlorine cylinder
96. A vacuum is formed in the chlorinator by the:
- chlorine cylinder pressure
 - pressure differential through the ejector
 - chlorine feed pump
 - rotameter-
97. When calcium hypochlorite is used for disinfecting a water supply, it should be be:
- 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
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- a. A higher pH requires a higher chlorine residual
 - b. A higher pH requires a lower chlorine residual
 - c. A lower pH requires a higher chlorine residual
 - d. A lower pH has no effect on chlorine residual
99. 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
100. When two ton cylinders are feeding gas and one of them is frosted, what might be the problem?
- a. The feed rate is too high
 - b. The line on the frosted tank is clogged
 - c. The valve on the unfrosted tank
 - d. The injector is clogged
101. There is low vacuum on the system and the flow rate is low when the rate valve is wide open, what is the problem?
- a. The feed rate is too high
 - b. The injector is clogged
 - c. There is a clogged feed line
 - d. The rotameter is clogged
102. If ammonia vapor is passed over a chlorine leak in a cylinder valve, the presence of the leak is indicated by a
- a. Yellow cloud
 - b. White cloud
 - c. Gray cloud
 - d. Brown cloud
103. When chlorine is used as a disinfectant in water there reaches a point when the amount of chlorine added is reflected identically with the amount of free residual measured on your DPD
- a) chloramination
 - *b) breakpoint
 - c) ozone
 - d) liftoff

104. Chlorine gas is times than air
- a) 2.5 , lighter
 - b) 4.5 , heavier
 - c) 3.5 , lighter
 - *d) 2.5, heavier
105. Which disinfection method provides a residual safeguard?
- a) ozonation
 - *b) chlorination
 - c) membrane filtration
 - d) ultraviolet radiation
106. Which is the most effective disinfectant when chlorine is added to water?
- a) hydrogen ion
 - b) calcium dioxide
 - *c) hypochlorous acid
 - d) haloacetic acid
107. When chlorine reacts with organics in the water it has the tendency to produce
- a) chloramines
 - *b) trihalomethanes and haloacetic acids
 - c) macrofloc
 - d) apparent color
108. Which type of flow meter should be used for chlorinators which require very low flow
- a. Rotameter
 - b. Loss of head meter
 - *c. Positive displacement meter
 - d. Magnetic meter
109. The device used to regulate and control the rate of feed of chlorine gas is called a
- a. Pump regulator
 - b. Rotameter
 - c. Gas regulator
 - *d. Chlorinator
110. Disinfection by products can be formed by the reaction of disinfectants with
- a. Disinfection by products
 - b. Dissolved solids
 - c. Chemicals
 - *d. Natural organic matter
111. The best way to determine how much chlorine is in a chlorine cylinder is to
- a. Shake the cylinder
 - b. Measure the internal pressure
 - c. Measure the cylinder residual d
 - d. Weigh the cylinder

112. The fusible plugs on a chlorine container are designed to melt and release chlorine when the container reaches which temperature?
- *a. 158° to 165°F
 - b. 158° to 165°C
 - c. 212° to 220°F
 - d. 100° to 105°C
113. The 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. Total alkalinity
114. Which is the primary drawback for facilities that use ultraviolet light to disinfect water?
- a. It does not inactivate all microorganisms
 - b. It has the potential to produce trihalomethanes
 - c. Dissolved colloids can shield microorganisms from the UV light
 - *d. There is potential for the light bulbs to be coated with light-obscuring material, preventing the UV light from killing microorganisms
115. Potassium permanganate is most effective in
- a. color removal.
 - b. control of biological growth.
 - c. control of trihalomethanes formation potential.
 - *d. removing iron.
116. Chlorine is advantageous over chloramines in that chlorine
- *a. is a much stronger oxidant.
 - b. has long history of use.
 - c. has simple feeding.
 - d. has a persistent residual.
117. Which oxidant has the potential of producing ClO_3 by-products?
- *a. Chlorine dioxide
 - b. Chlorine
 - c. Chloramines
 - d. Calcium hypochlorite
118. Which is the working strength of sodium hydroxide solution in a chlorine neutralization tank?
- a. 15%
 - *b. 20%
 - c. 25%
 - d. 30%
119. Water treatment plants are increasingly using hypochlorination because it is

- *a. relatively safe compared to using gaseous chlorine.
 - b. very inexpensive compared to other disinfectants.
 - c. a stronger oxidant than gaseous chlorine.
 - d. not going to form trihalomethanes.
120. A single chlorine cylinder is delivering 48lb/d of chlorine to the water process, causing the cylinder to form a little frost. Which would be the best solution to this problem?
- a. Install a fan to improve air circulation
 - b. Heat the cylinder immediately below the valve with heat tape
 - c. Heat the valve only
 - *d. Add another cylinder and feed from both
121. The pressure-reducing and shutoff valve on a vaporizer will shut off when there is a/an
- *a. loss of electrical power.
 - b. high water level.
 - c. high water temperature.
 - d. over-pressurization of the vaporization system.
122. When chlorine gas is added to water the pH goes down due to
- a. chlorine gas producing caustic substances
 - b. two base materials that form
 - *c. *two acids that form
 - d. caustic soda being formed in the water
123. Taste and odor from Phenolic compounds are _____ by chlorination.
- *a. Increased
 - b. Decreased
 - c. Not affected

1. Name the type of valve that is sometimes found on the suction side of a centrifugal pump and is located where the water enters the casing.
 - a. Check valve
 - b. Gate valve
 - c. Altitude valve
 - d. Pressure relief valve
 - e. *Foot valve
2. After a pump is shut off but continues to run backwards indicates:
 - a. The bearings are failing
 - b. The packing needs tightening
 - c. The main lock nut needs to be tightened
 - d. *The check valve is leaking
 - e. A valve on the discharge side of the pump is shut
3. Wear rings are installed in a pump to:
 - a. hold the shaft in position
 - b. keep the impeller in place
 - c. *keep wear concentrated on economically replaceable part
 - d. wear out the sleeve
4. 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
5. Head is measured in
 - a. absolute pressure.
 - b. gauge pressure.
 - c. *feet.
 - d. foot-pounds.
6. To ease installation of impeller wear rings, they can be
 - a. lubricated with a light oil.
 - b. greased with lithium.
 - *c. heated.
 - d. cooled.
7. Packing is designed to
 - a. add lubricant to the shaft.
 - b. expand and deteriorate with normal use.
 - c. protect the shaft.
 - *d. wear and deteriorate with normal use.
8. Bearings on a line shaft turbine can be lubricated with
 - *a. oil or water.

- b. grease or oil.
 - c. lithium or grease.
 - d. graphite or grease.
9. Packing replacement is usually performed when
- *a. water leakage sprays out of the pump housing.
 - b. no further tightening can be done on the packing gland.
 - c. the packing gland bolts are exposed by more than $2^{1/2}$ inches above the nut.
 - d. the packing has completely disintegrated.
10. Which is at the top of a stuffing box?
- *a. Packing gland
 - b. Lantern ring
 - c. Mechanical seal
 - d. Seal cage
11. Which assembly holds the lantern ring and packing?
- a. Shaft assembly
 - b. Casing ring assembly
 - *c. Packing gland casing
 - d. Stuffing box
12. Which of the following prevents the impeller of a pump from turning on the shaft?
- a. Lock nut on threaded shaft
 - *b. Key
 - c. Steel pin
 - d. Caliper pin
13. Which device serves the same function as the packing?
- a. Inline suction gland
 - b. Packing gland
 - c. *Mechanical seal
 - d. Lantern seal
14. 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.
15. 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.

16. 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
17. 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
18. 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
19. The force used in an End-suction pump is called
 - a. Pressure
 - b. Centrifugal
 - c. Velocity
 - d. Kinetic
20. ___ is the loss of energy as a result of friction.
 - a. Velocity loss
 - b. Headloss
 - c. Elevation Loss
 - d. Pump Loss
21. 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
22. 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
23. Head is the energy that a body has by virtue of its position or state.
 - a. Velocity
 - b. Potential
 - c. Kinetic

- d. Pressure
- 24. 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
- 25. 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
- 26. 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
- 27. Velocity of a pump is measured in:
 - a. Inches per second
 - b. PSI
 - c. Feet per second
 - d. Yards per second
- 28. 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
- 29. To change the discharge of displacement you have to change the:
 - a. Speed
 - b. Discharge valve
 - c. Suction valve
 - d. Rotation
- 30. Which pump component prevents leakage from the pump discharge to the suction?
 - a. Lantern ring
 - b. Volute
 - c. Wear ring
 - d. Shaft sleeve
- 31. 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.
32. 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.
33. 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
34. The flow of electrical current is measured in
- *a. Amperes
 - b. Ohms
 - c. Volts
 - d. Watts
35. An operator hears a pinging sound coming from the pump. What is the probable cause?
- a. Descaling
 - b. Cavitation
 - c. Corrosion
 - d. Hardness
36. 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
37. The-leakage of seal-water-around-the-packing on a centrifugal pump is required because it acts as a(n)
- a. Adhesive
 - b. Coolant
 - c. Corrosion inhibitor
 - d. Scale inhibitor
38. 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

39. The difference between water levels upstream and downstream of a pump when it is not in operation is known as the
- Suction lift
 - Total dynamic head
 - Discharge head
 - Friction loss
 - Total static head
40. Static suction head plus friction suction head plus static discharge head plus friction discharge head is a pump's
- Pump curve
 - Operating pressure
 - Efficiency
 - Total dynamic head
 - Velocity head
41. Pumps are primed to
- *Replace air inside the pump with water
 - Seat the valves
 - Wet the packing
 - Provide water for flow testing
 - Overcome positive suction head
42. Backspin is occurring after well shutdown; this indicates
- A high water table
 - A low water table
 - A confined aquifer
 - A faulty check valve
 - A leak in the sanitary seal
43. A water seal on a pump serves many purposes, including
- Acts as a coolant to keep the pump bearing from overheating
 - Keeps gritty material from entering the packing box
 - Keeps the pumps primed
 - Is a reserve water supply
 - Prevents cavitation
44. Enclosed, open, and semi-closed are terms used for the designation and selection of:
- Impellers
 - Lantern rings
 - Sleeves
 - Stuffing boxes
 - None of the above
45. A device that converts electrical energy into mechanical or kinetic energy is called a
- Motor

- b. Generator
 - c. Transformer
 - d. Battery
 - e. Pump
46. 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
47. The rotating element in a centrifugal pump is commonly called the
- a. Fan
 - b. Impeller
 - c. Rotor
 - d. Volute
 - e. Stator
48. 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
49. 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
50. 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
51. The linkage between a centrifugal pump and its motor is commonly called the
- a. Coupling
 - b. Impeller
 - c. Bearings
 - d. Volute
 - e. Stator

52. The electrical equivalent to friction in water lines is
- Voltage
 - Resistance
 - Amperage
 - Capacitance
 - Inductance
53. The main water-containing body of a centrifugal pump is commonly called the
- Shaft
 - Impeller
 - Bearings
 - Volute
 - Stator
54. A type of pump that produces high flow rates with low discharge heads is a
- Radial flow
 - Axial flow
 - Vertical turbine
 - Piston
 - Mixed flow
55. Alternating current is produced by
- A single battery
 - Two (or more) batteries in series
 - Two (or more) batteries in parallel
 - A solenoid
 - A generator
56. What do electrical transformers do?
- Step-up or step-down current
 - Step-up or step-down voltage
 - Increase power output
 - Decrease power output
 - Reduce resistance
57. An "Open" electrical circuit is one in which
- Resistance is low
 - Power production is high
 - Capacitance is low
 - Conductivity is high
 - *e. Amperage is zero
58. Adding more stages (bowls) to a deep well turbine pump assembly will
- Increase the pump discharge capacity
 - Decrease the pump discharge capacity
 - Increase the pump discharge pressure

- d. Decrease the pump discharge pressure
 - e. None of the above
59. 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
60. 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
61. 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
62. 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.
63. 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
64. 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
65. 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
66. The inlet to the pump is called:
- a. Suction
 - b. Volute
 - c. Impeller
 - d. Effluent
67. The rotating element in a centrifugal pump is commonly called a(n):
- a. Fan
 - b. Impeller
 - c. Rotor
 - d. Volute
68. 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
69. A vertical turbine pump is an example of a : a) centrifugal pump b) parshall flume c) positive displacement pump
- d) reciprocating pump
 - e) all of the above
70. 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
71. 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 line valves are open and discharge line valves are closed
72. Proper alignment between two shafts can be checked using a:
- a. caliper
 - b. micrometer
 - c. straight edge d. feeler gauge
73. The maximum practical suction lift of a properly engineered centrifugal pump is about:
- a. 5 – 10ft

- b. 10 – 15ft
 - c. 15 – 25ft
 - d. 25 – 34ft
74. 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
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- a. centrifugal pump
 - b. parshall flume
 - c. positive displacement pump
 - d. reciprocating pump
 - e. all of the above
76. 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
77. Ppmps 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
78. If the packing on an operating centrifugal pump has a slight leakage, the following action should be taken:
- a. shut down immediately
 - b. tighten packing gland
 - c. lubricate pump packing gland
 - d. decrease pump speed and head
 - *e. nothing
79. If bearings on a centrifugal pump are running hot, checking for over lubrication or under lubrication would be. listed as a general preventive maintenance service. If the lubrication is satisfactory, the next preventive maintenance check would be:
- a. replace bearings
 - b. operate only when needed
 - c. clean the pump

- d. recheck TDH
 - *e. inspect alignment of pump and motor
80. If a wastewater pump is to be shut down for a long period of time, the proper procedure is to open and lock out the motor disconnect switch and shut the valves on both sides of the pump.
- a. True
 - *b. False
81. Centrifugal pump parts include
- a. Diaphragm
 - *b. Impeller
 - c. Piston
 - d. Rotor
82. Where does wear most frequently occur on a plunger pump?
- *a. Cylinder
 - b. Rotor
 - c. Stators
 - d. Volute
83. As rotors or stators accumulate wear on progressive cavity pumps, the capacity of the pump is decreased. What is the easiest way to tell if the pump elements are worn?
- a. Tap into the line between the pump and the discharge valve and determine the pump capacity by timing how long it takes to fill a 20-liter pail
 - *b. Measure the pressure on the discharge side of the pump with valves open and the pump pumping
 - c. Disassemble the pump, measure the parts and compare it to the original specifications
 - d. Close the discharge valve and measure the resultant pressure
84. A centrifugal pump vibrates and is noisy. From the choices below, select the most probable cause
- a. Impeller too small
 - b. Foot valve too small
 - c. Dirt or grit in sealing liquid
 - *d. Air in the pump
85. Given the following data, what is the most likely cause of the pump problem?
- DATA: Pump is running
Reduced discharge from lift station
Impeller is clear
Level sensors are operating properly
- a. Improper packing
 - b. Misaligned belt drives
 - *c. Pump air bound
 - d. None of the above

86. Excessive leakage around seals on the shafts and plungers of a plunger pump may indicate what?
- a. Attempting to pump against too great a head
 - *b. Excessive wear of the shaft and plunger
 - c. The eccentric needs replacement
 - d. The pump needs new ball checks
87. In operating a small pumping station, which is provided with two identical pumps, it is best to adjust the controls so that
- a. One pump does most of the work and the second pump is held in reserve being operated intermittently to keep it in good running condition
 - *b. The pumps alternate in operation
 - c. The pumps both turn on together
 - d. None of the above
88. A positive displacement sludge pump should never be placed into operation
- a. Without being primed.
 - *b. With the discharge valve closed.
 - c. With the discharge valve opened.
 - d. None of the above
89. Prior to repairing a pump's electrical circuit, which of the following actions should you take?
- *a. Disconnect the circuit breaker, place a red tag stating "do not activate," and lock out
 - b. Notify your supervisor
 - c. Tell all of the operators not to activate the circuit
 - d. Turn pump off
90. Pump maintenance includes
- a. Checking operating temperature of bearings
 - b. Checking packing gland.
 - c. Operating two or more pumps of the same size alternately to equalize wear
 - *d. All of the above
91. When carrying out a routine inspection on a centrifugal pump, it is noted by the operator that the bearings are excessively hot This could be caused by
- *a. Over lubrication
 - b. Speed too slow
 - c. Worn impeller
 - d. Worn packing
92. In a centrifugal pump, internal leakage is prevented by
- a. Impellers
 - b. Sleeves
 - c. Volutes
 - *d. Wear rings

93. A horizontal centrifugal pump has "rope" packing. When the pump is operating, water slowly drips from the packing gland. This indicates that the
- a. Packing bolts or nuts on the packing gland should be tightened.
 - b. Packing bolts or nuts on the packing gland should be loosened.
 - *c. Packing bolts or nuts on the packing gland are properly adjusted.
 - d. Packing should be replaced.
94. Wear rings are installed in a pump to
- a. Hold the shaft in position
 - b. Keep the impeller in place
 - *c. Concentrate wear on an economically replaceable part
 - d. Wear out rings instead of sleeves
95. A water seal on a pump serves a dual purpose. It acts as a lubricant and it also
- a. Acts as a coolant to keep the pump bearing from overheating
 - *b. Keeps gritty material from entering the packing box
 - c. Keeps the pump primed.
 - d. Is a reserve water supply
96. The elevation of any pump above the source of supply should not exceed feet
- a. 2.2
 - *b. 22
 - c. 200
 - d. 224
97. What is the vertical distance between the elevation of the free water surface at the suction and that of the free water surface at the discharge of a pump called?
- a. Discharge head.
 - b. Dynamic head.
 - c. Velocity head.
 - *d. Static head.
98. In electrical circuits, a device used to reduce the voltage is a(n)
- a. Ammeter
 - b. Transducer
 - c. Transformer
 - d. Voltmeter
99. 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
100. Connect a motor to a pump using:
- a. A sleeve clamp

- b. A coupling
- c. Mechanical seals
- d. Bailing wire and bubble gum

101. Which of the following would be a good application for a peristaltic pump?

- a. Booster pump
- b. Well pump
- c. Chemical feed pump
- d. Air compressor

102. Which component in a diaphragm pump causes the most maintenance problems?

- a. Shaft
- b. Check valves
- c. Diaphragm
- d. Pump head

103. The shaft's main function is to transmit

- a. Centrifugal force
- b. Kinetic energy
- c. Thrust
- *d. Torque

1. What is the reason for keeping adequate, reliable records in a treatment plant?
 - a. *to record the plant's effectiveness and because of requirements by regulatory agencies
 - b. to maintain records for cold cases
 - c. in case the IRS wishes to check files for due diligence
 - d. because of homeland security issues and files being available to the public
2. Which statement about displacement meters is not correct:
 - a. The most common type of water service meter is the displacement type
 - b. Displacement meters are accurate at low flows
 - c. Excess sediment can cause the meter to stop registering
 - d. *Displacement meters have little head loss due to friction
 - e. Displacement meters operated at a rate in excess of its stated capacity can result in excessive wear
3. A fire hydrant should be closed slowly to avoid:
 - a. Excessive wear
 - b. *Water hammer
 - c. Excessive head loss
 - d. Injury to operator
4. The minimum separation between municipal water mains and sanitary sewers for installation in a common trench shall be:
 - a. 5 feet horizontal separation
 - b. *10 feet horizontal separation
 - c. 15 feet horizontal separation
 - d. 25 feet horizontal separation
5. 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/l for 24 hours
 - c. use a 10% solution of calcium chloride
 - d. don't use them main for one week
6. When using a dry-barrel fire hydrant, the valve:
 - a. should never be opened completely
 - b. be opened only during the hours of 8AM to 5PM
 - c. be opened to the desired amount of flow
 - d. be opened all the way
7. The primary reason for dry barrel-fire hydrants is to:
 - a. allow easy maintenance
 - b. prevent water hammer
 - c. *keep the hydrant from freezing
 - d. keep the barrel from rusting
8. A centrifugal pump should not be run empty except momentarily because:
 - a. a serious counter pressure could develop and damage the pump casing.
 - b. it is a waste of

- energy to run a pump without water.
- c. the excessive end thrust of the shaft would damage the thrust bearing.
 - d. *the parts lubricated by water could be damaged.
9. Pipes of dissimilar metal should not be connected together because of problems due:
- a. to scale formation
 - b. *corrosion
 - c. water hammer
 - d. the venturi effect
10. Which type of valve will prevent the collapse of a pipe?
- a. Pressure-relief valve
 - b. Needle valve
 - c. Pinch valve
 - d. *Air-and-vacuum relief valve
11. The correct protective methods for backflow-prevention devices in order of decreasing effectiveness are
- a. air gap, VB, RPZ, and DCVA.
 - b. air gap, VB, DCVA, and RPZ.
 - c. air gap, RPZ, VB, and DCVA.
 - d. *air gap, RPZ, DCVA, and VB.
12. The C-value is a measure of a pipe's wall
- a. smoothness.
 - b. smoothness giving even flow.
 - c. smoothness that retards turbulent flow.
 - d. *roughness that retards flow due to friction.
13. Which one of the following is a type of joint for ductile iron piping?
- a. Expansion joint
 - b. *Push-on joint
 - c. Bell and spigot with rubber o-ring
 - d. Rubber gasket joint
14. Water hammer can be described as
- a. particle waves.
 - b. *acoustic waves.
 - c. rogue waves.
 - d. longitudinal waves.
15. Which thrust control is easy to use, especially in locations where existing utilities or structures are numerous?
- a. *Restraining fittings
 - b. Tie rods
 - c. Thrust anchors
 - d. Thrust blocks The backfill material for a pipe installation should contain enough to

allow for thorough compaction.

- a. moisture
 - b. *sand
 - c. gravel
 - d. mixed sizes
16. Thrust from a water surge almost always acts pushes against. to the inside surface that it
- a. *vertically
 - b. horizontally
 - c. perpendicular
 - d. vertically and horizontally
17. The breaking of a buried pipe when it is unevenly supported is called
- a. stress breakage.
 - b. shear breakage.
 - c. *beam breakage.
 - d. flexural breakage.
18. Compression fittings used with copper or plastic tubing seal by means of a
- a. *beveled sleeve.
 - b. compression ring.
 - c. compressed beveled gasket.
 - d. compressed o-rings located at either end of the fitting's beveled neck.
19. Which should be installed at a dead-end water main?
- a. Vacuum valve
 - b. Air valve
 - c. *Blowoff valve
 - d. Water quality sampling station
20. First draw samples for the analysis of lead and copper water must be collected from taps where the water has stood motionless in the plumbing for at least
- a. 4 hours.
 - b. 6 hours.
 - c. 8 hours.
 - d. *24 hours.
21. According to AWWA Standard C651, disinfection of water mains requires 24-hour exposure to which minimum free chlorine residual?
- a. 10mg/L
 - b. *25mg/L
 - c. 50mg/L
 - d. 100mg/L
22. 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
23. 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
24. 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
25. 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
26. ___ 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
27. ___ 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
28. 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
29. The sudden closure of a check valve will result in

- a. water hammer
 - b. flow reversal
 - c. cavitation
 - d. water aeration
30. 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
31. 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
32. 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
33. 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
34. 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
35. 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
36. 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.
37. A nutating disc is found in certain:
- a. Centrifugal pumps
 - b. Positive displacement pumps
 - c. Main line valves
 - d. Chemical feeder
 - *e. Water meters
38. 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
39. 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
40. 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
41. Check valves are used to prevent
- a. Excessive pump pressure
 - b. Priming
 - c. Water from flowing in two directions
 - d. Water hammer
42. 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
43. 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
44. 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
45. 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
46. 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
47. 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
48. 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
49. 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
50. 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
51. 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
52. What category of meters is exemplified by propeller and turbine types?
- a. Differential pressure
 - b. Positive displacement
 - c. Mass flow
 - d. Velocity
53. 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
54. 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
55. 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
56. 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
57. The valve type most commonly used for isolation in a water distribution system is the
- a. Gate valve
 - b. Air relief valve
 - c. Globe valve
 - d. Ball valve
 - e. Butterfly valve
58. 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
59. 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
60. 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
61. The most common valve in a water distribution system is the
- a. Gate valve
 - b. Air relief valve
 - c. Globe valve
 - d. Ball valve
 - e. Butterfly valve
62. 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. Ultrasonic flow meter
63. 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
64. Features that impact the " C " 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
65. 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
66. "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
67. 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
68. 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
69. 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
70. 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
71. 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
72. Two hydraulic conditions can induce backflow. These are backsiphonage and
- a. Peak flow
 - b. Diurnal flow
 - c. Faulty solenoid valves
 - d. Back pressure
 - e. Fire flow
73. 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 faster
 - d. the main may collapse
74. 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
75. 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
- 76. 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
- 77. 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
- 78. 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. Ultrasonic flow meter
- 79. 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
- 80. 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
- 81. 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
- 82. 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
- 83. 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
- 84. 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
- 85. 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
- 86. 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.
- 87. 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.
- 88. A venturi meter measures flow of a fluid in a pipe based upon the:
 - a. Difference in pressure between a constricted and a full size portion of the pipe,
 - b. Electronic measurement
 - c. Velocity of the fluid past a given point.
 - d. Weight of the fluid
- 89. 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.
90. 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
91. 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
92. The size of water mains, pumping stations, and storage tanks is primarily determined by:
- a. Maximum day demand during a 24hr. period during the previous year.
 - b. Population served
 - c. Per-capita water use
 - d. Fire protection requirement
93. 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
94. 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)
95. The peak capacity of water mains is often reduced by
- a. High pressure
 - b. Looping
 - *c. Tuberculation
 - d. Vacuum breakers
96. 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
97. Water should be delivered with a minimum working pressure of:

- a. 45psi
 - a. 100psi
 - b. 35psi
 - c. 50psi
 - d. 15psi
98. Thrust blocks are installed to
- a. boost flexible joints.
 - b. boost water pressure.
 - c. minimize corrosion
 - d. prevent movement of pipes & joints.
99. Distribution system pressure (even during fire fighting demands) should not be allowed to drop below psi.
- a. 0
 - b. 5
 - c. 20
 - d. 40
100. Whenever possible the end of a distribution system should be to prevent taste and odor problems.
- a. inspected
 - b. looped.
 - c. plugged
 - d. capped
101. 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
102. 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
103. 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
104. 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

item The best way to protect the water supply from contamination by cross-connection is:

- a. A double check valve
- b. A vacuum breaker
- c. An air gap
- d. A reduced pressure zone device

105. The positive side of the cathodic protection system is the:

- a. Tank
- b. Cathode
- c. Rectifier
- d. Sacrificial anode

106. A flow meter on a fire line would probably be a:

- a. Venturi meter
- b. Nutating disk meter
- c. Oscillating piston meter
- d. Compound meter

107. When filling a main, the water velocity should never exceed:

- a. 1ft/sec
- b. 2.5ft/sec
- c. 10ft/sec
- d. 20ft/sec

108. When two storage tanks that serve the same area have different overflow elevations, what type of valve should be included on the lower tank?

- a. Check valve
- b. Altitude valve
- c. Air relief valve
- d. Ball valve

109. Water hammer is caused by:

- a. Opening a valve too slowly
- b. Closing a valve too quickly
- c. Excessive hardness
- d. High pressure on the suction side of a pump

110. Comprehensive maps of medium to large systems generally have scales ranging from

- a. 250-500 feet to 1 inch.
- b. 500 – 1,000 feet to 1 inch.
- c. 1,000 – 1,500 feet to 1 inch.
- d. 1,500 – 2,000 feet to 1 inch.

111. Sectional maps generally have scales ranging from
- a. 50-100 feet to 1 inch.
 - b. 100 – 200 feet to 1 inch.
 - c. 200 – 250 feet to 1 inch.
 - d. 250-400 feet to 1 inch.
112. A comprehensive map should be
- a. compact enough to fit in a folder.
 - b. as large as possible.
 - c. as detailed as possible.
 - d. written in technical language so that only engineers can read it.
113. On a plan and profile drawing, what does the abbreviation EL mean? a. English language
- b. Estimated length
 - c. Electric
 - d. Elevation
114. What type of map is also referred to as a wall map?
- Comprehensive map
115. What type of map, commonly called a plat, is a series of maps covering sections of the water system?
116. When comparing friction loss in various types of pipes, a larger Hazen-Williams ' C ' value indicates the pipe
- a. is rougher inside
 - b. is rougher outside.
 - d. is able to withstand a higher pressure.
 - c. *is smoother inside.
117. What is the recommended minimum contact time water mains with the chlorine slug method?
- a. 3 hours
 - b. 6 hours
 - c. 10 hours
 - d. 12 hours
118. 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
119. has been implicated in more waterborne disease outbreaks than any other factor.
- a) improper treatment
 - *b) main breaks
 - c) improper or inadequate flushing

- d) backflow
120. A physical link between a potable water supply and one of unknown or questionable quality is
- *a) a cross connection
 - b) a Tier 1 violation
 - c) a Boil Water Advisory
 - d) a backflow prevention assembly
121. The best cross connection device is
- *a) air gap
 - b) double check
 - c) atmospheric vacuum breaker
 - d) barometric loop
122. _____corrosion is the corrosivity due to dissimilar metals.
- a) saline
 - b) hydroxyl
 - c) excessive
 - *d) galvanic
123. The two types of backflow are
- *a) backsiphonage and backpressure
 - b) backpressure and cavitation
 - c) air gap and rpz
 - d) dynamic and backsiphonage
124. This device is approved to protect against backflow and backsiphonage in high hazard applications.
- a) double check valve assembly
 - b) vacuum pressure breaker
 - c) a hose bib
 - *d) reduced pressure zone assembly
125. Coupon testing is a viable indicator of
- a) treatment optimization
 - b) the speed at which macrofloc is formed
 - *c) the corrosive or scale forming tendencies of your water
 - d) the super saturation level of dissolved oxygen in your water
126. An atmospheric vacuum breaker backflow prevention device protects against
- a) backflow
 - b) backsiphonage and backpressure
 - c) neither
 - *d) backsiphonage
127. An approved air gap separation must be
- a) 12 inches or 3 times the diameter whichever is greater

- *b) $2\frac{1}{2}$ times the inside diameter or a minimum of 1 inch
 - c) $.785 \times D' \times D'$
 - d) a barometric loop
128. Cathodic protection refers to
- a) personal protective equipment
 - b) thermal electric protection
 - *c) corrosion
 - d) filtration
129. Which of the following physical factors does not influence the rate of corrosion
- a. Higher flow velocities
 - b. Higher water temperatures
 - *c. Higher system pressures
 - d. Higher alkalinity levels
130. The most serious potential problem that water distribution systems can experience during high flows such as during fire fighting is:
- *a. Back-siphonage caused by negative or low pressures
 - b. Movement of buried pipes caused by surge
 - c. Loss of chlorine residual in system
 - d. Temporary dirty-water complaints
131. A new section of pipeline must be disinfected:
- a. at the factory
 - b. after delivery to utility storage yards
 - *c. after installation and prior to potential use
 - d. just before delivery to the site
132. Which water quality complaint is the most common for most utilities?
- a. Appearance of the water
 - *b. Taste and odors
 - c. Stained laundry and plumbing fixtures
 - d. Illness caused by the water
133. 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
134. _____ corrosion is the corrosivity due to dissimilar metals.
- a) saline
 - b) hydroxyl
 - c) excessive

*d) galvanic

135. If a water system collects at least 40 samples per month for the analyses of total coliforms, which percent of total coliform positive samples are acceptable for the system to remain in compliance with the maximum contaminant level for total coliforms?
- a. No more than 2%
 - b. No more than 3%
 - c. No more than 4%
 - *d. No more than 5%
136. Water systems are required to achieve at least _____ removal and/or inactivation of viruses between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer.
- a. 2 log b. 2.5 log c. 3 log *d. 4 log
137. Where are the sampling points located for required sampling of organics (except trihalomethanes) in a community water system?
- a. Representative points within the distribution system
 - b. 75% at locations representative of population distribution and 25% at the farthest points in the distribution system
 - *c. Entry points to the distribution system
 - d. Entry points to the distribution system and representative points within the distribution system
138. Where are the sampling point(s) located for required sampling of natural radionuclides in a community water system?
- a. Consumer's faucet
 - b. Representative points within the distribution system
 - *c. Each entry point to the system
 - d. 75% at locations representative of population distribution and 25% at the farthest points in the distribution system
139. Continuous chlorine residual monitoring is required where the water enters the distribution system under the Surface Water Treatment Rule when the
- *a. population served is > 3,300 people.
 - b. population served is > 10,000 people.
 - c. number of taps is > 1,000.
 - d. number of taps is > 2,500.
140. Which of the following physical factors does not influence the rate of corrosion
- a. Higher flow velocities
 - b. Higher water temperatures
 - c. Higher system pressures
 - d. Higher alkalinity levels

1. What is the most important aspect in maintaining a high degree of safety awareness in the water treatment facility?
 - *a. Making sure carelessness or negligence is stressed
 - b. driver's training away from the workplace
 - c. reading the MSDS postings each day
 - d. maintaining batteries in flashlights and emergency storage areas
2. Which is the approximate angle of repose for average soils when using the sloping method for the prevention of cave-ins? (Note: horizontal to vertical distance, respectively)
 - a. 0.5 : 1.0
 - b. 1.0 : 1.0
 - *c. 1.5 : 1.0
 - d. 2.0 : 1.0
3. What federal law is designed to protect the safety and health of operators?
 - *a. OSHA
 - b. FMLA
 - c. FLSA
 - d. ADEA
4. 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
5. Which document provides a profile of hazardous substances?
 - a. CERCLA
 - b. SARA
 - c. CFR
 - *d. SDS
6. 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
7. Atmosphere is considered oxygen deficient when the oxygen level is below
 - a. 21.5%
 - b. 20%
 - *c. 19.5%
 - d. 17%
8. Employee hazards include
 - a. Noxious or toxic gases or vapors
 - b. Oxygen deficiency

- c. Physical injuries
 - *d. All of the above
9. 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.
10. 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.
11. 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.
12. 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.
13. 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.
14. 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
15. Some gases in a confined space can be:
- a. Colorless
 - b. Odorless
 - c. Deadly
 - d. All of the above
16. 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 com-

- panies 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
17. 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
18. 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
19. 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
20. 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
21. 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
22. In an occupied trench where exits (i.e., ladders) are required, what is the maximum allowed travel distance between an occupant and the nearest exit?
- i. 25 feet
 - b. 50 feet
 - c. 100 feet
 - d. At the discretion of the safety officer
 - e. None of the above
23. 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
24. 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
25. Which of the following gases is toxic at the lowest concentration?
- a. Carbon dioxide
 - *b. Hydrogen sulfide
 - c. Methane
 - d. Nitrogen
 - e. Oxygen
26. 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
27. 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
28. 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
29. 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
30. 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. Required to use a complete "A" suit for personal protective equipment
31. 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
32. 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
33. 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
34. 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
35. 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
36. Which of the following compounds emits a "rotten egg" odor?
- *a. Hydrogen sulfide
 - b. Chlorine dioxide
 - c. Chloramines

- d. Hydrochloric acid
 - e. Hypochlorous acid
37. 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
38. Which of the following is a hazard when handling hydrofluosilicic acid?
- a. fire
 - b. explosion
 - c. corrosion
 - *d. inhalation
39. Which of the following chemical substances is most likely to cause corrosion or deterioration of metal and concrete surfaces
- a. carbon dioxide
 - b. ethanol
 - c. methane
 - *d. hydrogen sulfide
40. An employee is caught in a room where chlorine 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.
41. 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
42. 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
43. A trench must be shored if it is feet deep or more.
- a. 3
 - *b. 4
 - c. 5
 - d. 6

44. When employees are working in a trench 5 ft deep or more, an adequate means of exit, such as a ladder or steps, must be located no more than _____ ft away from them.
- a. 5
 - b. 10
 - *c. 25
 - d. 40
45. What should a supervisor do if an employee is performing work in an unsafe manner?
- a. Discuss the incident with the employee during the next performance appraisal
 - *b. Stop the work immediately and train the employee to perform the work safely
 - c. Call OSHA immediately to investigate the incident.
 - d. Give the employee a written warning that the work was performed unsafely
46. Water treatment personnel should only use self-contained breathing apparatus equipment that has been approved by
- a. the Occupational Safety and Health Administration (OSHA).
 - b. their state's Department of Public Health.
 - *c. the National Institute of Occupational Safety and Health (NIOSH).
 - d. the American Standards and Testing Methods.
47. If a substantial chlorine leak incident occurs, which agency should be called for actual hands-on assistance?
- a. The Occupational Safety and Health Administration (OSHA)
 - *b. The Chemical Transportation Emergency Center
 - c. The Transportation Emergency Institute
 - d. The Chlorine Institute
48. In regards to safety, wet activated carbon will remove which from the air?
- a. Organic gases and hydrogen sulfide
 - *b. Oxygen
 - c. Carbon dioxide
 - d. Carbon monoxide
49. An employee's average airborne exposure in any 8-hour shift in a 40-hour workweek that should not be exceeded is called
- a. Short Term Exposure Limit (STEL).
 - *b. Time-Weighted Average (TWA).
 - c. Threshold Limit Value (TLV).
 - d. Recommended Exposure Limits (REL).
50. Sites are required to do a site assessment under the process safety management (PSM) regulations (OSHA) if the facility in a single process has more than how many pounds of chlorine?
- a. 1,000lb
 - *b. 1,500lb

- c. 2,000lb
 - d. 4,000lb
51. Which statement concerning contact with chlorine is true?
- a. If chlorine contacts the eyes, flush for 15 minutes with water, then neutralize with appropriate electrolytes that are safe for the eyes
 - b. Flush the eyes and give a sedative to the person that contacted chlorine, as it usually leads to excited behavior
 - c. Apply an appropriate ointment to the area of the skin that liquid chlorine came in contact with
 - *d. Chlorine inhalation may lead to delayed reactions such as pulmonary edema
52. Which gas is commonly called swamp gas?
- a. Hydrogen sulfide
 - *b. Methane
 - c. Carbon monoxide
 - d. Radon
53. Self-contained breathing apparatus (SCBA) units
- a. are very different than the units used by SCUBA divers.
 - *b. are fitted with a low-air-pressure alarm that sounds, alerting the wearer to leave the contaminated site.
 - c. should not be stored in storage rooms far away from the chlorine location, but two units should be stored in the chlorine feed room and two in the chlorine room.
 - *d. should have all straps rolled up so they can properly fit in their cases.
54. In permit entry confined space, who is responsible for knowing the behavioral effects of exposure?
- a. Authorized entrant, entry supervisor and the standby attendant
 - b. Entry supervisor and authorized attendant
 - *c. Authorized attendant
 - d. Standby attendant
55. Which is the highest recommended stacking height for bags of powdered activated carbon and granular activated carbon?
- a. 5 ft
 - *b. 6 ft
 - c. 8 ft
 - d. 10 ft
56. Which national law authorizes the government to clean up contaminants from hazardous waste sites or contaminants caused by chemical spills that could possibly threaten the environment?
- a. The Toxic Substances Control Act (TSCA)
 - *b. The Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)

- c. The Resource Conservation and Recovery Act (RCRA)
 - d. The Safe Drinking Water Act
57. During a pumping test for a public water supply well, which must be held constant?
- a. The pumping water level
 - b. The pump's amperage
 - c. The drawdown
 - *d. The pumping rate
58. Which type of wells are commonly used near the shore of a lake or near a river?
- a. Monitoring wells
 - b. Bedrock wells
 - c. Gravel wall wells
 - *d. Radial wells
59. Chemical splash goggles (no face shield) are required PPE when working with potential exposure to 3 to 20 % sodium hypochlorite solutions at temperatures below 100Deg. F only when
- a. handling the material.
 - b. an initial line break occurs.
 - *c. inspecting the dome and no product is flowing.
 - d. loading that is remotely activated.
60. In permit entry confined space, who is responsible for knowing the conditions within that confined space?
- a. Standby attendant
 - *b. Entry supervisor
 - c. Authorized entrant
 - d. Authorized attendant
61. Introducing water into a strange tank containing ammonia vapors can cause
- a. a rapid exothermic reaction.
 - b. a rapid endothermic reaction.
 - *c. the tank to collapse.
 - d. an explosion.
62. The IDLH (Immediately Dangerous to Life and Health) represents the maximum concentration from which, if respiratory equipment failed, one could not escape within without a respirator and without experiencing any escape impairing or irreversible health effects.
- a. 10 minutes
 - b. 20 minutes
 - *c. 30 minutes
 - d. 60 minutes
63. Gaseous ammonia may be fatal when it reaches levels of
- a. 400 to 700 ppm.
 - b. 800 to 1,100 ppm.

- c. 1,100 to 1,700 ppm.
 - *d. 2,000 to 3,000 ppm.
64. Which mixture may be produced if ammonia hydroxide is accidentally unloaded into a sodium hypochlorite tank?
- a. Cyanide
 - b. Strychnine
 - *c. An explosive mixture of nitrogen trichloride
 - d. An explosive mixture of nitroglycerin
65. Which national law regulates the storage, transportation, treatment, and disposal of solid and hazardous wastes?
- a. The Toxic Substances Control Act (TSCA)
 - b. The Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
 - *c. The Resource Conservation and Recovery Act (RCRA)
 - d. The Safe Drinking Water Act
66. Sites using chlorine in a single process are required by the US Environmental Protection Agency to write a risk management plan (RMP), if chlorine exceeds
- a. 2,000 lb.
 - *b. 2,500lb.
 - c. 4,000lb.
 - d. 6,000lb.
67. Which plan is a mutual aid program for chlorine incidents that occur during transportation or at user locations?
- *a. North American Chlorine Emergency Plan
 - b. Chemical Transportation Emergency Plan
 - c. Chlorine Institute Plan
 - d. Transportation Emergency Assistance Plan
68. What is the only type of self-contained breathing apparatus that should be used at water plants?
- a. Negative-pressure
 - b. Zero-pressure
 - *c. Positive-pressure
 - d. Air-pressure

Multiple Choice Math Questions

1. How many pounds per day of 100% chlorine gas are needed to arrive at a dosage of 2mg/L, when the flow is 8.8mgd and a zero chlorine demand exists?
 - a. *147
 - b. 1,097.9
 - c. 1,468
 - d. 211.3
 - e. 417
2. How many pounds per day of 100% chlorine gas are needed to arrive at a residual of 2.3mg/L, when the flow is 8.25mgd and a chlorine demand is 0.35mg/L ?
 - a. 21.8
 - c. 27.4
 - e. 812.3
 - b. *182.3
 - d. 158.3
3. When a filter whose surface loading rate is 1,500gpd/sq.ft. and its size is 400 -sq. ft. Determine the total flow through the filter in gallons per day.
 - a. 0.6
 - c. 7.85
 - e. *600,000
 - b. 375,000
 - d. 3.75
4. Determine the Unit Filter Run Volume of a 15-ft. x 20-ft. filter when it registered 2,000,000 gallons during its run.
 - a. 600
 - c. 989
 - b. 9423
 - d. *6667
 - e. 7200
5. A filter has the dimensions of 15 – ft. x20 – ft and a backwash rate of 19.5gpm/sq.ft. Determine its backwash rise rate in, inches per minute.
 - a. 58.5
 - c. 5.85
 - e. *31.2
 - b. 37
 - d. 81.3
6. Using the Quantity formula ($Q = AV$), determine the Q when A = 15sq. ft. and velocity is 3.3ft/sec.
 - a. *49.5cfs

- c. 19.88cfs
 - e. 4.9cfs
 - b. 495cfs
 - d. 4.545cfs
7. Find the gpm/sq.ft. filtration rate when 6,775,000 gallons were produced in 24-hours through a filter that measures 30 – ft.x54 – ft.
- a. 0.029
 - c. 2904.2
 - e. 4.18
 - b. 0.29
 - d. *2.9
8. What is the grain per gallon (gpg) hardness of water that has a total hardness of 228mg/L ?
- a. *14
 - c. 18
 - e. 133.3
 - b. 3898.8
 - d. 39
9. A water tank had a pressure gauge reading of 14 psig on its bottom. Determine the water level in the tank.
- a. 23.3 feet
 - c. *32.3 feet
 - e. 19.8
 - b. 28.6 feet
 - d. 38.3 feet
10. A tank had a diameter of 22 -feet and a pressure of 7.7psi on its bottom. Determine how many pounds of 65% calcium hypochlorite (dry powder chlorine) are needed to arrive at a dosage of 1ppm.
- a. 0.42 pounds
 - b. *0.65lbs
 - c. 50,302.5 pounds
 - d. 41.9lbs
 - e. 6.5lbs
11. An iron removal plant processes water with an average iron concentration of 2.5mg/l. If the iron concentration is 0.01mg/l after treatment and the total daily pumpage is one million gallons, how many pounds of iron will be removed per day?
- a. 10.77 pounds
 - a. *20.77 pounds
 - b. 25.77 pounds
 - c. 30.77 pounds

- d. 35.77 pounds
12. A water system bills quarterly at a rate of 25 ¢ /1000 gallons for the first 10,000 gallons, 30 ¢ /1000 gallons for the next 10,000 gallons, 35¢/1000 gallons for all over 20,000 gallons. If a customer uses 35,000 gallons per quarter, what is the water bill?
- a. \$9.50
b. *\$10.75
c. \$12.25
d. \$12.50
e. \$13.25
13. A ground level storage tank is 25 feet long, 20 feet wide, and 10 feet deep. When the storage tank is completely empty, calculate how many minutes it will take to fill the tank with a pump that has a capacity of 300 gallons per minute.
- a. 60 minutes
b. 100 minutes
c. *125 minutes
d. 150 minutes
e. 200 minutes
14. A room measures 12ft high, 30ft long, and 17ft wide. How many cubic feet per minute of air must a blower in an air exchange unit move to completely change the air every 10 minutes?
- a. 102
b. 612
c. 1,020
d. 6,120
15. If a trench is 526ft long, 4.0ft wide, and 5.5ft deep, how many cubic yards of soil were excavated?

$$526 \times 4 \times 5.5 = \frac{11,572\text{ft}^3}{27} = 428$$

16. If exactly 100gal of polymer costs \$19.50, what will 5,500gal cost, assuming no quantity discount?

$$\frac{19.50}{100} \times 5500 = 1,072.5$$

17. What is the velocity of flow in feet per second for an 8.0-in. diameter pipe if it delivers 675 gpm?

$$\frac{675}{449} = 1.5 \text{ cuft/s}$$

$$\frac{150}{6.35} = 23.6 \text{ ft/s}$$

18. What should the setting be on a chlorinator in pounds per day if the dosage desired is 2.90mg/L and the pumping rate from the well is 975gpm ?

$$\frac{975}{69)^1} = 1.4MGD$$

$$1.4 \times 8.34 \times 2.90$$

19. A treatment plant uses 278lb/d of chlorine gas. If the chlorine demand is 0.85mg/L and the chlorine residual is 1.50mg/L, how many million gallons per day are being treated?

$$\frac{278}{8.34 \times 2 \times 35} =$$

dojarge ;

$$0.85 + 1.50 =$$

$$2.35mg/h$$

20. A water tank that is 105ft in diameter needs to be disinfected with a 5.0% sodium hypochlorite solution. If the tank is to be filled to only a depth of 5.0ft and the concentration required is 20.0mg/L, how many gallons of sodium hypochlorite are needed? Assume the sodium hypochlorite solution weighs 8.92lb/gal.

$$\frac{0.323MGD}{0.323 \times 8.34 \times 20} =$$

9/23/19

21. Convert 8.0cfs to gpm.

a. 1.07gpm

b. 64.2gpm

c. 480gpm 8×449

e. 3,436gpm

22. Conyert 4,000gpm to cfs.

a. 8.91cfs

b. 66.65cfs

c. 499cfs

d. 535cfs

e. 32,076cfs

23. Convert 12MGD to gpm.

a. 0.00833gpm

b. 7,200gpm 12×700

d. 17,280gpm

e. 199,992gpm

24. Convert 5.5 cfs to MGD.

a. 0.059MGD

b. 0.148MGD

c. 0.475MGD

(64) more Aaumole

e. 7,920 MGD

25. Convert 45 Acre-feet into million gallons.

a. 6.02Mgal

b. 1.96Mgal

c. 14.7Mgal

d. 45Mgal

e. 336.6Mgal

26. Convert 6.5 feet per second into miles per hour.

a. 4.43mph

c. 13.3mph

d. 106mph

e. 266mph

27. Convert 3.4 miles into feet.

a. 5,000 feet

b. 5,280 feet

c. 5,984 feet

d. 10,000 feet

(e.) 17,952 feet

$$= \frac{6.5/5280}{1/60 \times 60}$$

$$1 \text{ m/e} = 25\text{ft}$$

28. Convert 2,250gpm into MGD.

a. 0.054MGD

b. 3.24MGD

d. 2, 250MGD

e. 3,240 MGD

29. Convert 9.75MGD into cfs.

a. 15.1cfs

b. 37.75cfs

c. 113cfs

d. 363cfs

e. 845cfs

30. Convert 1,000,000 cubic feet into Acre-feet.

a. 0.04356AF

b. 0.325829AF

c. 3.07AF

d. 22.96AF

e. 172AF

31. What is the chlorine residual in a treated water if the dosage is 2.1mg/l and has a demand of 0.8mg/l

- a. 0.8mg/l
 - b. 1mg/l
 - c. 2.1mg/l
 - d. 2.9mg/l
32. What is the maximum amount of chlorine gas that can be removed from a 150-lb cylinder in 24hrs ?
- a. 26 lbs.
 - b. 40lbs.
 - c. 75lbs.
 - d. there is no maximum
33. How many gallons would be contained in a circular tank that is 100ft. in diameter and 10ft deep?
- a. 587,000 gallons
 - b. 657,000 gallons
 - c. 1,340,000 gallons
 - d. 2,349,000 gallons
34. In order to rebuild a manhole, it will be necessary to remove the asphalt from a 35-foot diameter circle in a street. The pavement area involved is:
- a. 208 sq.ft
 - b. 241, sq.ft
 - c. 962 sq.ft
 - d. 1125 sq.ft
35. If the chlorine demand of water is 2.5mg/l and you want a residual of 0.5mg/l, how much chlorine would need to be fed to one million gallons?
- a. 25lbs.
 - b. 30lbs.
 - c. 34lbs.
 - d. 38lbs.
36. If you need to feed chlorine at a rate of 2.1mg/l and you treat 2,300,000 gallons. How many pounds of chlorine should you use?
- a. 4lbs.
 - b. 17lbs.
 - c. 35lbs.
 - d. 40lbs.
37. What is the head on a system exerting a static pressure of 62 psi?
- a. 89 feet
 - b. 107 feet
 - c. 143 feet
 - d. 189 feet
38. A head of 200 feet would equal:

- a. 46.6psi
- b. 56.6psi
- c. 66.6psi
- d. 86.6psi

39. If a 3,000,000 gpd flow is to be dosed with 1.2mg/l, what should the chlorinator feed rate be set at in lbs. of chlorine per day?

- a. 3.0lbs./ day
- b. 4.51lbs./day
- c. 10lbs./ day
- d. 30lbs./ day

40. Calculate the area in square feet of: a space 100ft long and 75ft svide. 100×75 Ans. TTur Sq. Fr.

41. Calculate the volume of a rectangular tank 20 feet high, 100ft long, and 75 feet wike. Ans. $\frac{10 \text{ wo}}{1}$ Cu.Ft.

42. Calculate the gallons the tank in the preceding problem will hold. Ans. 1,122,000 Gallons

43. Calculate the area in square feet of a space 40ft long and 50 feet vvide. Ans, 2000 Sq. Ft

44. Calculate the volume of a rectangular tank 40ft long, 50ft wide and 25 feet tall.

Ans. 50, 000 Cu.Ft

45. Calculate the gallons the tank in the preceding problem will contain. Ans. 374,000 Gallons

46. Calculate the area of a circle with a 10ft radius.

Ans. 314SqFt

47. Calculate the aren of a circle with a 10ft diameter.

Ans. $78 - 5$

48. Calculate the yolmue of a tank with a 50ft diameter that is 20 feet high.

Ans. 39, 260

Cu.Ft

49. How many gallons will the tank in the preceding problem hold?

50. Calculate the area of a circle with a 100ft dibmeter.

Ans. 293, 590

textbfAns. 7, 800SqFt

51. Calculate the volume of a tank with a 100ft diameter that is 50 feet high. Ans.

52. How many gallons ryill the tank in the preceding problem hold? Auls.

2,935,960

$$18 \times 18 \times 0.0408 \times 1200$$

53. How many gallons will an 18" diameter pipeline, 1200 ' long contain?

imi = 5280 Ans. 15,863 Gallons

54. How many gallons will a 24 " pipeline, 2 miles long contain?

$$24 \times 24 \times 0.0408 \times 248,168$$

55. 500 GPM is how many gallons per hour?

10560

$$\frac{500 \text{ g}}{1 \text{ m}} = \frac{500}{1/10 \text{ h}} = \text{Ans. } \frac{30 \text{e0r}}{\text{gph}}$$

56. 30,000gph is how many gallons per day?

$$\frac{30,000 \text{ g}}{h} = \frac{30,000}{1/24} = 30,020 \times 24 \text{ Ans. } \frac{720,010}{\text{gpd}}$$

57. A flow of 25gpm is low many gpd?

$$\frac{25 \text{ g}}{m} = \frac{25}{1/60} \times \frac{1}{24} \quad (25 \times 1440) \text{ Ans. } 36,0 \text{w gpd}$$

58. A flow of 800,000gpd is how many gpm? $\frac{800,000}{0.8 \text{MGD} \times 700} = 560 \times 24 \times 60 \quad 555.55 \text{ } 0.80 \text{gpm}$

59. A flow of 150gpm is how many MGD?

700 (wm.

Ans.

MGD

60. How many gallons will an 8" pipeline 550 ' long contain?

$$8 \times 8 \times 0.0408 \times 550$$

$$\text{Ans. } 1436 \cdot \frac{16}{\text{gallons}}$$

61. Water is filling a tank at the rate of 50gpm for a 10 min. period, How many gallons of water are contained in the tank at the end of the 10 minute time period?

62. A well pump is discharging water at the rate of 400gpm into a tank for 15 minutes. How many gallons will be in the tank at the end of this time period?

6,000... Gal.

$$\text{Dose} = \text{Demand T Residual } \frac{300}{20} \times 16$$

63. A tank is filling at the rate of 300gpm for a 20 minute period. How many of water will be contained in the tank at the end of 16 minutes?

4880 Gal.

64. 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? $45 - 15 = 30$

a. 15

b. 30

c. 45

d. 60

e. 90

65. Over a four year period, the hour meter on a electrical panel at a well site had the following readings at the end of each year: 1st year -976.3, 2nd year -1325.8, 3rd year -2007.1, and 4th year -2371.4 . How many hours does the meter show the well ran during the 3rd year?

a. 349.5hrs

- b. 3364.3hrs
- c. 981.3hrs
- d. 830.2hn/s
- e. 900.1

66. One gallon of water weighs how many lbs?

- a. 7.48
- b. 8.34
- c. 2.31
- d. 43318 .

67. A water tank is filled to depth of 22 feet. What is the psi at the bottom of the tank?

$$22/2.31 = 9.52$$

68. The static pressure in a water main is 85 psi. What elevation of water is needed to provide that kind of pressure?

$$85 \times 2.31 = 196$$

69. Calculate the pressure at the bottom of a water tank if it is filled to a depth of 33 feet.

$$33/2.31$$

ft

70. A psi gauge is located at the bottom of a water tank and reads 24 psi. What is the elevation of the water inside the tank?

$$24 \times 2.31 = 55$$

71. A gauge is reading the pressure at the outlet of a fire hydrant. A tank is elevated 200 feet above the hydrant. What is the gauge pressure at the hydrant?

$$200/2.31$$

72. A gauge is attached to a hose bib at a house. The gauge reads 45 psi. How much elevation is needed to supply that pressure?

$$45 \times 2.31 = 104$$

73. How many gallons will the above cylinder hold?

$$100 \times 7.48 = 748$$

74. Calculate the area in square feet of a space 100ft. long and 75ft wide.

Ans. 7500 Sq. Ft

75. Calculate the volume of a rectangular tank 20 feet high, 100ft long, and 75 feet wide. Ans. 150,00 Cu.Ft.

76. Calculate the gallons the tank in the preceding problem will hold.

77. Calculate the area in square feet of a space 40ft long and 50 feet wide. Ans, $\frac{2,000}{1}$ Sq. Ft

78. Calculate the volume of a rectangular tank 40ft long, 50ft wide and 25 feet tall. Ans. 50000 Cu.Ft

79. Calculate the gallons the tank in the preceding problem will contain.

$$50,000 \times 7.48 \text{ Ans. } 374,000 \text{ Gallons}$$

80. Calculate the area of a circle with a 10ft radius.

$$D = 20$$

Ans. 314SqFt

81. Calculate the area of a circle with a 10ft diameter. Ans. 78.5 SqFt

82. Calculate the volume of a tank with a 50ft diameter that is 20 feet high.

Ans. 250 Cu. Ft

83. How many gallons will the tank in the preceding problem hold?

84. Calculate the area of a circle with a 100ft diameter. Ans. $\frac{293590}{7850}$ Gallons

85. Calculate the volume of a tank with a 100ft diameter that is 50 feet high,

$$\frac{300 \text{ gallons}}{1 \text{ minute}} \times 6 \text{ mm}$$

86. A tank is filling at the rate of 300gpm for a 20 minute period. How many of water will be contained in the tank at the end of 16 minutes?

87. 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. 15
- b. 30
- c. 45
- d. 60
- e. 90

88. Over a four year period, the hour meter on a electrical panel at a well site had the following readings at the end of each year: 1st year -976.3, 2nd year -1325.8, 3rd year -2007.1, and 4th year -2371.4. How many hours does the meter show the well ran during the 3rd year?

- a. 349.5hrs
- b. 3364.3 hrs
- c. 81.3hrs
- d. 830.2hrs
- e. 900.1

89. Approximately how many gallons of water can fit into a reservoir that is 35 feet tall and has a 100 foot diameter?

- a. 2,000,000
- b. 2.055MG
- c. 4MG
- d. 275,000

90. Determine the detention time in hours for the following water treatment system:

Distribution pipe from water plant to storage tank is 549ft in length and 14in. in diameter

- Storage tank averages 2,310,000 gal of water at any given time. Flow through system is 6.72mgd
 - a. 7.2hr
 - b. 7.4hr
 - c. 8.0hr
 - d. 8.3hr
- 91. If chlorine is being fed at a rate of 260lb/day for a flow rate of 23cfs, what should be the adjustment on the chlorinator when the flow rate is decreased to 16cfs, if all other water parameters remain the same?
 - a. 160lb/day
 - b. 180lb/day
 - c. 310lb/ day
 - d. 370lb/ day
- 92. How many gallons of a sodium hypochlorite solution that contains 12.1% available chlorine are needed to disinfect a 1.5 -ft diameter pipeline that is 283ft long, if the dosage required is 50.0mg/L ? Assume the sodium hypochlorite is 9.92lb/gal.
 - a. 0.87 gal sodium hypochlorite
 - b. 1.0 gal sodium hypochlorite
 - c. 1.3 gal sodium hypochlorite
 - d. 1.5 gal sodium hypochlorite
- 93. A storage tank has a 60.0-ft radius and averages 25.5ft in water depth. Calculate the average detention time in hours for this storage tank, if flow through the tank averages 2.91 mgd during the month in question.
 - a. 17.5hr
 - b. 17.8hr
 - c. 18.6hr
 - d. 19.8hr
- 94. A 24.0-in. pipeline, 427ft long, was disinfected with calcium hypochlorite tablets with 65.0% available chlorine. Determine the chlorine dosage in mg/L, if 7.01b of calcium hypochlorite was used.
 - a. 25mg/L chlorine
 - b. 39mg/L chlorine
 - c. 43mg/L chlorine
 - d. 54mg/L chlorine
- 95. 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
- 96. What is the area of a circular tank pad in ft², if it has a diameter of 102ft ?
 - a. 6,160ft²

- b. 6,167ft²
 - c. 8,170ft²
 - d. 8,200ft²
96. What is the pressure at 1.85 feet from the bottom of a water storage tank if the water level is 28.7 feet?
- a. 11.6psi
 - b. 12.4psi
 - c. 62.0psi
 - d. 66.3 psi
97. How many gallons are in a pipe that is 18.0 inches in diameter and 1,165 feet long?
- a. 2,060 gal
 - b. 10,300gal
 - c. 15,400 gal
 - d. 17,200 gal
98. Convert 37.4 degrees Fahrenheit to degrees Celsius.
- a. 3.0C
 - b. 5.3C
 - c. 7.9C
 - d. 9.7C
99. If 288 is 70.3%, how much is 100% ?
- a. 410
 - b. 202
 - c. 218
 - d. 438
100. If the pressure head on a fire hydrant is 134ft, what is the pressure in psi?
- a. 50psi
 - b. 52psi
 - c. 54 psi
 - d. 58psi
101. A meter indicates the water flow from a fire hydrant is 5.5ft³/min. How many gallons will flow from the hydrant in 20 minutes?
- a. 820 gal
 - b. 850gal
 - c. 880gal
 - d. 920 gal
102. Records for a pump show that on June 1 at exactly 9:00 a.m. the number of pumped gallons was 71,576,344 and on July 1 at exactly 9:00 a.m. it was 72,487,008 gallons. Determine the average gallons pumped per day (gal/day) for this month to the nearest gallon.
- a. 18,605gal/day
 - b. 25,875gal/day

- c. 30,355gal/day
 - d. 34,325gal/day
103. 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
104. 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
105. If a lake is 574 feet deep, what is the pressure in pounds per square inch at the bottom of the lake?
- a. 248psi
 - b. 1326psi
 - c. 69psi
 - d. 62.4psi
106. A pressure gauge reading is 80 psi. How many feet of head is this?
- a. 173 feet
 - b. 185 feet
 - c. 200 feet
 - d. 212 Feet
107. The pump is 150 feet below the reservoir level. What is the pressure reading on the gauge in psi?
- a. 52psi
 - b. 60 psi
 - c. 65 psi
 - d. 75psi
108. A tank is 20' ' 60' ' by 15' deep. What is the volume in gallons?
- a. 115, 000 gallons
 - b. 128,000 gallons
 - c. 135,000 gallons
 - d. 154,000 gallons
109. A tank is 60 ' in diameter and 22' high. How many gallons will it hold?
- a. 465,000 gallons
 - b. 528,000 gallons

- c. 640,000 gallons
 - d. 710,000 gallons
110. A dosage of 2.4mg/l of chlorine gas is added to 3.8mgd. How many pounds per day of chlorine are needed?
- a. 68lbs/ day
 - b. 76lbs/day
 - c. 82lbs/ day
 - d. 88lbs/ day
111. How many gallons are in a 6" pipe 950 feet long?
- a. 1108 gallons
 - b. 1253 gallons
 - c. 1308 gallons
 - d. 1395 gallons
112. A 12 " pipe is carrying water at a velocity of 5.8fps. What is the flow?
- a. 4.55cfs
 - b. 5.36cfs
 - c. 5.67cfs
 - d. 6.04cfs
113. The pressure at the top of the hill is 62 psi. The pressure at the bottom of the hill, 60 feet below, is 100psi. The water is flowing uphill at 120gpm. What is the friction loss, in feet, in the pipe?
- a. 24.6 feet
 - b. 27.8 feet
 - c. 31.2 feet
 - d. 33.8 feet
114. A tank is 82 ' in diameter and 31 feet high. The flow is 1600gpm. What is the detention time in hours?
- a. 12.75 hours
 - b. 14.80 hours
 - c. 16.00 hours
 - d. 18.25 hours
115. A tank is 120' x 50' ' 14' 'deep. The flow is 2.8mgd. What is the detention time in hours?
- a. 3.8 hours
 - b. 4.4 hours
 - c. 5.3 hours
 - d. 6.2 hours
116. A 16" pipe is 1250 feet long. How much 65% HTH is needed to dose it with 50mg/l of chlorine?
- a. 6.50lbs
 - b. 7.25lbs

- c. 7.96lbs
 - d. 8.34lbs
117. A solution of hydrofluosilicic acid is 22% fluoride. If 750ppb are added to 5,600,000 gallons/day, how many ml/min should the pump be feeding?
- a. 26ml/min
 - b. 35ml/min
 - c. 42ml/min
 - d. 50ml/min
118. A bleach system feeds 12% bleach. The dosage is 1.4mg/l for 8.2mgd. How many ml/min should the pump feed?
- a. 200ml/min
 - b. 250ml/min
 - c. 300ml/min
 - d. 350ml/min
119. Pump Data:
- Feet - Positive Suction Head
 - 158 Feet - Discharge Head
 - 26 Feet - Friction Loss
 - 1200 gpm - Flow
 - Motor Efficiency - 86%
 - Pump Efficiency - 78%
 - What is the motor horsepower?
- a. 60MHP
 - b. 65MHP
 - c. 70MHP
 - d. 75MHP
120. Pump Data:
- 20 Feet - Positive Suction Head
 - 185 Feet - Discharge Head
 - 18 Feet - Friction Loss
 - 300gpm - Flow
 - Motor Efficiency - 90%
 - Pump Efficiency - 80%
 - Kw-Hour Cost = 0.11/Kw – Hr
 - Average Run Time - 6 Hours/day
 - What is the cost to run the pump for 30 days?
- a. \$245.08
 - b. \$284.34
 - c. \$410.50
 - d. \$463.82

121. 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
122. 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
123. What is the chlorine demand of a tank that is dosed at 3.5ppm and has a residual of 1.25 ppm.
- a. 2.25
 - b. 4.75
 - c. 1.25
 - d. 3.5
 - e. not enough information
124. What is the area of a trench that is 22.4ft long and 3.3 feet wide?
- a. 26 sq.ft
 - b. 74 sq. ft.
 - c. 143 sq. ft
 - d. 187 sq. ft.
125. What is the pounds per square inch pressure at the bottom of a tank if the water level is 38.29 feet?
- a. 7.3psi
 - b. 16.6psi
 - c. 53.9psi
 - d. 88.4psi
126. What is the pressure head on a system exerting a static pressure of 62 psi?
- a. 27ft
 - b. 89ft
 - c. 143ft
 - d. 175ft
127. How many gallons are in a pipe that is 18 " in diameter and 216 feet long?
- a. 1908 gallons
 - b. 2246 gallons
 - c. 2430 gallons

- d. 2861 gallons
128. How many pounds of chlorine are required to treat 8.65mgd if the dosage is 2.75ppm ?
- a. 11lb/ day
 - b. 24lb/day
 - c. 72lb/ day
 - d. 198lb/ day
129. What should the setting be on a chlorinator in pounds per day if the dosage desired is 2.9 mg/l and the pumping rate from the well is 975gpm ?
- a. 29lb/ day
 - b. 34lb/day
 - c. 41lb/ day
 - d. 336lb/day
130. What is the chlorine residual in a system that has a chlorine dosage of 2.75mg/l and a chlorine demand of 1.93mg/l ?
- a. 0.82mg/l
 - b. 1.75mg/l
 - c. 4.67mg/l
 - d. 5.31mg/l
131. How many pounds per day of chlorine are needed to treat 38.75mgd if the residual is 2.0 mg/l and the demand is 1.5mg/l ?
- a. 42lb/ day
 - b. 136lb/day
 - c. 323lb/day
 - d. 1131lb/day
132. A pump discharges 680 gpm, How many gallons will it discharge in 8 hours?
- a. 5440 gallons.
 - b. 130560 gallons
 - c. 1 ac-ft
 - d. 408000 gallons.
133. How many gallons are contained in 2167 cu.ft?
- a. 260 gallons
 - b. 295 gallons
 - c. 16253 gallons
 - d. 18070 gallons
134. What is the typical strength of calcium hypochlorite, i.e., available chlorine range?
- a. 5 to 10%
 - b. 45 to 50%
 - c. 65 to 70%
 - d. 80 to 85%
135. A four log removal is

- a. 90.00%
 - b. 99.00%
 - c. 99.90%
 - d. 99.99%
136. 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?
- a. 0.92MG
 - b. 4.62MG
 - c. 18.50MG
 - d. 7.50 MG
137. A sedimentation basin is 400 feet length, 50 feet in width, and 15 feet deep. What is the volume expressed in cubic feet?
- a. 100,000ft³
 - b. 200,000ft³
 - c. 300,000ft³
 - d. 400,000ft³
138. A clearwell holds 314,000ft³ of water. It is 100ft in diameter. What is the height of the clearwell?
- a. 25ft
 - b. 30ft
 - c. 35ft
 - d. 40ft
139. A treatment plant operator must fill a clearwell with 10,000ft³ of water in 90 minutes. What is the rate of flow expressed in GPM?
- a. 111 GPM
 - b. 831 GPM
 - c. 181 GPM
 - d. 900 GPM
140. 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?
- a. 3,333 GPM
 - b. 6,333 GPM
 - c. 8,333 GPM
 - d. 16,666 GPM
141. 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 7 AM. At what time will the clearwell be full?
- a. 10:00 PM
 - b. 10:40 PM

- c. 11:00 PM
 - d. 11:40 PM
142. There are four filters at a water treatment plant. The filters measure 20 feet wide by 30 feet in length. What is the filtration rate if the plant processes 8.0 MGD?
- a. 1.51GPM/sq.ft.
 - b. 2.31GPM/sq.ft.
 - c. 2.61GPM/sq.ft.
 - d. 2.91GPM/sq.ft.
143. A water treatment plant treats 6.0 MGD with four filters. The filters use 60,000 gallons per wash. What is the percent backwash at the plant?
- a. 10%
 - b. 8%
 - c. 6%
 - d. 4%
144. A treatment plant filter washes at a rate of 10,000GPM. The filter measures 18ft. wide by 24ft. long. What is the rate of rise expressed in inches per minute?
- a. 17inch/min
 - b. 27inch/min
 - c. 37inch/min
 - d. 47inch/min

0.20 TREATMENT I AND II MATH

1. Which is the hardness in mg/l of a treatment plant's well water if the hardness is 18.44 grains per gallon (gpg)?
 - a. 1.1 mg/l
 - *b. 315.7 mg/l
 - c. 415.7 mg/l
 - d. 535.2 mg/l
2. Find the specific yield in gpm/ft if a well produces 105 gpm and the drawdown for the well is 16.3 ft.
 - a. 6.00 gpm / ft
 - *b. 6.44 gpm / ft
 - c. 7.20 gpm / ft
 - d. 7.28 gpm / ft
3. If the static level in the well was 138.6 ft and the drawdown was 21.1 ft, which must have been the pumping water level in the well?
 - a. 117.5 ft
 - b. 129.0 ft
 - c. 150.0 ft
 - *d. 159.7 ft
4. Which is the pressure in lb/ft², 189 ft below a lake's surface if the lake is 386 ft in depth?
 - a. 11,789 lb/ft²
 - b. 11,790 lb/ft²
 - c. 11,793 lb/ft²
 - *d. 11,800 lb/ft²
5. A circular clarifier has a weir length of 162 ft. Which is the weir overflow rate in gpd/ft, if the flow is 2,330,000 gallons per day (gpd)?
 - a. 14,000 gpd/ft
 - b. 14,380 gpd/ft
 - c. 14,383 gpd/ft
 - *d. 14,400 gpd/ft
6. Convert 35.1 cfs to gpm.
 - a. 14,200 gpm
 - *b. 15,800 gpm
 - c. 17,600 gpm
 - d. 18,300 gpm
7. Convert 7.7 million gallons a day (mgd) into cubic feet per second (cfs).
 - a. 11 cfs
 - *b. 12 cfs
 - c. 15 cfs

- d. 19cfs
8. How many million gallons (mil gal) are there in 318 acre-ft?
- *a. 104 mil gal
 - b. 107milgal
 - c. 110 mil gal
 - d. 116 mil gal
9. Convert 68 degrees Fahrenheit to degrees Celsius.
- *a. 20°C
 - b. 37°C
 - c. 45°C
 - d. 65°C
10. Calculate 81.5% of 316 .
- a. 219
 - b. 232
 - *c. 258
 - d. 267
11. If 8.25 pounds of soda ash are mixed into 45 gallons of water, which is the percent of soda ash in the slurry?
- a. 2.0% soda ash slurry
 - b. 2.1% soda ash slurry
 - *c. 2.2% soda ash slurry
 - d. 2.3% soda ash slurry
12. Calculate the area of a circular reservoir in ft², with a diameter of 411 ft.
- a. 108,000ft²
 - b. 112,000ft²
 - c. 125,000ft²
 - *d. 133,000ft²
13. Determine the circumference of a clarifier, if the radius is 95 ft.
- a. 300 ft
 - b. 400 ft
 - c. 500 ft
 - *d. 600 ft
14. Determine the volume in gallons for a pipe completely full of water given the following data:
- Diameter = 1.5 feet
 - Length = 1.09 miles
- a. 65,000gal
 - b. 68,000gal
 - c. 74,000gal
 - *d. 76,000gal

15. Which is the concentration of alum in mg/l, if 5.0 mL of a 0.30 grams/liter alum solution is added to 1,000 mL of deionized water?
- a. 1.2 mg/l alum
 - *b. 1.5 mg/l alum
 - c. 1.8 mg/l alum
 - d. 1.9 mg/l alum
16. Which is the phenolphthalein alkalinity as mg/L CaCO_3 of a water sample given the following parameters?
- Sample size = 100 mL
 - Normality of the sulfuric acid = 0.02 N
 - Titrant used to pH of 8.3 = 1.8 mL (designated by convention as A)
- a. 1.8 mg/l as CaCO_3
 - b. 3.6 mg/l as CaCO_3
 - *c. 18 mg/l as CaCO_3
 - d. mg/l as CaCO_3
17. How many gallons are there in 28.65 acre-ft?
- a. 9,354,282gal
 - b. 9,322,137gal
 - *c. 9,335,000gal
 - d. 9,763,599 gal
18. If 7.3lb of polymer (assume 100%) are mixed into 35 gal of water, determine the percentage of polymer in the slurry.
- a. 2.1% slurry
 - *b. 2.4% slurry
 - c. 2.5% slurry
 - d. 2.8% slurry
19. Which is the percentage of removal across a settling basin, if the influent is 17.1 NTU and the effluent is 1.13 NTU ?
- a. 90.5% NTU removed
 - b. 92.5% NTU removed
 - c. 93.0% NTU removed
 - *d. 93.4% NTU removed
20. Find the detention time in hours for a clarifier that has an inner diameter of 112.2 ft and a water depth of 10.33 ft if the flow rate is 7.26mgd.
- a. 2.10hr
 - b. 2.14hr
 - *c. 2.52hr
 - d. 2.96hr
21. Calculate the lime dosage in mg/l that is required given the following parameters:
- Jar test determines the alum dosage 8.5 mg/l

- Raw alkalinity 9.0 mg/l
- Residual alkalinity needed for precipitation 14 mg/l

Know: 1 mg/l of alum reacts with 0.45 mg/l alkalinity

1 mg/l of alum reacts with 0.35 mg/l lime

*a. 6.9 mg/l lime

b. 11.3 mg/l lime

c. 11.34 mg/l lime

d. 20.9 mg/l lime

22. A dosage of 0.35 mg/l of copper sulfate pentahydrate is desired to control algae in an 8,850 acre-ft capacity reservoir. If the available copper is 25%, how many pounds of copper sulfate pentahydrate are required?

Know: 1 ac-ft=43,560 ft³

a. 4,495 lb copper sulfate

*b. 4,500 lb copper sulfate

c. 4,510 lb copper sulfate

d. 4,511 lb copper sulfate

23. Determine the specific gravity (SG) for a solution that weighs 11.87lb/gal.

a. 1.38SG

b. 1.40SG

*c. 1.42SG

d. 2.58SG

24. A filter is 24 ft by 28 ft. Calculate the filtration rate in gpm, if it receives a flow of 3,250gpm.

a. 4.4gpm/ft²

*b. 4.8gpm/ft²

c. 5.0gpm/ft²

d. 5.1gpm/ft²

25. Determine the backwash rate in gpm/ft² given the following:

- Backwash flow of 13cfs (ft³/sec)

- Filter is 25 ft by 18.2 ft

a. 12.8 gpm/ft²

b. 12.9 gpm/ft²

*c. 13 gpm/ft²

d. 14 gpm/ft²

26. Calculate the backwash pumping rate if a filter requires a backwash rate of 18gpm/ft² and the filter is 20.0 ft by 24.0 ft.

a. 8,600gpm

*b. 8,640gpm

c. 8,700gpm

d. 8,780gpm

27. Which is the raw water alkalinity in mg/l as CaCO₃ of a water sample with a beginning pH

of 7.18, given the following parameters?

- Sample size = 100 mL
 - Normality of the sulfuric acid = 0.02 N
 - Titrant used to pH of 4.6 = 11.4 mL
- a. 100 mg/l as CaCO₃
b. 110 mg/l as CaCO₃
*c. 114 mg/l as CaCO₃
d. 120 mg/l as CaCO₃
28. A chemical metering pump is pumping 26.3 gallons per day (gal/day). How many mL/min is this?
- a. 47.6 mL/min
b. 60.8 mL/min
*c. 69.1 mL/min
d. 75.4 mL/min
29. Find the number of gal/ft³ of a solution, if it weighs 112.7lb/ft³.
- *a. 13.5gal/ft³
b. 16.2gal/ft³
c. 18.0gal/ft³
d. 19.9gal/ft³
30. Find the drawdown of a well that has a specific yield of 28.4 , if the well yields 325 gpm.
- a. 9.8 ft
*b. 11.4 ft
c. 12.9 ft
d. 14.1 ft
31. A water treatment plant has an emergency shutdown. How many water supply hours are left in a 119.8-ft diameter tank given the following data?
- Tank's water level =27.6 ft
 - Water cannot go below 16.0 ft at any time to comply with fire control
 - Water usage averages 483gpm
- *a. 33.7hr
b. 35.0hr
c. 35.4hr
d. 36.2hr
32. A lime tank is conical at the bottom and cylindrical at the top. If the diameter of the cylinder is 14 ft with a depth of 24 ft and the cone depth is 12.5 ft, calculate the volume of the tank in cubic feet.
- a. 3,700ft³
b. 4,000ft³
c. 4,200ft³
*d. 4,300ft³

33. Flow through a channel 5.8 ft wide is 20.3cfs. If the velocity is 1.4ft/sec, how deep is the water in the channel?
- 2.3 ft
 - *2.5 ft
 - 2.6 ft
 - 2.7 ft
34. A lake is 107 ft deep. Which is the psi on the bottom?
- 44.8psi
 - 45.2psi
 - 45.6psi
 - *46.3psi
35. How many gallons per day flow through a 2.18-mil gal capacity sedimentation basin, if the detention time is 2.79hr ?
- 17,100,000gal/ day
 - *18,800,000gal/ day
 - 19,700,000gal/ day
 - 20,300,000gal/day
36. An ion exchange softener is treating a flow rate of 245gpm. Which is the operating time in hours, if the softener unit treats 434,000 gal before it requires regeneration?
- 27.7hr
 - 28.6hr
 - *29.5hr
 - 30.1hr
37. Zinc orthophosphate (ZOP) is used at a treatment plant for corrosion control. The plant is treating 12.1 MGD with a dosage of 0.15 mg/l. Determine the feeder setting for ZOP in mL/min, if the specific gravity of the ZOP is 1.63 .
- *2.9 mL/min of ZOP
 - 3.2 mL/min of ZOP
 - 3.5 mL/min of ZOP
 - 3.9 mL/min of ZOP
38. Determine the feed rate for alum in mL/min with the following conditions:
- Plant flow= 30.9 MGD
 - Alum dosage rate =10.4 mg/l
 - Alum percentage 48.4 %
 - Alum specific gravity = 1.31
- 1,250 mL/min
 - 1,270 mL/min
 - *1,330 mL/min
 - 1,410 mL/min
39. A 1.50 -ft diameter pipe that is 1.62 miles long was disinfected with chlorine. If 47.2lb of

chlorine were used, which was the dosage in mg/l ?

- a. 25.0 mg/l
- b. 30.0 mg/l
- *c. 50.0 mg/l
- d. 60.0 mg/l

40. Calculate the specific gravity (SG) for an unknown liquid with a density of 87.6 lb/ft³.

- *a. 1.40SG
- b. 1.43SG
- c. 1.51SG
- d. 1.62SG

0.21 TIII AND TIV MATH

1. The alum dosage for a plant with a flow of 26.5cfs is 655 mL/min. If the raw water flow rate is adjusted to 18.5cfs, which should be the theoretical alum dosage in mL/min, if all water parameters remain the same?
 - a. 410 mL/min
 - b. 418 mL/min
 - c. 436 mL/min
 - *d. 457 mL/min
2. Which is the percentage recovery for a reverse osmosis unit with a 4-2-1 arrangement given the following data?
 - Product flow is 570 gpm
 - Feed flow is 1.03mgd
 - *a. 79.7%
 - b. 80.0%
 - c. 80.2%
 - d. 80.5%
3. How many lb /day of sodium fluorosilicate (Na_2SiF_6) are required given the following parameters?
 - Flow rate is 1,750gpm
 - Fluoride desired is 1.20 mg/l
 - Fluoride in raw water is 0.15 mg/l
 - Sodium fluorosilicate is 98.1% pure
 - Fluoride (F) ion percent is 60.6%
 - a. 34lb/ day, F
 - *b. 37lb/ day, F
 - c. 42lb/ day, F
 - d. 48lb/ day, F
4. An ion exchange softener is treating a flow rate of 125gpm. Which is the operating time in hours if the softener unit treats 297,000 gallons before it requires regeneration?
 - a. 37hrs
 - *b. 39.6hrs
 - c. 40hrs
 - d. 41.1hrs
5. A water treatment plant has 8 filters with an average flow rate of 4.89gpm/ft². If the plant flow is 32.7cfs, what is the filtration area of each filter?
 - *a. 375ft²/ filter
 - b. 398ft²/ filter
 - c. 400ft²/ filter
 - d. 410ft²/ filter

6. Calculate the amount of iron removed in pounds per year from a water plant that treats an average of 20.2mgd if the average iron concentration is 0.52 mg/l and the removal efficiency is 84 %.
 - a. 26,859lb/yr of Fe removed
 - *b. 27,000lb/yr of Fe removed
 - c. 31,975lb/yr of Fe removed
 - d. 32,000lb/yr of Fe removed
7. Determine the percent mineral rejection from a reverse osmosis plant if the feedwater contains 1,230mg/l TDS and the product water contains 135 mg/l TDS.
 - a. 88%
 - *b. 89%
 - c. 90%
 - d. 91%
8. Calculate the log removal for a water treatment plant if the samples show a raw water coliform count of 295/100 mL (through extrapolation) and the finished water shows 2.0/100 mL.
 - a. 1.8 log removal
 - b. 2 log removal
 - c. 2.1 log removal
 - *d. 2.2 log removal
9. A 0.25 Normal solution of H_3PO_4 (phosphoric acid) is to be prepared. If 4.5 liters of solution is desired, how many grams of H_3PO_4 are required? The gram formula for H_3PO_4 is 98.00 . Give answer to nearest 100 th of a gram.
 - a. 8.17 grams
 - b. 24.50 grams
 - *c. 36.75 grams
 - d. 42.31 grams
10. A 2.00% stock polymer solution (20,000 ppm or 20,000 mg/L) is desired for performing a jar test. If the polymer has a specific gravity of 1.27 and is 84.5 % polymer, how many milliliters are required to make exactly 1,000 mL stock solution?
 - a. 12.3 mL polymer
 - b. 15.3 mL polymer
 - *c. 18.6 mL polymer
 - d. 21.8 mL polymer
11. Calculate the theoretical detention time in hours for the following water treatment plant:
 - Flow rate of 12.2mgd
 - Four flocculation basins measuring: 45.0 ft by 10.0 ft by 11.0 ft in average depth each
 - Sedimentation basin measuring: 285 ft by 65.0 ft by 11.4 ft in average depth
 - Eight filters measuring: 35.0 ft by 28.0 ft by 12.3 ft in depth each

- Clear well averages 2.05 million gallons (mil gal)

- a. 7.61hr
- b. 8.60hr
- c. 8.78hr
- *d. 8.85hr

12. Calculate the CT and inactivation ratio for a water treatment plant that has the following parameters; and does this treatment facility meet the CT?

- Daily Parameters:
- Detention time = 83 min
- pH = 7.8
- Lowest Temperature = 12°C
- Lowest chlorine residual 0.60 mg/l
- A 1.0 log removal is required for this system

- a. 0.9 inactivation ratio
- *b. 1.2 inactivation ratio
- c. 1.3 inactivation ratio
- d. 1.35 inactivation ratio

13. Calculate the feed rate for fluorosilicic acid in mL/min given the following data:

- Flow rate is 11.8mgd
- Fluoride desired is 1.20 mg/l
- Fluoride in raw water is 0.20 mg/l
- Treated with 20.5% solution of H_2SiF_6
- Fluoride ion percent is 79.0%
- H_2SiF_6 weighs 9.8lb/gal

- a. 30 mL/min, H_3SiF_6
- b. 32 mL/min, H_3SiF_6
- *c. 33 mL/min, H_3SiF_6
- d. 35 mL/min, H_3SiF_6

MOLECULAR WEIGHTS OF CHEMICAL COMPOUNDS	
COMPOUND	MOLECULAR WEIGHT
Alkalinity, as CaCO_3	100.1
Carbon Dioxide, CO_2	44.0
Hardness, as CaCO_3	100.1
Hydrated Lime, $\text{Ca}(\text{OH})_2$	74.1
Magnesium, Mg^{2+}	24.3
Magnesium Hydroxide $\text{Mg}(\text{OH})_2$	58.3
Quicklime, CaO	56.1
Soda Ash, Na_2CO_3	106.0

Use this table to solve problem 14.

14. Determine the hydrated lime dose required in mg/l for water with the following characteristics:

	Source Water	Softened Water
Total Alkalinity, mg/L	165 mg/l as CaCO ₃	39 mg/l
Total Hardness, mg/l	248 mg/l as CaCO ₃	76 mg/l
CO ₂ , mg/l	13 mg/l	0 mg/l
Mg ²⁺	21 mg/l	7.8 mg/l
pH	7.0	7.8
Lime Purity	92%	

Use an excess lime dosage of 15% (115% or 1.15 in decimal form)

- *a. 190mg/L, Ca(OH)₂
 - b. 194mg/L, Ca(OH)₂
 - c. 195mg/L, Ca(OH)₂
 - d. 200mg/L, Ca(OH)₂
15. What is the flow through a membrane unit in gpd/ft², if the water flux of the unit is 4.75×10^{-4} gm/cm²/s ?
- a. 10gpd/ft²
 - *b. 10.1gpd/ft²
 - c. 100gpd/ft²
 - d. 101gpd/ft²
16. A conventional water treatment plant had to discontinue pre-chlorination, that is, no addition of chlorine to the flocculation basins and the sedimentation basin due to elevated trihalomethane levels. Consequently, the chlorine dose was increased before the filters and the clear well and a lithium chloride tracer study was performed. The plant requires a 1.5 log removal for Giardia cysts. Given the following parameters on the first day of this process change and referring to the CT values table in Appendix B, determine if this plant

is in CT compliance:

Unit Process or Piping	T ¹⁰ Value, Min	Lowest Chlorine Residual
Filtration	12	0.45 mg/l
Piping (filter to clear well)	4.5	0.40 mg/l
Clearwell	51	1.20 mg/l

Unit Process or Piping	Temperature	pH	CT Value, Tables
Filtration	11	6.9	47.5
Piping (filter to clear well)	11	6.9	47.1
Clear well	12	7.6	45.5

- a. 0.9 inactivation ratio, plant is out of compliance
 - *b. 1.1 inactivation ratio, plant is in compliance
 - c. 1.13 inactivation ratio, plant is in compliance
 - d. 1.27 inactivation ratio, plant is in compliance
17. A 5-min drawdown test result showed that 106 mL of a polymer aid was being used to help treat the raw water. The specific gravity (SG) of the polymer aid is 1.26. If the plant is treating 3,225gpm, what is the polymer dosage in mg/l ? Give answer to three significant figures.
- a. 1.74mg/l polymer aid
 - *b. 2.19mg/l polymer aid
 - c. 10.94mg/l polymer aid
 - d. 15.12mg/l polymer aid

18. A lime tank is conical at the bottom and cylindrical at the top. If the diameter of the cylinder is 15 ft with a depth of 28 ft and the cone depth is 12 ft, what is the volume of the tank in cubic feet? Give answer to three significant figures.
- a. 1,040ft³
 - b. 5,510ft³
 - *c. 5,650ft³
 - d. 7,060ft³
19. A watershed, 158 square miles, receives an average of 22.6 inches of rain each year. The amount of rain collected for treatment is 6.75%. How many million gallons (mil gal) of water are available per year for the small community that resides there?
- a. 4,060 mil gal/year
 - *b. 4,190milgal/year
 - c. 25,400milgal/ year
 - d. 50,300 mil gal/year
20. A softener unit has 118ft³ of resin with a capacity of 25.5 kilograins /ft³. How many gallons of water will the unit treat, if the water contains 14.2 gpg?
- a. 195,000 gal
 - b. 210,000 gal
 - *c. 211,900 gal
 - d. 212,500 gal
21. A solution of lime needs to be prepared for a jar test. How many grams of quicklime, CaO, would you mix with 1 L of water to make a 1.0% (Wt-volume) solution?
- a. 0.1 g of CaO
 - b. 1 g of CaO
 - *c. 10 g of CaO
 - d. 100 g of CaO
22. Calculate the percent removal across a settling basin and filter complex, if the raw water influent is 5.45ntu and the effluent (post filters) is 0.018ntu. Give answer to three significant figures.
- a. 98.4%
 - b. 99.0%
 - c. 99.3%
 - *d. 99.7%
23. Determine the psi at the bottom of an alum storage tank if the level of the alum in the tank is 8.95 ft and the density of the alum is 11.32lb/gal.
- a. 5.13psi
 - *b. 5.26psi
 - c. 5.37psi
 - d. 5.41psi
24. Find the detention time in minutes for a clarifier that has a diameter of 152 ft and a water

depth of 14.8 ft, if the flow rate is 4.25mgd.

- a. 650 min
- *b. 680 min
- c. 700 min
- d. 710 min

25. A 3-minute drawdown test used 191 mL of polymer for treating the raw water. The specific gravity of the polymer is 1.34 . Which is the polymer dosage in mg/l, if the plant is treating 3,280gpm ?

- a. 6.63mg/l
- b. 6.72mg/l
- *c. 6.87mg/l
- d. 6.99mg/l

26. A polymer solution has a specific gravity of 1.35 and a concentration of 80%. How many microliters are required to do a jar test, if the test uses 2-liter jars and the dosage needed is 6 mg/l ? Give result to nearest tenth of a microliter.

- *a. 11.1 microliters
- b. 11.3 microliters
- c. 11.4 microliters
- d. 11.7 microliters

27. Which should be the chemical feeder setting in lb/min if 12.5mgd is treated with 7.25 mg/l of soda ash?

- a. 0.486lb/min
- *b. 0.525lb/min
- c. 0.548lb/min
- d. 0.561lb/min

28. How many pounds per day of 65% calcium hypochlorite are required for maintaining a 2.5 mg/l dosage for a 2,575gpm treatment plant?

- a. 100lb/ day
- b. 110lb/ day
- *c. 120lb/ day
- d. 130lb/ day

29. Determine the chemical feeder setting in mL/min for a polymer solution, if the desired dosage is 3.95 mg/l and the treatment plant is treating 10.0mgd. The specific gravity of the polymer is 1.33 .

- a. 70.1 mL/min
- b. 73.9 mL/min
- c. 76.2 mL/min
- *d. 78.1 mL/min

30. Four filters have a surface area of 450 ft each, measured to the nearest foot. Calculate the filtration rate in gpm, if the flow received is $21.5\text{ft}^3/\text{s}$. Give answer to three significant

figures.

- a. 5.11gpm/ft²
 - b. 5.21gpm/ft²
 - *c. 5.36gpm/ft²
 - d. 5.58gpm/ft²
31. Determine the hardness of a particular body of raw water in mg/l, if the hardness of a water sample is 19.4 grains per gallon (gpg).
- *a. 332 mg/l
 - b. 339 mg/l
 - c. 342 mg/l
 - d. 350 mg/l
32. The exchange capacity of a softener is 8,850,000 grains. The softener treats water with an average hardness of 347 mg/l. Which is the capacity of the softener in gallons?
- a. 429,000 gal
 - *b. 437,000 gal
 - c. 444,000 gal
 - d. 449,000 gal
33. Find the backwash rate in gpm per ft², if a filter has an area of 620ft² with a backwash rate of 13.5cfs.
- a. 9.1gpm/ft²
 - b. 9.4gpm/ft²
 - c. 9.6gpm/ft²
 - *d. 9.8gpm/ft²
34. The level in a storage tank drops 4.25 ft in exactly 12 hours. If the tank has a diameter of 50.0 ft and the plant is producing 2.95mgd, which is the average discharge rate of the treated water discharge pumps in gallons per minute?
- a. 2,090 gpm
 - b. 2,100 gpm
 - c. 2,120 gpm
 - *d. 2,140 gpm
35. Ten filters have a surface area of 480 ft each. Calculate the filtration rate in gpm, if the total flow through the filters is 16.5 cubic feet per second.
- a. 1.2gpm/ft²
 - b. 1.3gpm/ft²
 - *c. 1.5gpm/ft²
 - d. 1.9gpm/ft²
36. Determine the amount of iron removed per year, if the iron concentration is 0.21 mg/l, the plant treats an average of 14.1mgd, and the removal efficiency is 95.7% (0.957).
- a. 8,000lb/yr
 - b. 8,200lb/yr

*c. 8,600lb/yr

d. 9,000lb/yr

0.22 DI AND DII MATH

1. 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
2. Convert 37.4 degrees Fahrenheit to degrees Celsius.
 - *a. 3.0°C
 - b. 5.3°C
 - c. 7.9°C
 - d. 9.7°C
3. What is the area of a circular tank pad in ft², if it has a diameter of 102 ft ?
 - a. 6,160ft²
 - b. 6,167ft²
 - *c. 8,170ft²
 - d. 8,200ft²
4. What is the pressure 1.85 feet from the bottom of a water storage tank if the water level is 28.7 feet?
 - *a. 11.6psi
 - b. 12.4psi
 - c. 62.0psi
 - d. 66.3psi
5. Calculate the well yield in gpm, given a drawdown of 14.1 ft and a specific yield of 31 gpm / ft.
 - a. 2.2gpm
 - b. 7.3gpm
 - c. 45.1gpm
 - *d. 440gpm
6. How many gallons are in a pipe that is 18.0 in. in diameter and 1,165 ft long?
 - a. 2,060 gal
 - b. 10,300 gal
 - *c. 15,400 gal
 - d. 17,200 gal
7. A water tank with a capacity of 5.75 million gallons (mil gal) is being filled at a rate of 2,105gpm. How many hours will it take to fill the tank?
 - a. 31.6hr
 - b. 37.8hr
 - c. 42.9hr
 - *d. 45.5hr

8. Determine the detention time in hours for the following water treatment system:
- Distribution pipe from water plant to storage tank is 549 ft in length and 14in. in diameter
 - Storage tank averages 2,310,000 gal of water at any given time
 - Flow through system is 6.72mgd
- a. 7.2 hr
b. 7.4 hr
c. 8.0 hr
*d. 8.3 hr
9. Convert 28.7 cubic feet per second (cfs) to gallons per minute (gpm).
- a. 12,477gpm
b. 12,700gpm
c. 12,880gpm
*d. 12,900gpm
10. Convert 16,912,000 liters to acre-feet.
- *a. 13.7 acre-ft
b. 41.5 acre-ft
c. 51.9 acre-ft
d. 767 acre-ft
11. Convert -22.6Deg. C to degrees Fahrenheit.
- a. -4.6Deg. F
*b. -8.7Deg. F
c. -11.8Deg. F
d. -12.8Deg. F
12. A sodium hypochlorite solution contains 11.3% hypochlorite. Calculate the mg/l hypochlorite in the solution.
- a. 11.3 mg/l sodium hypochlorite
b. 1,130 mg/l sodium hypochlorite
c. 11,300 mg/l sodium hypochlorite
*d. 113,000 mg/l sodium hypochlorite
13. Records for a pump show that on June 1st at exactly 9:00 a.m. the number of pumped gallons was 71,576,344 and on July 1st at exactly 9:00 a.m. it was 72,487,008 gallons. Determine the average gallons pumped per day (gal/day) for this month to the nearest gallon.
- a. 18,605gal/day
b. 25,875gal/day
*c. 30,355gal/day
d. 34,325gal/day
14. If chlorine is being fed at a rate of 260lb/ day for a flow rate of 23cfs, which should be the adjustment on the chlorinator when the flow rate is decreased to 16cfs, if all other water

parameters remain the same?

- a. 160lb/ day
- *b. 180lb/ day
- c. 310lb/ day
- d. 370lb/ day

15. Calculate the diameter of a clarifier with a circumference of 215 ft.

- a. 34.8 ft
- b. 56.7 ft
- *c. 68.5 ft
- d. 76.2 ft

16. Determine the depth of water in a reservoir, if the psi is 31.9 .

- a. 13.8 ft deep
- b. 24.9 ft deep
- c. 45.6 ft deep
- *d. 73.7 ft deep

17. Calculate the area of a tank, if the tank's radius is 39.8 ft.

- *a. 4,970ft²
- b. 5,670ft²
- c. 7,820ft²
- d. 9,940ft²

18. Determine the specific gravity (SG) of an unknown liquid, if the density of the liquid is 70.9lb/ft³.

- a. 1.05
- *b. 1.14
- c. 1.18
- d. 1.21

19. A water treatment plant is feeding an average of 295lb/ day of chlorine. If the dosage is 2.25 mg/l, which is the number of millions of gallons per day (mgd) being treated?

- *a. 15.7mgd
- b. 35.1mgd
- c. 58.3mgd
- d. 79.6mgd

20. How many gallons of a sodium hypochlorite solution that contains 12.1% available chlorine are needed to disinfect a 1.5 -ft diameter pipeline that is 283ft long, if the dosage required is 50.0 mg/l ? Assume the sodium hypochlorite is 9.92lb/gal.

- a. 0.87 gal sodium hypochlorite
- b. 1.0 gal sodium hypochlorite
- *c. 1.3 gal sodium hypochlorite
- d. 1.5 gal sodium hypochlorite

21. A water treatment plant is treating 16.4 million gallons per day (mgd). If the chlorine feed

rate is 415lb/day, which is the chlorine dosage in mg/l ?

- *a. 3.03 mg/l
- b. 3.38 mg/l
- c. 3.43 mg/l
- d. 3.67 mg/l

22. A 1.65-million gallon (mil gal) storage tank needs to be disinfected with a sodium hypochlorite solution that has 11.8% available chlorine. The tank is to be filled at 10% capacity, and the initial chlorine dosage required is 50.0 mg/l. How many gallons of sodium hypochlorite will be needed, if it weighs 9.84lb/gal ?

- a. 50 gal sodium hypochlorite
- b. 53 gal sodium hypochlorite
- *c. 59 gal sodium hypochlorite
- d. 63 gal sodium hypochlorite

23. How many pounds of a calcium hypochlorite that contains 64.3% available chlorine are needed to disinfect a water main that is 24in. in diameter, if the pipeline is 781 ft long and the dosage required is 50.0 mg/l ?

- a. 5.95lb calcium hypochlorite
- b. 8.25lb calcium hypochlorite
- *c. 11.9lb calcium hypochlorite
- d. 13.8lb calcium hypochlorite

24. A well is pumping water at a rate of 428gpm. Which should be the setting on a chlorinator in pounds per day, if the dosage desired is 1.20 mg/l and the chlorine demand is 3.85 mg/l ?

- a. 19.8lb/ day of chlorine
- b. 20.6lb/ day of chlorine
- c. 23.7lb/ day of chlorine
- *d. 26.0lb/ day of chlorine

25. Convert 48.1 million gallons a day (mgd) to cubic feet per second (cfs).

- a. 68.7cfs
- *b. 74.4cfs
- c. 79.1cfs
- d. 82.0cfs

26. Convert 184 gpm to liters per second (L/s).

- a. 10.3 L/s
- b. 11.1 L/s
- *c. 11.6 L/s
- d. 12.3 L/s

27. Which is the average turbidity in ntu at the end of a sedimentation basin given the following data?

1	2	3	4	5	6	7
1.08ntu	0.98ntu	0.94ntu	0.88ntu	0.96ntu	1.03ntu	1.25ntu

- a. 1.00ntu
 - b. 1.01ntu
 - *c. 1.02ntu
 - d. 1.03ntu
28. If 288 is 70.3%, how much is 100% ?
- *a. 410
 - b. 412
 - c. 415
 - d. 418
29. The iron (Fe) content of a water source averages 0.81 mg/l iron. Which is the percent removal, if the treated water averages 0.01 mg/l iron?
- a. 96% Fe removal efficiency
 - b. 97% Fe removal efficiency
 - c. 98% Fe removal efficiency
 - *d. 99% Fe removal efficiency
30. Which will be the percent of soda ash in the resulting slurry, if 28.2 pounds of soda ash are mixed with exactly 100.0 gallons of water?
- *a. 3.27% soda ash slurry
 - b. 3.38% soda ash slurry
 - c. 3.45% soda ash slurry
 - d. 3.54% soda ash slurry
31. Which is the exposed exterior surface area of a ground-level storage tank that is 24.0 ft high and has a diameter of 80.1 ft ? Assume top is flat.
- a. 10,800ft²
 - b. 10,900ft²
 - c. 11,000ft²
 - *d. 11,100ft²
32. A pipe is 1.43 miles long and has an inner diameter of 18.0 inches. How many gallons are in the pipeline if it is full?
- a. 66,500 gal
 - b. 79,200 gal
 - *c. 99,800 gal

- d. 104,000 gal
33. A storage tank has a 60.0-ft radius and averages 25.5 ft in water depth. Calculate the average detention time in hours for this storage tank, if flow through the tank averages 2.91 MGD during a particular month in question.
- a. 17.5hr
 - *b. 17.8hr
 - c. 18.6hr
 - d. 19.8hr
34. If the pressure head on a fire hydrant is 134 ft, which is the pressure in psi?
- a. 50psi
 - b. 52psi
 - c. 54psi
 - *d. 58psi
35. A meter indicates the water flow from a fire hydrant is $5.5\text{ft}^3/\text{min}$. How many gallons will flow from the hydrant in 20 minutes?
- *a. 820gal
 - b. 850gal
 - c. 880gal
 - d. 920gal
36. A polymer weighs 8.25lb and occupies 3.150 liters. Which is the density of the polymer in g/cm^3 ?
- a. 1.18 g/cm^3
 - *b. 1.19 g/cm^3
 - c. 1.20 g/cm^3
 - d. 1.21 g/cm^3
37. Determine the percent accuracy for a meter being tested, if it reads 245.7 cubic feet and the volumetric tank used to measure the water that flowed through the meter indicates the actual volume as 1,863 gallons.
- a. 97.8% meter efficiency
 - *b. 98.6% meter efficiency
 - c. 99.0% meter efficiency
 - d. 99.3% meter efficiency
38. Which is the chlorine dosage at a water treatment plant, if the chlorinator is set on 320lb/day and the plant is treating 11.6mgd ?
- a. 2.8 mg/l
 - b. 3.0 mg/l
 - *c. 3.3 mg/l
 - d. 3.7 mg/l
39. A 1.75-mil gal storage tank needs to be disinfected with a sodium hypochlorite solution that contains 12.0% available chlorine and weighs 8.97lb/gal. If the chlorine dosage is to

be 50.0 mg/l, how many gallons of sodium hypochlorite are required?

- *a. 678 gal
- b. 729 gal
- c. 750 gal
- d. 791 gal

40. A 24.0-in. pipeline, 427 ft long, was disinfected with calcium hypochlorite tablets with 65.0% available chlorine. Determine the chlorine dosage in mg/l, if 7.0 lb of calcium hypochlorite was used. Assume that the hypochlorite is so diluted that it weighs 8.34 lb/gal.

- a. 25 mg/l chlorine
- b. 39 mg/l chlorine
- c. 43 mg/l chlorine
- *d. 54 mg/l chlorine

41. Water from a well is treated with a sodium hypochlorite solution that contains 10.3% available chlorine and weighs 8.95 lb/gal. The well is pumping water at 260 gpm. Calculate the chlorine dosage, if the chlorinator is pumping at a rate of 95 liters/day.

- a. 5.6 mg/l sodium hypochlorite
- b. 6.3 mg/l sodium hypochlorite
- *c. 7.4 mg/l sodium hypochlorite
- d. 8.8 mg/l sodium hypochlorite

42. Which should be the setting on a chlorinator in pounds per day, if the dosage desired is 1.75 mg/l, the chlorine demand averages 2.45 mg/l, and the pumping rate from the well is 208 gpm?

- *a. 10.5 lb/ day chlorine
- b. 11.2 lb/ day chlorine
- c. 12.0 lb/ day chlorine
- d. 13.1 lb/ day chlorine

43. What is the maximum pumping rate (in gpm) of a pump that is producing 15 water horsepower against a head of 65 ft ?

- a. 115 gpm
- *b. 910 gpm
- c. 17,000 gpm
- d. 63,000 gpm

44. A water plant serves 23,210 people. If it treats a yearly average of 2.98 mgd, what are the gallons per capita per day (gpcd)? Note: A capita = 1 person.

- a. 115 gpcd
- b. 120 gpcd
- c. 122 gpcd
- *d. 128 gpcd

0.23 DIII AND DIV MATH

1. What is the velocity of flow in feet per second for a 6.0-in. diameter pipe, if it delivers 122gpm ? Assume pipe is full.
 - a. 1.3ft/sec
 - b. 1.35ft/sec
 - c. 1.38ft/sec
 - *d. 1.4ft/sec
2. A small cylinder on a hydraulic jack is 10in. in diameter. A force of 130lb is applied to the small cylinder. If the diameter of the large cylinder is 2.5 ft, what is the total lifting force?
 - a. 1,170lb
 - *b. 1,200lb
 - c. 1,250lb
 - d. 1,300lb
3. A 2.0-ft diameter pipe that is 2.45 miles long was disinfected with chlorine. If 126.9lb of chlorine were used, what was the initial dosage in mg/l ?
 - a. 25 mg/l
 - b. 40 mg/l
 - *c. 50 mg/l
 - d. 60 mg/l
4. What is the motor horsepower (mhp), if 200 horsepower (hp) is required to run a pump with a motor efficiency (Effic.) of 88% and a pump efficiency of 74% ? Note: The 200hp in this problem is called the water horsepower (whp). The whp is the actual energy (horsepower) available to pump water. Give results to two significant figures.
 - a. 130mhp
 - b. 180mhp
 - c. 200mhp
 - *d. 310mhp
5. What is the bowl horsepower (bhp) for a vertical turbine pump given the following parameters?
 - Pumping rate =385 gpm
 - Bowl head = 215 feet
 - Bowl efficiency =81 %
 - a. 17bhp
 - b. 20bhp
 - *c. 26bhp
 - d. 33bhp
6. Water is flowing at a velocity of 1.3ft/sec in a 4.0 -in. diameter pipe. If the pipe changes from the 4.0-inch to a 3.0-in. pipe, what will the velocity be in the 3.0-in. pipe?
 - a. 0.73ft/sec

- b. 1.28ft/sec
 - *c. 2.3ft/sec
 - d. 2.6ft/sec
7. The level in a storage tank drops 2.3 ft in exactly 18hr. If the tank has a diameter of 120 ft and the plant is producing 4.75mgd, what is the average discharge rate of the three treated water discharge pumps in gpm?
- a. 3,479gpm
 - *b. 3,500gpm
 - c. 4,578gpm
 - d. 4,600gpm
8. How many gallons of a 12.5% sodium hypochlorite solution (9.34lb/gal) are required to make exactly 1,000 gal of a 50 mg/l solution?
- a. 0.3 gal
 - *b. 0.4 gal
 - c. 0.43 gal
 - d. 0.63 gal
9. What percent hypochlorite solution would result, if 350 gal of an 11% solution were mixed with 225 gal of a 5.8% solution? Assume both solutions have the same density.
- a. 8.9% final solution
 - *b. 9.0% final solution
 - c. 9.1% final solution
 - d. 9.12% final solution
10. What water horsepower (whp) is required for a pump that delivers 650 gpm to a total head of 195 feet?
- a. 25 whp
 - b. 30 whp
 - *c. 32 whp
 - d. 40 whp
11. Determine the percentage strength of a solution mixture, if 875lb of a 49.5% strength solution is mixed with 293lb of a 17.2% strength solution.
- *a. 41.4%
 - b. 42.4%
 - c. 43.0%
 - d. 43.1%
12. How many fluid ounces (oz) of sodium hypochlorite (10.5% available chlorine and 9.10lb/gal) are required to disinfect a well with the following parameters?
- Depth of well is 287 ft
 - 12-in. diameter well casing extends down to 100.0 ft
 - The remainder is a 10.0-in. diameter casing
 - The residual desired dose is 50.0 mg/l

- The depth to water is 168.4 ft
 - The chlorine demand is 4.7 mg/l
- a. 21oz
 - b. 25oz
 - c. 27oz
 - *d. 30oz
13. Determine the cost to the nearest cent to operate a 300Hp motor for one month (assume 30 days), if it runs an average of 4.2hr/ day, is 82% efficient, and the electrical costs are \$0.041 per kW.
- a. \$948.04
 - b. \$970.92
 - *c. \$1,156.15
 - d. \$1,184.05
14. A storage tank has a level capacity of 24.50 ft. Currently the water level is 16.55 ft in the tank. Calculate the SCADA reading on the board in mA for a 4 mA to 20 mA signal.
- a. 13.5 mA
 - b. 13.51 mA
 - c. 14.8 mA
 - *d. 14.81 mA
15. A pipe that is 3,270 ft long has a diameter of 14.0in. for two-thirds of its length and 10.0 in. for the remaining one-third. How many gallons will it take to completely fill this pipe?
- a. 17,598 gal
 - *b. 21,900 gal
 - c. 52,670 gal
 - d. 87,500 gal
16. How many pounds of lime must be added to exactly 200 gal of water to produce a lime slurry of 15% ?
- a. 220lb
 - *b. 290lb
 - c. 340lb
 - d. 420lb
17. Determine the volume in gallons of a trapezoid-shaped canal that has the following dimensions:
- Length =6,091 ft
 - Height =4.10 ft
 - Bottom width = 5.85ft (b_1)
 - Top width = 10.6ft (b_2)
- a. 1,270,000 gal
 - b. 1,330,000 gal
 - c. 1,480,000 gal

*d. 1,540,000 gal

18. Calculate the detention time to the nearest 100hr for the following system:

- The clear well is 308 ft long, 118 ft wide, and has an average water depth of 12.85 ft
- Distribution pipe from clear well to storage tank is 1.34 miles long and has a diameter of 2.00 ft
- The storage tank has a diameter of 99.8 ft and averages a height of 26.48 ft of water
- The water production for the year averaged 30.02mgd

a. 4.02 hr

*b. 4.16 hr

c. 4.22 hr

d. 4.29 hr

19. A well has a depth of 276.5 ft. If the depth to water is 153.8 ft, which is the pressure in psi 5.0 ft above the bottom? Disregard the additional atmospheric pressure in the well.

a. 42 psi

b. 46 psi

c. 48 psi

*d. 51 psi

20. How many gallons per minute should a flowmeter register, if a 10.0-in. diameter main is to be flushed at 5.10ft/sec ?

a. 1,050 gpm

b. 1,100gpm

*c. 1,250gpm

d. 1,350gpm

21. Water is flowing at a velocity of 2.0ft/sec in an 8.0-in. diameter pipe. If the pipe changes from the 8.0-in. to a 10.0 -in. pipe, the velocity in the 10.0 -in. pipe will be

*a. 1.3ft/sec

b. 1.5ft/sec

c. 1.7ft/sec

d. 1.8ft/sec

22. An 18-in. diameter distribution pipe delivers 988,000 gallons in 24hr. Which is the average flow during the 24hr in ft/sec ?

a. 0.60ft/sec

b. 0.73ft/sec

*c. 0.87ft/sec

d. 0.94ft/sec

23. A 64.5% calcium hypochlorite solution was used to treat 10.6 mil gal. The tank containing the hypochlorite solution is 6.0 ft in diameter. If the tank dropped 8.03in. during the time the 10.6 mil gal were treated, which must have been the chlorine dosage in mg/l ?

a. 5.78 mg/l

b. 6.33 mg/l

- c. 7.25 mg/l
*d. 8.61 mg/l
24. A well that is 227 ft deep and 12in. in diameter requires disinfection. Depth to water from the casing top is 143 ft. If the desired dose is 50.0 mg/l, how many gallons of sodium hypochlorite (12.5% available chlorine) are required? Note: The specific gravity of the sodium hypochlorite is 1.15 or 9.59lb/gal.
*a. 0.17 gal
b. 0.19 gal
c. 0.21 gal
d. 0.25 gal
25. A pipe that is 2.50 ft in diameter and 1,058 ft long is to be disinfected with 64.5% calcium hypochlorite tablets. If the desired dose is 25.0 mg/l, how many pounds of calcium hypochlorite are required?
a. 10.1 lb
b. 11.7 lb
*c. 12.6 lb
d. 13.2 lb
26. A tank 84.0 ft in diameter and 24.25 ft high at the overflow requires disinfection. How much 12.5 % sodium hypochlorite that is 9.59lb/gal will be required for a dosage of 50.0 mg/l ?
a. 310 gal
*b. 350 gal
c. 380 gal
d. 410 gal
27. How many calcium hypochlorite tablets, each weighing 0.45lb, are needed to disinfect a water main, given the following information:
- Length of pipe =513 ft
 - Pipe diameter =2.50 ft
 - Calcium hypochlorite =64.0 % available chlorine
 - Dosage required =25.0 mg/l
- a. 10 tablets
b. 12 tablets
*c. 14 tablets
d. 16 tablets
28. A well that is 210 ft in depth and 14.0in. in diameter requires disinfection. The depth to water from top of casing is 91 ft. If the desired dose is 50.0 mg/l, which is the number of pounds and ounces of sodium hypochlorite (12.5% available chlorine) required? Assume the sodium hypochlorite solution is 9.59lb/gal.
*a. 43oz of NaOCl
b. 45oz of NaOCl

- c. 49oz of NaOCl
d. 54oz of NaOCl
29. Soda ash slurry is being added to water being released from a clear well to the distribution system to raise the pH. If the amount of soda ash being added averages 124.5 grams per minute for that day and the water leaving the distribution system averages 3,075 gpm for that day, which must have been the soda ash dosage in mg/l ?
- a. 8.18 mg/l
b. 9.70 mg/l
*c. 10.69 mg/l
d. 12.47 mg/l
30. The level in a clearwell tank drops 7.08 ft in exactly 12.0hr. If the tank has a diameter of 149.8 ft and the plant is producing 4.75mgd, calculate the average discharge rate for each pump of the four same capacity treated water discharge pumps in gallons per minute.
- *a. 1,150gpm
b. 1200gpm
c. 1,250gpm
d. 1,680gpm
31. Determine the horsepower (hp) required for a clear well water pump that needs to pump water to a storage tank given the following parameters:
- Elevation of clear well water pump 170.84 ft
 - Elevation of water storage tank 478.16 ft
 - Length of pipeline from clear well water pump to storage tank = 2,107 ft
 - Pump above clear well (suction lift) 2.5 ft
 - Friction loss in pipeline = 1.57 ft per 1,000 ft
 - Assume velocity head = 2.38 ft
 - Required flow per day (maximum) 4,000 GPM
 - Pump efficiency = 85 %
 - Motor efficiency = 89 %
- a. 375hp
b. 400hp
*c. 420hp
d. 450hp
32. Which is the net positive suction head available (NPSHA) given the following data? Will the pump cavitate, if the net positive suction head required (NPSHR) is 18.4 ft ? Note: There are 1.11ft/in. of Hg.
- Atmospheric pressure = 29.8 in Hg
 - Static suction lift = 15.1 ft
 - Friction headloss = 0.61 ft
 - Vapor pressure at 12°F (VP) = 0.50 ft
- a. 14 ft, therefore NPSHA < NPSHR so cavitation should occur

- *b. 17 ft, therefore $NPSHA < NPSHR$ so cavitation should occur
 - c. 20 ft, therefore $NPSHA > NPSHR$ so cavitation should not occur
 - d. 22 ft, therefore $NPSHA > NPSHR$ so cavitation should not occur
33. Determine the approximate C factor for a pipe that is 1.0 ft in diameter and has a flow of 1,225gpm given the following data:
- Upstream pressure gauge 120 ft
 - Downstream pressure gauge 105 ft
 - Distance between gauges 2,274 ft
- *a. 95
 - b. 100
 - c. 110
 - d. 120
34. A storage tank has a capacity of 34 ft. Currently there are 22.89 ft of water in the tank. Which would the SCADA reading be on the board in milliamps (mA) for a 4-mA to 20-mA signal?
- a. 13.9 mA
 - b. 14.1 mA
 - c. 14.3 mA
 - *d. 14.8 mA
35. How many pounds of lime must be added to exactly 200 gal of water to produce a lime slurry of 15% ?
- a. 220lb
 - *b. 290lb
 - c. 340lb
 - d. 420lb
36. Your water treatment plant uses 39.6lbs. of cationic polymer to treat a flow of 2.71 MGD. What is the polymer dosage?
- a) 0.07ppm
 - *b) 1.75ppm
 - c) 14.61ppm
 - d) 3.23ppm
37. The sedimentation basin at a water plant measure 60 feet long by 40 feet wide by 8 feet deep. The flow through this plant is 4.1 cuft/sec. What is the detention time?
- a) 1 hour 18 minutes
 - b) 144 minutes
 - *c) 449 minutes
 - d) 2 hours 24 minutes
38. How many gallons are there in 28.65 acre-ft?
- a. 9,354,282gal
 - b. 9,322,137gal

*c. 9,335,000gal

d. 9,763,599 gal

39. If 7.3lb of polymer (assume 100%) are mixed into 35 gal of water, determine the percentage of polymer in the slurry.

a. 2.1% slurry

*b. 2.4% slurry

c. 2.5% slurry

d. 2.8% slurry

40. Find the detention time in hours for a clarifier that has an inner diameter of 112.2 ft and a water depth of 10.33 ft if the flow rate is 7.26mgd.

a. 2.10hr

b. 2.14hr

*c. 2.52hr

d. 2.96hr