1. 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
2. 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
3. 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
4. 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
5. 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
6. An aquifer under pressure is often termed
   a. Unconfined
   b. Pacific
   *c. Artesian
   d. Alluvial
   e. Elevated
7. 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

8. 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

9. 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

10. 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

11. 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

12. 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

13. 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

14. 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%

15. 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
16. 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
17. 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
18. 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
19. Which source of water has the greatest natural protection from bacterial contamination?
    a. Shallow well
    b. Deep well
    c. Surface water
    d. Spring
20. 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
21. An operating well will drain the water from a volume of soil around the well during pump-

ing. This volume is referred to as the

a. Pumping water level

b. Radius of influence

c. Drawdown

d. Cone of depression

e. Recharge zone

22. 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

23. 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

24. 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

25. The freezing point of water is

a. 0°F

b. 32°C

c. 32°F

d. 0°C

e. 100°F

26. 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

27. The movement of water on the surface of the earth is called

a. Percolation

b. Evaporation

c. Evapotranspiration
d. Runoff
e. Infiltration

28. 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
29. 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
30. Water that is safe to drink is called water.
    a. Potable
    b. Palatable
    c. Good
    d. Clear
31. What is the middle layer of a stratified lake called?
    a. Thermocline
    b. Benthic Zone
    c. Epilimnion
    d. Hypolimnion
32. What is the conversion of liquid water to gaseous water known as?
    a. Advection
    b. Condensation
    c. Precipitation
    d. Evaporation
33. Water weighs
    a. 7.481bs/gal
    b. 8.34lbs/gal
    c. 62.4lbs/ft^3
    d. Both B. and C.
34. What is the static level of an unconfined aquifer also known as?
    a. Drawdown
    b. Water Table
    c. Pumping Water Level
    d. Aquitard
35. A water bearing geologic formation that accumulates water due to its porousness

a. Aquifer
b. Lake
c. Aquiclude
d. Well

36. What kind of stream flows continuously throughout the year?
    a. Ephemeral
    b. Perennial
    c. Intermittent
    d. Stratified
37. The surface to atmosphere movement of water is known as
    a. Precipitation
    b. Percolation
    c. Stratification
    d. Evapotranspiration
38. 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
39. What is the middle layer of a stratified lake known as?
    a. Hypolimnion
    b. Benthic Zone
    *c. Thermocline
    d. Epilimnion
40. The amount of water that can be pulled from a aquifer without depleting
    a. Drawdown
    b. Safe yield
    c. Overdraft
    d. Subsidence
41. 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
42. 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
43. The term "surface runoff" refers to

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

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

45. 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

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

47. 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

48. A well screen must be installed in
a. deep wells
b. consolidated materials
c. shallow wells
d. unconsolidated materials

49. A well is acidified in order to
a disinfect
b. increase yield
c. remove objectionable gases
d. remove disinfection by-products

50. A well is acidized in order to
a. Disinfect the water

b. Increase yield

c. Remove objectionable gasses

d. Remove disinfection by-products

51. 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

52. 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

53. 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

54. 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.

55. 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".

56. 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.

57. Movement of water through the ground is called:

a) Hydraulic subsidence

b) Runoff

c. Percolation

d. Infiltration

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

a. Agricultural pesticides

b. Industrial solvents

c. Acld rain

d. Agricultural fertilizers

59. 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.

60. 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

61. 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

62. 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

63. 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

64. The water table is defined as the

a. Pumping water level in a well

b. Upper surface of the groundwater

c. Water level in a reservoir

d. Bottom of the aquifer

65. Surface waters are more difficult to clean up or remediate than groundwater.

*a) true

b) false

66. A sanitary survey is used to determine
    *a) source water characteristics and effectiveness of treatment
    b) the hygienic and operational aspects of the plant
    c) compliance with the SDWA and other EPA mandates
    d) whether the CCR is complete and accurate
67. How much water an aquifer will yield depends
    a. on its size or volume.
    *b. on its porosity and permeability.
    c. almost entirely on the type of rock formation.
    d. on the pore spaces.
68. Which would most likely be the source of contaminants that include nitrates, sulfates, organic compounds (solvents), sodium, and microbiological contaminants?
    *a. Septic tanks and leech fields
    b. Agricultural activities
    c. Infiltration of urban runoff
    d. Municipal landfills
69. An artesian aquifer could occur in $a(n)$
    *a. confined aquifer.
    b. unconfined aquifer.
    c. water table aquifer.
    d. shale formation.
70. Which would most likely be the source of contaminants that include pesticides, herbicides, and nitrates?
    a. Land application of wastewater
    *b. Agricultural activities
    c. Municipal landfills
    d. Liquid waste leaching ponds
71. Manganese causes a
    a. brown stain.
    b. yellow stain.
    *c. black stain.
    d. yellow stain for mn^{+2} and black stain for mn^{+3}.
72. The principal source of excess lead and copper at the customer's tap is from
    a. transmission lines.
    b. distribution appurtenances.
    *c. household plumbing systems.
    d. raw groundwater or surface water.
73. 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

74. The "rate of reasonable sharing" of water is usually called the

*a. Riparian doctrine.

b. Legal use doctrine.

c. Priority use doctrine.

d. Beneficial use doctrine.

75. The hydrologic cycle relates to

a) the treatment processes

b) an old Harley

*c) movement of water in the environment

d) the moons pull on tidewaters

76. 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.

c. Water that is free of bacteria.

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

77. 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

78. The term aquifer refers to:

a. A special type of aquaduct.

b. A natural sourree of water.

c. Potable water.

*d. Water bearing strata.

79. 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".

80. 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. pressure gradient

81. 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
82. The gradual flow or movement of water into and through the pores of the soil is called
    a. *percolation
    b. run-off
    c. impermeable flow
    d. evapotranspiration
83. How much water a material will hold depends on its
    a. size and volume.
    b. permeability.
    c. hydraulic conductivity.
    *d. porosity.
84. Streams that flow only occasionally are called
    a. annual streams.
    b. perennial streams.
    *c. ephemeral streams.
    d. intermittent streams.
85. The movement of water from leaves, grasses, and other plants to the atmosphere is called
    a. organic evaporation.
    b. condensation.
    *c. transpiration.
    d. capillary action.
86. 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
87. 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
88. Oligotrophic is defined as an
    a. organism that requires very little light.

b. organism that feeds on the bottom.

*c. low nutrient body of water with abundant oxygen.

d. organism that is sessile in the immature stage, but later becomes free swimming in the adult stage.

89. Where will lake water first become anaerobic?

*a. In the hypolimnion

b. In the mesolimnion

c. In the thermocline

d. In the epilimnion

90. Which statement is true concerning dissolved oxygen (DO)?

a. Warm water contains more DO than cold water

*b. Cold water contains more DO than warm water

c. Saline water contains more DO than fresh water

d. Temperature and salinity have no impact on DO

91. A conventional water treatment plant in a rich farming area has to treat water high in nitrates. Which is its best course of action in the long term?

*a. Manage watershed to prevent nitrates from entering the water system

b. Change its treatment to ion exchange

c. Change its treatment to reverse osmosis

d. Add a strong oxidation chemical before coagulation

92. Which is the source of most radioactive contamination in water?

*a. It is naturally occurring

b. It comes from medical waste deposited in landfills that works its way into the water cycle

c. It comes from improper mining operations

d. It comes from nuclear power plant waste, past nuclear testing, and nuclear plant accidents

93. Which would most likely be the source of contaminants that include inorganic compounds, petroleum products, and heavy metals?

a. Land application of wastewater

b. Deicing activities to control snow and ice on roads

c. Liquid waste storage ponds

*d. Infiltration of urban runoff

94. Destratification of a lake will often reduce

a. turbidity.

b. nutrients.

c. fish.

*d. algae.

95. Which is an unconsolidated material?

a. Limestone

*b. Sand

c. Fractured rock

d. Volcanic rock

96. A term used to describe cloud formation is

a. transpiration.

b. evaporation.

*c. condensation.

d. precipitation.

97. Immediately above the water table is the

a. aquifer zone.

*b. unsaturated zone.

c. unconfined aquifer.

d. recharge zone.

98. A benefit of water conservation would be

*a. reduced demand on supply source.

b. loss of revenue for the utility.

c. possible stimulation of water service growth.

d. difficulty dealing with drought conditions.

99. A lake would be considered polluted if it had a preponderance of

a. green algae.

*b. blue-green algae.

c. yellow-green algae.

d. golden-brown algae.

100. When drilling a well it is important to identify (log) the various formations below the surface. Which type of logging measures how controlled radiation penetrates the different formations below the surface?

a. Electric logging

b. Magnetic-reversal logging

*c. Gamma-ray logging

d. X-ray logging

101. Water primarily becomes capable of dissolving iron and manganese because

a. of acid rain.

b. oxygen reacts with iron and manganese.

*c. oxygen is removed by the decomposition of organic materials making the water capable of dissolving iron and manganese.

d. erosional forces bring iron and manganese into contact with water capable of dissolving iron and manganese due to acid rain.

102. The outside boundary of a watershed would be defined by a

a. saddle.

*b. ridge.

c. river.

d. county, state, or country boundary.

103. Lakes and reservoirs that are (rich) in nutrients are referred to as

a. Mesotrophic

b. Dimictic

*c. Oligotrophic

d. Eutrophic

104. The zone affected by the drawdown extends outward from a well from at a distance that is dependent on the porosity of the soil.

*a. Cone of depression

b. Water table

c. Aquifer

d. Radius of influence

1. Water with a pH of 8.0 is considered to be
   a. acidic
   b. *basic or alkaline
   c. neutral
   d. undrinkable
2. Over which water quality indicator do operators have the greatest control?
   a. alkalinity
   b. pH
   c. temperature
   *d. turbidity
3. 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
4. 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
5. 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
6. Tastes and odors in surface water are most often caused by:
   a. clays
   b. hardness
   c. *algae
   d. coliform bacteria
7. 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
8. 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

9. 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
10. 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.
11. 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.
12. Which of the following is an indicator organism?
    a. Giardia
    b. Cryptosporidium
    c. Hepatitis
    *d. E. Coli
13. 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
14. What ls 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
15. 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

16. 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
17. The quantity of oxygen. that can remain dissolved in water is related to
    *a. Temperature
    b. pH
    c. Turbidity
    d. Alkalinity
18. In coliform analysis using the presence-absence test, a sample should be incubated for
    a. 24 hours at 25°C
    b. 36 hours at 35°C
    c. 24 and 36 hours at 25°0
    *d. 24 and 48 hours at 35°C
19. A major source of error when obtaining water quality information is improper:
    *a. Sampling
    b. Preservation
    c. Tests of samples
    d. Reporting of data
20. 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
21. The type of organisms that can cause disease are said to be microorganisms.
    a. Bad
    *b. Pathogenic
    c. Undesirable
    d. Sick
22. 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
23. 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

24. 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
25. Turbidity is measured as:
    a. mg/L
    b. mL
    c. gpm
    d. NTU
26. Giardia and cryptosporidium are a type of:
    a. Mineral
    b. Organism
    c. Color
    d. Bird
27. Chronic contaminants are those that can cause sickness after:
    a. Prolonged exposure
    b. Low levels or low exposure
28. 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
29. 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
30. 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
31. Samples taken for routine bacteriological testing should be preserved by:
    a. Freezing
    b. Boiling
    c. DPD preservative

d. Refrigeration

32. 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
33. 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
34. 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
35. 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
36. __ is a measure of the capacity of water to neutralize acids.
    a. Concentration
    b. Alkalinity
    c. pH
    d. Conductivity
37. The DPD method is used to determine the of a water sample.
    a. Dissolved oxygen content
    b. Conductivity
    c. pH
    d. Free chlorine residual
38. What color does N,N-diethyl-p-phenylenediamine (DPD) turn in the presence of chlorine?
    a. Brown
    b. Green
    c. Blue
    d. Pink
39. 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

40. 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
41. 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
42. What is the second step in the multiple tube fermentation test?
    a. Presumptive test
    b. Negative test
    c. Completed
    d. Confirmed
43. What is the removal and deactivation requirement for Giardia?
    a. 2log
    b. 3log
    c. 4log
    d. There is no requirement
44. The multiple barrier approach to water treatment includes removal through which method?
    a. Filtration
    b. Coagulation
    c. Disinfection
    d. a and c
45. A pH reading of 7 is considered
    a. Slightly acidic
    b. Acidic
    c. Basic
    d. Neutral
46. EDTA titration is used to determine the of a water sample.
    a. Hardness
    b. Conductivity
    c. Alkalinity
    d. Free chlorine residual
47. 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*

48. What is the ingredient used during the second multiple tube fermentation test?
    a. Colilert
    b. MMO/MUG
    c. Brilliant Green Bile
    d. Chlorine
49. 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
50. Black stains on plumbing fixtures might be attributed to
    a. calcium.
    b. copper.
    c. magnesium.
    d. manganese.
51. The multiple tube fermentation test consists of three distinct tests. These tests, in the order performed, are the:
    a. preliminary, confirmed, and completed tests.
    b. preliminary, presumptive and confirmed tests.
    c. presumptive, confirmed, and completed tests.
    d. prespumtive, preliminary, and completed tests.
52. 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
53. pH is a measure of :
    a. conductivity
    b. water's ability to neutralize acid
    c. hydrogen ion activity
    d. dissolved solids
54. Sodium Thiosulfate is used to
    a. Buffer chlorine solutions
    b. Neutralize chlorine residuals
    c. Detect chlorine leaks

d. Sterilize sample bottles

55. 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
56. A primary health risk associated with microorganisms in drinking water is
    a. Cancer
    b. Acute gastrointestinal diseases
    c. Birth defects
    d. Nervous system disorders
57. 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
58. Hardness in water is caused by
    a. Dissolved minerals
    b. High pH.
    c. Low turbidity
    d. Alkalinity
59. 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
60. 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
61. 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

62. 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
63. Trihalomethanes are classified as
    a. Metals
    b. Inorganic constituents
    c. Secondary drinking water standards
    d. Radiological contaminants
    e. Volatile organic compounds
64. 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
65. 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
66. 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
67. 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
68. The standard indicator of potential fecal contamination of a water supply is
    a. Cryptosporidium
    b. pH

c. Alkalinity
d. Hardness
e. Coliform Presence - Absence

69. 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
70. 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
71. 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
72. 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
73. 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
74. A water supply is found to have a calcium carbonate concentration of 50mg/l. This water would be considered
    a. soft water
    b. hard water

c. potable water

d. non-potable water

75. Cathodic protection refers to protection against

a. contamination

*b. corrosion

c. hardness

d. alkalinity

76. An operator uses to test for residual chlorine

a. DPD

b. Cresol red

c. Methyl orange

d. Sulfuric acid

77. 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

78. 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

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

a. Dissolved zinc

b. Algae

c. High pH

d. Low pH

80. 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

81. 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

82. Cathodic protection means protection against

a. contamination

b. corrosion

c. hardness

d. infiltration

83. Under no circumstances should a composite sample be collected for which type of analysis?

*a. Bacteriological

b. Total dissolved solids

c. Alkalinity

d. Turbidity

84. 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.

85. Which is (are) the ideal indicator for pathogens?

a. Salmonella species

*b. Coliform group bacteria

c. Gram-negative cocci

d. Gram-negative coccobacilli

86. 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

87. Acids, bases, and salts lacking carbon are

a. ketones.

b. aldehydes.

c. organic compounds.

*d. inorganic compounds.

88. 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.

89. 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
90. 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.
91. Which chemical is used to remove residual chlorine from water?
    *a. $Na_2\ S_2O_3$
    b. Na_2SiO_3
    c. Na_2SiF_6
    d. NaOCl
92. When a sample is collected, which causes its quality to begin to change?
    a. CO_2
    b. Dissolved gases
    *c. Biological activity
    d. pH
93. Chemical analysis for synthetic organic compounds should not be collected in containers made of
    a. polytetrafluoroethylene.
    b. stainless steel.
    *c. polypropylene.
    d. borosilicate.
94. 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
95. 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.
96. 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

97. 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

98. 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

99. 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

100. 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

101. 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

102. 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

103. 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

104. Total Coliform samples have a hold time.
    a) 12 hour
    b) 24 hour
    *c) 30 hour
    d) 36 hour
105. 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
106. Which, surface water or groundwater, usually contain a higher level of pathogens?
    *a) surface water
    b) groundwater
    c) both are equal
    d) neither
107. High nitrate levels in the water can cause
    a) rickets
    b) cholera
    *c) blue baby syndrome
    d) dysentery
108. 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
109. Sources of taste and odor issues include
    *a) raw water
    b) distribution systems
    c) consumer plumbing
    d) all of the above
110. Algae has a profound effect on our surface waters. During the day algae and at night it
    a) produces carbon dioxide, produces oxygen
    b) secrets sludge, produces toxins
    *c) produces oxygen, produces carbon dioxide
    d) sleeps soundly, parties hardy
111. 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

112. Which of the following is a strong acid
    *a. pH=2
    b. pH=4
    c. pH=5
    d. pH=13
113. 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
114. Which radioactive nuclide is a gas?
    a. Radium
    b. Uranium
    *c. Radon
    d. Thorium
115. 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
116. 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
117. Which gas occurs mainly in groundwater, is heavier than air, and is odoriferous?
    *a. Hydrogen sulfide
    b. Carbon dioxide
    c. Radon
    d. Methane
118. 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
119. Which species causes typhoid?
    *a. Salmonella

b. Shigella

c. Klebsiella

d. Pseudomonas

120. In humans, Salmonella will cause

a. hemochromatosis.

b. cholera.

*c. gastroenteritis.

d. dysentery.

121. The freezing point of water is _____.

a. 0°F

*b. 32°C

c. 32°F

d. 100°C

122. 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

123. 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

124. 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

125. Which piece of laboratory equipment is used to titrate a chemical reagent?

a. graduated cylinder

*b. burette

c. pipet

d. Buchner funnel

126. 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

127. 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

128. 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

129. 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

130. Hard water contains an abundance of

a. sodium

b. iron

c. lead

d. *calcium carbonate

131. 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

132. What ls 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

133. 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

134. 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.

135. 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.

136. 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)

137. 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

138. 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

139. Which gas is radioactive, occurs in many groundwater supplies, and is colorless and odorless?

a. Neon

b. Argon

c. Boron

*d. Radon

140. 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

141. Which type of hardness is considered permanent hardness?
    a. Carbonate hardness
    *b. Noncarbonated hardness
    c. Calcium hardness
    d. Magnesium hardness
142. Which organisms are prokaryotes and release odorous compounds such as geosmin and 2-methylisoborneal?
    a. Methylomonas
    b. Chlorobium
    c. Clostridium
    *d. Cyanobacteria
143. Which is the most common radionuclide in water?
    *a. Radium
    b. Uranium
    c. Radon
    d. Thorium
144. 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.
145. The process whereby water moves with the air currents in the atmosphere is called
    a. transpiration.
    b. evaporation.
    c. interception.
    *d. advection.
146. 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.
147. 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
148. 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

149. 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

150. 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

151. 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

152. 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.

153. Which is the unit of gamma radiation?
a. Muon
b. Neutrino
c. X-ray
*d. Photon

154. Which of the following causes lung cancer?
a. Uranium
b. Radium
*c. Radon
d. Thorium

155. Which genera of cyanobacteria primarily release neurotoxins?
a. Nodularia
b. Microcystis
*c. Anabaena
d. Cylindrospermopsis

156. 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
157. Beta radiation consists of $a(n)$
    *a. electron.
    b. neutron.
    c. proton.
    d. muon.
158. Which naturally occurring radionuclide is most prevalent in drinking water?
    a. Gamma
    *b. Alpha
    c. Beta
    d. Muson
159. 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.
160. Which is the size range of Cryptosporidium?
    *a. 4 to 6μm
    b. 6 to 8μm
    c. 10 to 12μm
    d. 12 to 18μm
161. Prolonged Entamoeba histolytica disease can cause amoebic abscesses which usually occur in the
    *a. liver.
    b. urinary tract.
    c. small intestine.
    d. kidney.
162. 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
163. Which type of solution contains 1 gram equivalent weight of a reactant compound per liter of solution?
    a. Molar solution

b. Molal solution

c. Normal solution

d. Percentage strength solution

164. What laboratory device sterilizes laboratory apparatus and microbial media by using pressurized steam?

a. Muffle furnace

b. Aspirator

*c. Autoclave

d. Membrane filter

1. 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.
2. 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
3. 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
4. What does the acronym MCL stand for?
   a. Minimum contaminant level
   b. Micron contaminant level
   c. Maximum contaminant level
   d. Milligrams counted last
5. How long do sanitary surveys have to be retained for records?
   a. 3 years
   b. 5 years
   c. 7 years
   d. 10 years
6. 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.
7. 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

8. Regulations based on the aesthetic quality of drinking water
   a. Primary Standards
   b. Secondary Standards
   c. Microbiological Standards
   d. Radiological Standards
9. The lowest reportable limit for a water sample
   a. $0.5 mg/1$
   b. Zero
   |*|c. Public health goal
   d. Detection Level for reporting
10. Primary Standards are based on
    a. Color and Taste
    b. Aesthetic quality
    c. Public Health
    d. Odor
11. A disease causing microorganism
    a. Pathogen
    b. Colilert
    c. Pathological
    d. Turbidity
12. According to Surface Water Treatment Rule, what is the combined inactivation and removal for Giardia?
    a. $1.0 \log s$
    b. $2.0 \log s$
    c. $3.0 \log s$
    d. 4.0 Logs
13. 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%
14. 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
15. 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

16. 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
17. Records on turbidity analyses should be kept for a minimum of
    |*|a. 5 years
    |*|b. 7 years
    |*|c. 10 years
    |*|d. 25 years
18. Records on bacteriological analyses should be kept for a minimum of
    a. 5 years
    b. 7 years
    c. 10 years
    d. 25 years
19. 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.
20. 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
21. 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 .

22. What US agency establishes drinking water standards?
    a. AWWA
    b. USEPA
    c. NIOSH
    d. NSF
23. 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
    |*|
24. According to the Lead and Copper Rule. the action for the 90th percentile lead level is:
    a. 0.005mg/1
    |*|b. 0.015mg/l
    c. 0.030mg/1
    |*|d. 0.050mg/l
25. 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
26. 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
27. 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
28. Trihalomethanes are classified as:
    a. Metals
    b. Inorganic constituents
    c. Secondary drinking water standards

d. Radiological contaminants

e. Volatile organic compounds

29. 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

30. 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

31. 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

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

a. Cryptosporidiosis

b. Giardiasis

c. Cholera

d. Typhoid

e. Tuberculosis

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

a. 0.2mg/L

b. 2.0mg/L

c. $2.0\mu\text{g/L}$

d. 4.0mg/L

e. There is no maximum disinfectant residual standard

34. 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

35. 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

36. Final determination of vulnerability is made by

a. Private contractor/consultants

b. The primacy agency

c. The water supplier

|*|d. All of the above

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

a. Maximum contaminant level

b. Minimum contaminant level

c. Public health goal

d. Maximum contaminant level goal

e. Minimum contaminant level goal

38. The presence of coliform bacteria in a distribution system

a. Is positive proof that pathogenic organisms are present

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

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

e. Has no particular significance

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

a. The Disinfection By-Product Rule

b. Secondary Drinking Water Standards

c. The Total Coliform Rule

d. The Lead and Copper Rule

e. Maximum Contaminant Level

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

|*|a. Every 4 hours

|*|b. Daily

|*|c. Weekly.

|*|d. Monthly

|*|

41. 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

42. According to the Lead and Copper Rule. the action for the 90th percentile lead level is:
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    b. 0.015mg/l
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    c. Small and medium public water systems (serving > 25 and $< 3,300$ people)
    d. All public water systems
45. BARF is an acronym for
    a) Boil Advisory Reference Form
    *b) Bacteriological Analysis Report Forms
    c) Biological Activity Reactive Format
    d) vomit
46. Which of these does NOT have a primary MCL?
    a) nitrate
    b) fluoride
    *c) manganese
    d) copper
47. 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
48. The LT2ESWTR has decreed that we test our source water for the presence of
    a) algae
    b) pharmaceuticals
    *c) cryptosporidium
    d) nitrate
49. 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

50. 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.

51. 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

52. 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

53. 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

54. 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

55. 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. 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
   e. traditional plant
   d. is located on the plant effluent line after the clearwell
4. 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
5. 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
6. Water that is safe to drink is called water.
   a. Potable
   b. Palatable
   c. Good
   d. Clear
7. The type of organisms that can cause disease are said to be microorganisms.
   a. Bad
   b. Pathogenic
   c. Undesirable
   d. Sick
8. 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

9. Four types of aesthetic contaminants in water include the following:
   a. Odor, turbidity, color, hydrogen sulfide gas
   b. Pathogens, microorganisms, arsenic, disinfection by-products
10. What does mg/L stand for?
   a. Microorganisms/Liter
   b. Milligrams/Loser
   c. Milligrams/Liter
   d. None of the above
11. Disinfection by-products are a product of:
   a. Filtration
   b. Disinfection
   c. Sedimentation
   d. Adsorption
12. Acute contaminants are those that can cause sickness after:
   a. Prolonged exposure
   b. Low levels or low exposure
13. Chronic contaminants are those that can cause sickness after:
   a. Prolonged exposure
   b. Low levels or low exposure
14. TTHMs and HAA5s can affect:
   a. Health
   b. Aesthetics
   c. Color
   d. Odor
15. Oxidation, coagulation, and disinfection are processes.
   a. Physical
   b. Chemical
   c. Biological
   d. Mechanical
16. Flocculation, sedimentation, filtration, and adsorption are processes.
   a. Physical
   b. Chemical
   c. Biological
   d. Mechanical
17. A precipitate can be formed after which one of the following processes:
   a. Oxidation
   b. Flocculation

c. Filtration
d. Adsorption

18. Giardia and cryptosporidium are a type of:
    a. Mineral
    b. Organism
    c. Color
    d. Bird
19. 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
20. The process of decreasing the stability of colloids in water is called:
    a. Flocculation
    b. Coagulation
    c. Sedimentation
    d. Clarification
21. Slowly agitating coagulated materials is the process of:
    a. Flocculation
    b. Coagulation
    c. Sedimentation
    d. Filtration
22. The sedimentation portion of water treatment is also called a(n):
    a. Clarifier
    b. Filter
    c. Adsorber
    d. Water treater
23. Particles that are less than 1μm in size and will not settle easily and are called:
    a. Light particles
    b. Colloidal particles
    c. Colored particles
    d. Flat particles
24. One micrometer is also equal to:
    a. 0.1 mm
    b. 0.0001 mm
    c. 0.001 mm
    d. 1 m
25. Particles less than 0.45μm in size are considered to be:
    a. Dissolved

b. Really little
c. Colored particles
d. Flat particles

26. Turbidity is measured as:
    a. Mg/L
    b. mL
    c. gpm
    d. NTU
27. Al2(SO4)3 · 18H20 is the chemical formula for:
    a. Alum
    b. Iron
    c. Manganese
    d. Lead
28. A(n)_polymer is commonly used as a coagulant.
    a. Anionic
    b. Cationic
    c. Nonionic
    d. Ionic
29. A(n)_polymer is used to enhance flocculation.
    a. Anionic
    b. Cationic
    c. Nonionic
    d. Ionic
30. The concentration of a chemical added to the water is measured in:
    a. mL
    b. mg
    c. mg/L
    d. Liters
31. The quantity of chlorine remaining after primary disinfection is called a residual.
    a. Chlorine
    b. Permaganate
    c. Hot
    d. Cold
32. Primary disinfectants are used to microorganisms.
    a. Hurt
    b. Inactivate
    c. Burn up
    d. Evaporate
33. Secondary disinfectants are used to provide a in the distribution system.
    a. Color

b. Chemical
c. Smell
d. Residual

34. 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
35. In a typical water treatment plant, alum would be added into the mixer.
    a. Speed
    b. Large
    c. Slow d. Flash
36. The process of cleaning a filter by pumping water up through the filter media is called _ the filter.
    a. Backwashing
    b. Rewashing
    c. Purging
    d. Lifting
37. Bag and cartridge filters are used to remove which two pathogenic microorganisms?
    a. Viruses and giardia
    b. Giardia and cryptosporidium
    c. Viruses and bacteria
    d. None of the above
38. List the four types of membrane filtration processes commonly used in water treatment.
    a. MF, UF, NF, and RO
    b. MNF, UOF, NOF, and ROO
    c. CFM, FM, FN, and OR
    d. None of the above
39. What is a method of reducing hardness?
    a. Softening
    b. Hardening
    c. Lightning
    d. Flashing
40. Adsorption of a substance involves its accumulation onto the surface of a:
    a. Solid
    b. Rock
    c. Pellet
    d. Snow ball
41. The solid that adsorbs a contaminant is called the:
    a. Adsorbent

b. Adsorbate

c. Sorbet

d. Rock

42. The adsorption process is used to remove:

a. Organics or inorganics

b. Bugs or salts

c. Organisms or dirt

d. Color or particles

43. 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

44. 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

45. GAC contactors are used to reduce the amount of contaminants in water.

a. Inorganic

b. Turbidity

c. Particle

d. Organic

46. 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

47. 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

48. What chemical reduces blue-green algae growth?

a. Chlorine

b. Caustic Soda

c. Copper Sulfate

d. Alum

49. 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

50. The optimal coagulant dose is determined by a
    a. Chlorine Test
    b. Flocculation test
    c. Jar Test
    d. Coagulation test
51. The most common primary coagulant is
    a. Alum
    b. Cationic polymer
    c. Fluoride
    d. Anionic polymer
52. Bacteria and Viruses belong to a particle size known as
    a. Suspended
    b. Dissolved
    c. Strained
    d. Colloidal
53. The purpose of coagulation is to
    a. Increase filter run times
    b. Increase sludge
    c. Increase particle size
    d. Destabilize colloidal particles
54. The purpose of flocculation
    a. Destabilize colloidal particles
    b. Increase particle size
    c. Decrease sludge
    d. Decrease filter run times
55. Primary coagulant aids used in treatment process are
    a. Poly-aluminum chloride
    b. Aluminum sulfate
    c. Ferric chloride
    d. All of the Above
56. How do water agencies monitor the effectiveness of their filtration process?
    a. Alkalinity
    b. Conductivity
    c. Turbidity
    d. pH
57. 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

58. 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*
59. Which step in the treatment process is the shortest?
    a. Filtration
    b. Sedimentation
    c. Flocculation
    d. Coagulation
60. To lower the pH for enhanced coagulation the operator will add
    a. Chlorine
    b. Sulfuric acid
    c. Lime
    d. Caustic Soda
61. The flocculation process lasts how long?
    a. Seconds
    b. 5-10 minutes
    c. 15-45 minutes
    d. Over an hour
62. 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
63. 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
64. Sedimentation produces waste known as
    a. Backwash water
    b. Sludge
    c. Waste water
    d. Mud

65. What kind of process is the sedimentation step?
    a. Physical
    b. Chemical
    c. Biological
    d. Direct
66. The weirs at the effluent of a sedimentation basin are also called
    a. Effluent weirs
    b. Baffling
    c. Launders
    d. Spokes
67. Sedimentation is used in water treatment plants to
    a. Settle pathogenic material
    b. Destabilize particles
    c. Disinfect water
    d. Reduce loading on Filters
68. 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
69. 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
70. The removal and inactivation requirement for Giardia is?
    a. 99.9%
    b. 99.99%
    c. 99.00%
    d. 90%
71. 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
72. How much solids should be removed during sedimentation?
    a. 95% or more
    b. $80 - 95\%$
    c. $70 - 80\%$
    d. $60 - 70\%$

73. The type of basin that includes coagulation and flocculation is
    a. Rectangular
    b. Triangular
    c. Up-Flow
    d. None of the above
74. Recarbonation basins are used to stabilize water after
    a. Filtration
    b. Disinfection
    c. Softening
    d. Coagulation
75. 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
76. How can iron bacteria be controlled in a water distribution system?
    a. by aeration
    b. filtration
    c. chlorination
    d. precipitation
77. Which of the following is a hazard when handling hydrofluosilicic acid?
    a. fire
    b. explosion
    c. corrosion
    d. inhalation
78. Which of the following forms of iron is most soluble in water?
    a. Ferric $\left(Fe^{+3}\right)$
    b. Ferric hydroxide $\left[Fe\left(OH_3\right)\right]$
    c) Ferrous $\left(Fe^{+2}\right)$
    d. Ferrous oxide (FeO)
79. 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
80. 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
81. The problem caused by dissolved carbon dioxide in the water of the distribution system is

a. increased Trihalomethanes
b. Corrosion
c. Excessive encrustation
d. Tastes and odors

82. The presence of the coliform group of bacteria in water indicates
    a. Contamination
    b. Inadequate disinfection
    c. Improper sampling
    d. Taste and odor problems
83. At what pH would a chlorinated water have the highest concentration of hypochlorous acid?
    a. 5
    b. 7
    c. 9
    d. 11
84. One use of polyphosphates is to
    a. Control algae
    b. Improve taste
    c. Sequester iron and manganese
    d. Kill bacteria
85. 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
86. A method used to soften water is
    a. Aeration
    b. Sedimentation
    c. Ion exchange
    d. Adsorption
87. 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
88. Which of the following chemicals will most likely keep iron in suspension?
    a. Chlorine
    b. Fluoride
    c. Polyphosphate
    d. Lime inhibitor

89. If raw water turbidity changed from 10 to 300 turbidity units and the finished water turbidity had increased from 0.1 to 1.0 turbidity units, the unit process having the most impact to correct this situation is
    a. Coagulation
    b. Sedimentation
    c. Filtration
    d. Disinfection
90. The granular filtration process is designed to reduce
    a. Calcium and magnesium sulfates
    b. True color
    c. Total dissolved solids
    d. Turbidity
91. Aeration in water treatment plants is used to
    a. Lower the pH
    b. Reduce concentrations of dissolved gasses
    c. Reduce turbidity
    d. Stabilize chlorine residuals
92. What can the operator do if iron fouling appears to be a problem in an ion exchange softener?
    a. Decrease the strength of the brine used in the regeneration stage
    b. Increase backwash flow rates
    c. Inçrease duration of backwash stage
    d. Increase duration of service stage
93. Trihalomenthane may be partially removed from water by:
    a. fluoridation
    b. chlorination
    c. oxidation
    d. ultraviolet radiation
94. Temporary cloudiness in a freshly drawn sample of tap water may be caused by:
    a. air
    b. chlorine
    c. hardness
    d. silica
95. 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
96. A zeolite softening unit will replace calcium and magnesium ions with ions.

a. Fluoride
b. Iron
c. Sodium
d. Sulfur

97. 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

98. Which two chemicals are used to remove turbidity?
a. Soda Ash and lime
b. Copper sulphate and caustic soda
c. Alum and lime

99. Which of the following is considered to be a coagulant aid?
a. Lime
b. Polymer
c. Bentonite
d. All of the above

100. Alum precipitates as
a. Aluminum carbonate
b. Aluminum sulphate
c. Aluminum hydroxide

101. Turbidity removal with alum is best accomplished at what pH ?
a. 3.5
b. 5.0
c. 6.5

102. Which of the following will not lower the pH ?
a. Alum
b. Carbonic acid
c. Ferric chloride
d. Sodium carbonate

103. Liquid fluoride is delivered as:
a. Sodium Fluoride
b. Hydrofluorosilicic acid
c. Sodium Silicofluoride
d. Hydrofluoric acid

104. An upflow clarifier will have which of the following processes?
a. Coagulation
b. Flocculation
c. Sedimentation
d. All of the above

105. Sludge that rises to the surface of a sedimentation basin is caused by:
    a. Not removing sludge often enough
    b. Removing sludge too often
    c. pH is too low
    d. Surface loading rate is too low
106. Pin floc leaving a sedimentation basin may indicate a problem with:
    a. Coagulation
    b. Flocculation
    c. Sedimentation
    d. Disinfection
107. What is the backwash rate for a rapid sand filter?
    a. 2 gpm/sq.ft.
    b. 15gpm/sq.ft.
    c. 20gpm/sq.ft.
    d. 25gpm/sq.ft.
108. What is the maximum run time for a gravity filter?
    a. 8 hours
    b. 20 hours
    c. 48 hours
    d. 100 hours
109. During backwash, the filter bed should expand:
    a. $5-10\%$
    b. $15-20\%$
    c. $30-50\%$
    d. $60-80\%$
110. If the backwash time is too short, what may result?
    a. Too much freeboard
    b. Mudballs
    c. Loss of filter media
    d. Filter breakthrough
111. If the filtration rate is too high, what may result?
    a. Filter breakthrough
    b. Mudballs
    c. Reduction in operating costs
    d. Lower headloss
112. Solids removed from a filter are most commonly removed by what method?
    a. Adsorption
    b. Straining
    c. Deactivation
    d. Flocculation

113. 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. $1.0 - 2.0 \text{GPM}/\text{sq. ft.}$
    *d. $0.5 - 0.10 \text{GPM}/\text{sq. ft.}$
114. 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
115. 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
116. 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
117. Filter performance is measured by the removal of
    a. Oxygen
    b. Head loss
    c. Turbidity
    d. Chlorine
118. What is the biologically active layer of a slow sand filter called?
    a. Mixed Media
    b. Duel Media
    c. Sludge Layer
    d. Schmutzdecke
119. The pressure drop in a filter is called
    a. Turbidity breakthrough
    b. Head Loss
    c. Filtration
    d. Backwash
120. 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

121. 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
122. Important processes which occur during filtration are
    a. Sedimentation
    b. Adsorption
    c. Straining
    d. All of the Above
123. 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.
124. 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.
125. 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.
126. 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
127. 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
128. 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

TII-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 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.

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

0.4 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

0.5 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.

0.6 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 $< 10°C$.

*b. high in color and low in turbidity.

c. low in color and high in turbidity.

d. high in organic acids.

0.7 Monitor, Evaluate, & Adjust Treatment Processes-Filtration

0.8 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 $2 gpm/ft^2$

*b. 2 to $3 gpm/ft^2$

c. 3 to $5 gpm/ft^2$

d. 5 to $8 gpm/ft^2$

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/LCl_2.

b. 75mg/LCl_2.

*c. 100mg/LCl_2.

d. 200mg/LCl_2.

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.

0.9 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 KMnO4

c. requires regeneration with manganese dioxide - 2 hour soak with 25% by weight solution of MnO2

d. requires regeneration with manganese hydroxide - 4 hour soak with 200 grams Mn(OH)2)

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

a. Oxidation

b. Aeration

c. Flocculation

*d. Sedimentation

0.10 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.

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

0.12 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

TG-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

TG-7 Which process works best for sequestering manganese?

a. Sodium silicate alone

b. Sodium silicate and chlorine

c. Polyphosphates alone

*d. Polyphosphates and chlorine

TG-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

TG-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.

TG-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.

0.13 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 CaCO3.

c. all hardness down to 17.2 mg/l, as CaCO3.

d. all hardness down to about 25.0 mg/l, as CaCO3.

0.14 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. 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
2. Core sampling is a viable way to check the condition of your
   a) raw water
   b) coagulation process
   c) finished water
   *d) filters
3. 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
4. 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
5. In their soluble or reduced state, iron and manganese are
   a) alkalinity enhancers
   *b) colorless
   c) negatively charged
   d) won't dissolve in water
6. 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
7. 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

8. 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
9. Generally, the more uniform the media, the the rate of headloss.
   *a) slower
   b) same
   c) smaller
   d) larger
10. polymers are positively charged.
   a) nonionic
   b) anionic
   *c) cationic
   d) platonic
11. 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
12. 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
13. Overdosing of potassium permanganate will likely cause
   a) an extremely high pH
   *b) pink water
   c) taste and odor
   d) inadequate settling
14. 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
15. Desirable media characteristics include
   a) permeability

b) solubility in water
c) full of impurities
*d) hard and durable

16. 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
17. 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
18. The best pH level for coagulation usually falls in the range of
    a) 4-6
    *b) 5 – 7
    c) 7 – 9
    d) 1 – 3
19. The mixing of coagulant chemicals and raw water is called
    a) flocculation
    b) aeration
    c) reverse osmosis
    *d) flash mixing
20. Sedimentation basins have zones.
    a) five
    *b) four
    c) three
    d) two
21. 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
22. When backwashing filters, bed expansion should be between
    *a) 15 – 30% percent.
    b) 10 – 20%
    c) 20 – 40%
    d) 30 – 50%
23. 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

24. 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

25. 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

26. 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

27. 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

28. Solids contact units (clarifiers) generally demand a higher level of operator knowledge and skill than conventional treatment techniques and processes.
a) true
b) false

29. Filtration actually particulates.
a) destroys
*b) stores
c) dissolves
d) suspends

30. 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

31. 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
32. 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
33. Solids removed from a filter are most commonly removed by what method?
    a. Adsorption
    b. Straining
    c. Deactivation
    d. Flocculation
34. 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
35. 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
36. 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
37. 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
38. Filter performance is measured by the removal of _____.
    a. Oxygen
    b. Head loss
    c. Turbidity

d. Chlorine

39. What is the biologically active layer of a slow sand filter called?
    a. Mixed media
    b. Duel media
    c. Sludge layer
    d. Schmutzdecke
40. The pressure drop in a filter is called _____.
    a. Turbidity breakthrough
    b. Head Loss
    c. Filtration
    d. Backwash
41. 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
42. 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
43. Important processes which occur during filtration are _____.
    a. Sedimentation
    b. Adsorption
    c. Straining
    d. All of the above
44. 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
45. 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
46. 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

47. 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
48. When used with alum which chemical improves coagulation
    a. Ferric chloride
    b. Ferric sulfate
    c. Sodium aluminate
    d. Aluminum sulfate
49. 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
50. 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
51. 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
52. 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
53. The zeta potential measures the number of excess found on the surface of all particulate matter
    a. Electrons
    b. Ions
    c. Cations
    d. Protons

54. 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
55. 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
56. Ferric sulfate has which advantage over aluminum sulfate (alum)
    a. Less staining characteristics
    b. Less cost
    c. More dense floc
    d. Not as corrosive
57. 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
58. 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
    *d. All ofthe above
59. 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
60. 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
61. 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

62. The branch of science which deals with water or fluids at rest or in motion is

a. conductivity

b. geology

c. oceanography *d. hydraulics

63. What is the ratio of lime to copper sulfate for controlling algae growth on basin walls?

*a. l 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

64. Copper sulfate is used in surface water reservoirs to control

a. Emergent weeds

*b. Algae

c. Mosquito larvae

d. Snails

65. 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

66. About how much alkalinity is required for each milligram per liter of alum added to raw water?

*a. 0.5mg/L

b. l.0mg/L

c. 1.5 mg/L

d. 2.0 mg/L

67. 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

68. Which of the following is an example of a weighting agent?

a. Polyelectrolytes

*b. Bentonite clay

c. Calcium carbonate

d. Sodium bicarbonate

69. Algae can shorten filter runs by
    *a. Clogging the filters
    b. Increasing chlorine demand
    c. Lowering the pH
    d. Increasing turbidity
70. 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
71. 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
72. 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
73. 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
74. 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
75. 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.
76. Which material is manganese greensand and which is the coating?
    a. Quartz sand coated with manganese hydroxide $[Mn(OH)_2]$
    b. Garnet sand coated with manganese dioxide $[MnO_2]$

c. Ilmenite sand coated with manganese hydroxide

*d. Glauconite sand coated with manganese dioxide

77. 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

78. 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

79. Which filter media material is given an abrasive number?

a. Garnet

*b. Activated carbon

c. Sand

d. Greensand

80. 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.

81. 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.

82. 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

83. 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

84. 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
85. 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
86. When handling fluoride chemicals, personnel should wear a respirator or mask approved by
    a. OSHA
    b. MSA
    c. EPA
    *d. NIOSH
87. 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
88. 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
89. Chlorine gas is _____ times heavier than breathing air
    a. 2.5
    b. 20
    c. 60
    d. 460
90. 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

91. 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

92. 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

93. 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

94. 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

95. 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

96. 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

97. 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

98. 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

99. 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

100. 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.

101. 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

102. 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

103. 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

104. 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

105. 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

106. 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

107. At which minimum angle must self-cleaning tube settlers be placed?

*a. 50 degrees

b. 60 degrees

c. 65 degrees

d. 70 degrees

108. 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

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

a. Giardia

b. Entamoeba

*c. Cryptosporidium

d. Naegleria

110. Reverse osmosis membranes will compact faster with

a. higher iron content.

b. higher chlorine contact.

*c. higher pressure.

d. higher pH.

111. 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

112. 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.
113. 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
114. 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 %
115. 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
116. 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
117. 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
118. 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

119. 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

120. Magnetic ion exchange resin has been developed to remove

*a. total organic carbon.

b. chlorides.

c. iron and magnesium.

d. sulfates and sulfides.

121. Approximately how much carbon is lost during the reactivation process for granular activated carbon?

*a. 5 %

b. 7 %

c. 10 %

d. 15 %

122. 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

123. 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

124. 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

125. The copper sulfate dose for controlling algae in lakes is predominately based on a lake's

a. temperature.

b. pH.

c. turbidity.

*d. alkalinity.

126. Which is the typical filtration rate for high-rate filters?
    a. 0.5 to 2.0gpm/ft^2
    *b. 3.0 to 12.0gpm/ft^2
    c. 15.0 to 20.0gpm/ft^2
    d. $>$ 25.0gpm/ft^2
127. Particle counters use the principle of light
    a. scattering.
    b. reflection.
    c. refraction.
    *d. blockage.
128. 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.
129. 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
130. At which temperature should the slaking process be maintained?
    a. 120Deg. F
    b. 135Deg. F
    c. 150Deg. F
    *d. 160Deg. F or higher
131. 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
132. A diatom is a type of
    a. bacterium.
    *b. algae.
    c. virus.
    d. protozoan.
133. Over which water quality indicator do operators have the greatest control?
    a. alkalinity
    b. pH
    c. temperature

d. *turbidity

134. 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
135. The bulk of synthetic organic compounds (SOCs) are
    a. solvents.
    b. PAHs, PCBs, and polynuclear aromatic hydrocarbons.
    *c. pesticides.
    d. volatiles.
136. 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
137. For operational corrosion control, the total alkalinity concentration should be measured every
    *a. 8 hours.
    b. 12 hours.
    c. 4 hours.
    d. Week.
138. When manganese greensand filters are run in the continuous regeneration mode [continuous regeneration of the $MnO_2(s)$ 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.
139. The chemical that is used most for raising pH is:
    a. Calgon
    *b. Lime
    c. Alum
    d. Calcium chloride
140. 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

141. 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
142. 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
143. List three water treatment coagulant chemicals
    a. Turbidity, alkalinity, temperature
    *b. Alum, ferric chloride, polymers
    c. Chlorine, potassium permanganate, ozone
    d. Water, pH, alum
144. Low values for which water characteristic usually cause poor coagulation flocculation and settling characteristics
    a. Water temperature
    b. Turbidity
    c. Alkalinity
    d. pH
145. Which of the following is a required treatment technique for the control of lead?
    a. Ion exchange
    *b. Corrosion control
    c. Lime softening
    d. Activated carbon
146. Recarbonation basins are used to stabilize water after
    a. Filtration
    b. Disinfection
    *c. Softening
    d. Coagulation

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. Secondary disinfectants are used to provide a in the distribution system.
   a. Color
   b. Chemical
   c. Smell
   d. Residual
6. Primary disinfectants are used to microorganisms.
   a. Hurt
   b. Inactivate
   c. Burn up
   d. Evaporate
7. The quantity of chlorine remaining after primary disinfection is called a residual.
   a. Chlorine
   b. Permaganate
   c. Hot
   d. Cold
8. 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

9. 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
10. A__ residual of chlorine is required throughout the system.
    a. Large
    b. High
    c. Trace
    d. Hot
11. 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
12. 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
13. 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
14. Free chlorine can only be obtained after point chlorination has been achieved.
    a. Breakpoint
    b. Fastpoint
    c. Softpoint
    d. Onpoint
15. 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
16. Chloramine is most affective as a disinfectant.
    a. Primary
    b. Secondary
    c. Third

d. First

17. TTHMs and HAA5s can affect:
    a. Health
    b. Aesthetics
    c. Color
    d. Odor
18. The multiple barrier treatment approach includes
    a. Sterilization and filtration
    b. Disinfection and filtration
    c. Disinfection and sterilization
    d. Infection and filtration
19. 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
20. What is the disinfectant byproduct caused by ozonation?
    a. Trihalomethanes
    b. Bromate
    c. Chlorite
    d. No DBP formation
21. Haloacitic Acids are also known as
    a. TTHM
    b. HOCL
    c. Chlorite
    d. HAA5
22. What is the MCL for trihalomethanes?
    a. .10mg/L
    b. .06mg/L
    c. .08mg/L
    d. .12mg/L
23. What is the MCL for Haloacitic Acids?
    a. 100ppb
    b. 60ppb
    c. 80ppb
    d. 120ppb
24. What is the MCL for bromate?
    a. .010mg/L
    b. .020mg/L
    c. .030mg/L

d. .040mg/L

25. 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
26. When Chlorine reacts with natural organic matter in water it can create
    a. Disinfectant by-products
    b. Coliform bacteria
    c. Chloroform
    d. Calcium
27. What are trihalomenthanes classified as
    a. Salts
    b. Inorganic compounds
    c. Volatile organic compounds
    d. Radio
28. What disinfectant is used for emergency purposes and not utilized in the water treatment industry?
    a. Chlorine
    b. Iodine
    c. Ozone
    d. Chlorine Dioxide
29. 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
30. The active ingredient in household bleach is
    a. Calcium hypochlorite
    b. Calcium hydroxide
    c. Sodium hypochlorite
    d. Sodium hydroxide
31. Cryptosporidium is not resistant to this chemical
    a. Ozone
    b. Chlorine Dioxide
    c. Chlorine
    d. Both *A&B*
32. 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

33. 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

34. The form of Chlorine which is 100% available chlorine is?

    a. Sodium Hypochlorite

    b. Calcium Hypochlorite

    c. Calcium Hydroxide

    d. Gaseous Chlorine

35. 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

36. What is the approximate pH range of sodium hypochlorite?

    a. 4-5

    b. 6-7

    c. $9-11$

    d. $12-14$

37. What is the typical concentration of sodium hypochlorite utilized in water treatment?

    a. 5%

    b. 65%

    c. 100%

    d. 12.5%

38. Chlorine demand refers to

    a. Chlorine in the system for a given time

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

    c. Chlorine needed to produce a higher pH

    d. None of the above

39. What is the most effective chlorine disinfectant?

    a. Dichloramine

    b. Trichloramine

    c. Hypochlorite Ion

d. Hypochlorous acid

40. What can form when chlorine reacts with natural organic matter in source water?
    a. Disinfectant by-products
    b. Sulfur
    c. Algae
    d. Coliform bacteria
41. What kind of solution is used to check for a gas chlorine leak?
    a. Sodium hydroxide
    b. Ozone
    c. Ammonia
    d. Calcium hypochlorite
42. Chlorine is
    a. Heavier than air
    b. Lighter than air
    c. Brown in color
    d. not harmful to your health
43. Chlorine demand may vary due to
    a. Chlorine demand always stays the same
    b. Temperature
    c. pH
    d. Both B and C
44. 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
45. What is the target chlorine:ammonia ratio?
    a. 2 : 1
    b. 3 : 1
    c. 4 : 1
    d. 5 : 1
46. What is the MCL for Nitrates?
    a. 1ppm
    b. 10ppm
    c. 5ppm
    d. None of the above
47. What is the molecular weight of Chlorine?
    a. 70
    b. 14
    c. 65

d. 20

48. What disinfectant has the longest lasting residual?
    a. Ozone
    b. Chlorine
    c. Chloramine
    d. Chlorine Dioxide
49. 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
50. What are THMs classified as?
    a. Turbidity
    b. Radiological
    c. Volatile Organic Chemicals
    d. Salts
51. 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
52. How many times stronger is Chlorine compared to monochloramine?
    a. 250 times
    b. 20 times
    c. 1500 times
    d. 5 times
53. What chemicals are formed when chlorine is mixed with water?
    a. Hydrogen sulfide and ammonia
    b. DPD and carbon dioxide
    c. Sodium hypochlorite and calcium hypochlorite
    d. Hypochlorous acid and hydrochloric acid
54. Chlorine residual is measured in the field using the
    a. Electroconductivity method
    b. EDTA titrimetric method
    c. Ortho-tolidine colorimetric method
    d. DPD colorimetric method
    e. Differential pH method
55. In nitrification, bacteria consume excess ammonia in the water and produce
    a. Chloramines
    b. Free chlorine
    c. Urine

d. Nitrite
e. Sodium thiosulfate

56. Which of the following is a form of free chlorine?
    a. Nitrite
    b. Hypochlorous acid
    c. Monochloramine
    d. Hydrochloric acid
    e. Trichloramine
57. A distribution system operator measures a total chlorine residual of 1.25mg/L. How many points on the chlorine breakpoint curve may display this residual?
    a. Zero
    b. One
    c. Two
    d. Three
    e. Four
58. What is the chlorine dosage that must be applied when disinfecting a pipeline using the slug method?
    a. 300mg/L
    b. 100mg/L
    c. 50mg/L
    d. 25mg/L
    e. 6mg/L
59. Which of the following is a form of combined chlorine?
    a. Hypochlorite ion
    b. Hypochlorous acid
    c. Monochloramine
    d. Hydrochloric acid
    e. Free ammonia
60. 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
61. 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

62. Of the following, which is the most effective disinfectant?
    a. Hypochlorite ion
    b. Hypochlorous acid
    c. Monochloramine
    d. Dichloramine
    e. Trichloramine
63. 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
64. 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
65. Residual chlorine refers to
    a. The amount of chlorine in the chlorinated water after several minutes
    b. The chlorine needed to disinfect the water supply
    c. The chlorine needed to produce floc in the water
    d. The sludge in the bottom of the chlorine solution tank
    e. None of the above
66. While handling sodium hypochlorite, proper safety precautions include:
    a. Avoiding situations that could splash hypochlorite solution.
    b. Using a face shield and/or goggles to avoid eye contact.
    c. Minimizing skin contact with rubber gloves and/or protective clothing
    d. All of the above e. None of the above are necessary
67. The fusible plug that is in all chlorine containers
    a. Is not necessary
    b. May be used as a tap for the chlorine source
    c. Should be removed after the cylinders are empty
    d. Should never be removed or tampered with
    e. Should be removed prior to withdrawing chlorine from the container
68. Sodium hypochlorite is a a. Compound purchased in liquid solution used for disinfection
    b. Dry neutralizing powder for treating chlorine burns
    c. Gas delivered in 100-pound, 150-pound, or one-ton containers

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

e. None of the above

69. The chlorine demand abruptly jumps in your source water. This may indicate that a. The water source has been contaminated *b*. Flow rates in the distribution system have increased

c. The hypochlorite solution used for disinfection has deteriorated

d. The hypochlorite solution tank is empty

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

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

a. Sodium hypochlorite

b. Sodium hydroxide

c. Sodium chloride

d. Calcium hypochlorite

e. Calcium hydroxide

71. The maximum rate of withdrawal of gas from a 150-pound chlorine cylinder in 24-hours is

a. 20 pounds

b. 40 pounds

c. 100 pounds

d. 150 pounds

e. None of the above

72. 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

73. 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

74. 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

75. 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

76. 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
77. 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
78. 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
79. Killing of pathogenic organisms in water treatment is called
    a. Disinfection
    b. Oxidätion
    c. Pasteurization
    d. Sterilization
80. Chlorine reacts with nitrogenous compounds to form
    a. Ammonia nitrate
    b. Free chlorine
    c. Chlorinated hydrocarbons
    *d. Chloramines
81. 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
82. 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

83. 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

84. 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

85. Breakpoint chlorination is achieved when
a. Free ammonia can be tasted in the water
b. No chlorine residual is detected
c. The strong chlorine tasted at the plant did not persist in the distribution system
d. When chlorine dosage is increased, a corresponding increase in residual is detected

86. Because chlorine residual is related to the pH of the water, it may be said that
a. A higher pH requires a higher chiorine residual
b. A higher pH requires a lower chlorine residual
c. A lower pH requires a higher chlorine residual
d. pH has no effect on chlorine residual

87. As long as the temperature is steady, the pressure indicator on a chlorine cylinder will until all the chlorine has been gasified
a. Remain steady
b. Decrease slowly
c. Decrease rapidly
d. Increase slightly

88. When fresh, the typical concentration of sodium hypochlorite solution is
a. 1.25%
b. 6.5%
c. 12.5%
d. 65%
e. variable, depending on the manufacturer

89. Chlorine in a dry form is called:
a. hypochlorite
b. hypochlorous
c. hydrochlorite

d. hydroxide

90. Which of the following procedures is done when preparing to disconnect a chlorine cylinder?
    a. close the cylinder valve first to allow time for the chlorine to be drawn off
    b. loosen the line to the tank and then shut off the valve to the chlorine cylinder
    c. shut off the water supply and allow sufficient time for the chlorille to be drawn off
    d. tum the chlorinator feed rate valve off then turn the valve on the chlorinator cylinder
91. A vacuum is formed in the chlorinator by the:
    a chlorine cylinder pressure
    b. pressure differential through the ejector
    c. chlorine feed pump
    d. rotameter-
92. When calcium hypochlorite is used for disinfecting a water supply, it should be 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
93. Because chlorine residual is related to the pH of the water, it may be said that: 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
94. Which of the following best describes "chlorine demand"?
    a. The difference between the amount of chłorine 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
95. 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
96. 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

97. 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
98. 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
99. Chlorine gas is times than air
    a) 2.5 , lighter
    b) 4.5 , heavier
    c) 3.5 , lighter
    *d) 2.5, heavier
100. Which disinfection method provides a residual safeguard?
    a) ozonation
    *b) chlorination
    c) membrane filtration
    d) ultraviolet radiation
101. Which is the most effective disinfectant when chlorine is added to water?
    a) hydrogen lon
    b) calcium dioxide
    *c) hypochlorous acid
    d) haloacetic acid
102. 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
103. 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
104. The device used to regulate and control the rate of feed of chlorine gas is called a

a. Pump regulator
b. Rotarneter
c. Gas regulator
*d. Chlorinator

105. 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

106. 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

107. 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

108. 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

109. 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

110. Potassium permanganate is most effective in
a. color removal.
b. control of biological growth.
c. control of trihalomethanes formation potential.
*d. removing iron.

111. 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.

112. Which oxidant has the potential of producing ClO_3 by-products?

*a. Chlorine dioxide

b. Chlorine

c. Chloramines

d. Calcium hypochlorite

113. Which is the working strength of sodium hydroxide solution in a chlorine neutralization tank?

a. 15%

*b. 20%

c. 25%

d. 30%

114. 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.

115. 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

116. 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.

117. 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

118. Taste and odor from Phenolic compounds are _____ by chlorinatiqn.

*a. Increased

b. Decreased

c. Not affected

119. When certain organic precursors (humic and fulvic acids) and chlorine combine together in water during disinfection, by products can be formed these by products are called

a. Nitrate

b. Arsenic

*c. Trihalomethanes

d. Trichloroethylene

120. When should ammonia be added to the water when making disinfectant chloramines for secondary disinfection?

a. Before chlorine addition

*b. After chlorine addition

c. During filtration

d. Before filtration

121. Which of the following substances is the most effective disinfection residual?

a. Trichloramine

*b. Hypochlorous acid

c. Chloramine

d. Hypochlorite ion

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. Head is measured in
   a. absolute pressure.
   b. gauge pressure.
   c. *feet.
   d. foot-pounds.
5. To ease installation of impeller wear rings, they can be
   a. lubricated with a light oil.
   b. greased with lithium.
   *c. heated.
   d. cooled.
6. 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.
7. 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.
8. 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.

9. Which is at the top of a stuffing box?

*a. Packing gland

b. Lantern ring

c. Mechanical seal

d. Seal cage

10. Which assembly holds the lantern ring and packing?

a. Shaft assembly

b. Casing ring assembly

*c. Packing gland casing

d. Stuffing box

11. 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

12. Which device serves the same function as the packing?

a. Inline suction gland

b. Packing gland

c. *Mechanical seal

d. Lantern seal

13. 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.

14. 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.

15. 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

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

24. 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
25. 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
26. Velocity of a pump is measured in:
    a. Inches per second
    b. PSI
    c. Feet per second
    d. Yards per second
27. 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
28. To change the discharge of displacement you have to change the:
    a. Speed
    b. Discharge valve
    c. Suction valve
    d. Rotation
29. Which pump component prevents leakage from the pump discharge to the suction?
    a. Lantern ring
    |*|b. Volute
    c. Wear ring
    d. Shaft sleeve
30. 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.
31. 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.

32. 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

33. The flow of electrical current is measured in

*a. Amperes

b. Ohms

c. Volts

d. Watts

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

a. Descaling

b. Cavitation

c. Corrosion

d. Hardness

35. 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

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

a. Adhesive

b. Coolant

c. Corrosion inhibitor

d. Scale inhibitor

37. 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

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

a. Suction lift

b. Total dynamic head

c. Discharge head

d. Friction loss
e. Total static head

39. Static suction head plus friction suction head plus static discharge head plus friction discharge head is a pump's
    a. Pump curve
    b. Operating pressure
    c. Efficiency
    d. Total dynamic head
    e. Velocity head
40. Pumps are primed to
    a. *Replace air inside the pump with water
    b. Seat the valves
    c. Wet the packing
    d. Provide water for flow testing
    e. Overcome positive suction head
41. Backspin is occurring after well shutdown; this indicates
    a. A high water table
    b. A low water table
    c. A confined aquifer
    d. A faulty check valve
    e. A leak in the sanitary seal
42. A water seal on a pump serves many purposes, including
    |*|a. Acts as a coolant to keep the pump bearing from overheating
    b. Keeps gritty material from entering the packing box
    c. Keeps the pumps primed
    |*|d. Is a reserve water supply
    e. Prevents cavitation
43. Enclosed, open, and semi-closed are terms used for the designation and selection of:
    |*|a. Impellers
    b. Lantern rings
    c. Sleeves
    d. Stuffing boxes
    |*|e. None of the above
44. A device that converts electrical energy into mechanical or kinetic energy is called a
    a. Motor
    b. Generator
    |*|c. Transformer
    d. Battery
    e. Pump
45. 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

46. 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

47. 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

48. 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

49. The linkage between a centrifugal pump and its motor is commonly called the
a. Coupling
|*|b. Impeller
|*|c. Bearings
|*|d. Volute
|*|e. Stator

50. The electrical equivalent to friction in water lines is
a. Voltage
b: Resistance
c. Amperage
d. Capacitance
e. Inductance

51. The main water-containing body of a centrifugal pump is commonly called the
|*|a. Shaft
|*|b. Impeller
c. Bearings
|*|d. Volute

e. Stator

52. A type of pump that produces high flow rates with low discharge heads is a
    a. Radial flow
    b. Axial flow
    c. Vertical turbine
    d. Piston
    e. Mixed flow
53. Alternating current is produced by
    a. A single battery
    b. Two (or more) batteries in series
    c. Two (or more) batteries in parallel
    d. A solenoid
    e. A generator
54. What do electrical transformers do?
    a. Step-up or step-down current
    b. Step-up or step-down voltage
    c. Increase power output
    d. Decrease power output
    e. Reduce resistance
55. An "Open" electrical circuit is one in which
    a. Resistance is low
    b. Power production is high
    c. Capacitance is low
    d. Conductivity is high
    *e. Amperage is zero
56. Adding more stages (bowls) to a deep well turbine pump assembly will
    a. Increase the pump discharge capacity
    b. Decrease the pump discharge capacity
    c. Increase the pump discharge pressure
    d. Decrease the pump discharge pressure
    e. None of the above
57. 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
58. 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

59. 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

60. 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.

61. 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

62. 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

63. 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

64. The inlet to the pump is called:

a. Suction

b. Volute

c. Impeller

d. Effluent

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

a. Fan

b. Impeller

c. Rotor

|*|d. Volute

66. 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

67. 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

68. 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

69. Positive displacement pumps should be operated when

a. Suction and discharge line valves are closed

b. Suction and discharge line valves are open

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

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

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

a. caliper

b. micrometer

c. straight edge d. feeler gauge

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

a. $5-10$ft

b. $10-15$ft

c. $15-25$ft

d. $25-34$ft

72. 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

73. A vertical turbine is an example of a:

a. centrifugal pump

b. parshall flume
c. positive displacement pump
d. reciprocating pump
e. all of the above

74. 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

75. 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

76. 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

77. 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

78. 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

79. Centrifugal pump parts include
a. Diaphragm
*b. Impeller
c. Piston

d. Rotor

80. Where does wear most frequently occur on a plunger pump?
    *a. Cylinder
    b. Rotor
    c. Stators
    d. Volute
81. 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
82. 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
83. 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
84. 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
85. 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

86. 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

87. 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

88. 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

89. 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

90. In a centrifugal pump, internal leakage is prevented by

a. Impellers

b. Sleeves

c. Volutes

*d. Wear rings

91. 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.

92. 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

93. 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
94. The elevation of any pump above the source of supply should not exceed feet
    a. 2.2
    *b. 22
    c. 200
    d. 224
95. 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.
96. In electrical circuits, a device used to reduce the voltage is a(n)
    a. Ammeter
    b. Transducer
    c. Transformer
    d. Voltmeter
97. 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
98. Connect a motor to a pump using:
    a. A sleeve clamp
    b. A coupling
    c. Mechanical seals
    d. Bailing wire and bubble gum
99. 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
100. Which component in a diaphragm pump causes the most maintenance problems?
    a. Shaft
    b. Check valves

c. Diaphragm

d. Pump head

101. The shafts main function is to transmit

a. Centrifugal force

b. Kinetic energy

c. Thrust

*d. Torque

102. What type of motor is the simplest of all AC motors, with rotors consiting of a series of bars placed in slots?

*a. Squirrel-cage

b. Wound-rotor

c. Capacitor-start

d. Synchronous

103. Which of the following typer of valve is used in maintaining prime to a pump?

a. Suction

*b. Foot

c. Vacuum header

d. Butterfly

104. Which of the following characteristics of a pump is shown on a pump curve?

a. Wire-to-water horsepower

b. Motor horsepower

c. Friction loss

*d. Efficiency

105. What type of motor is used when infrequent starting is required and the load needs to be brought up to speed very quickly?

a. Repulsion- induction

*b. Capacitor-start

c. Wound-rotor

d. Synchronous

106. Which of the following pumps should be used to increase pressure at large distribution systems?

a. Positive displacement

b. Progressive cavity

*c. Vertical turbine

d. Airlift

107. What type of pump is most used by public water systems?

a. Piston

*b. Velocity

c. Positive-displacement

d. Archimedes

108. In general, what is the maximum practical lift of pumps?
    a. 5 to 15 feet
    *b. 15 to 25 feet
    c. 30 to 40 feet
    d. 45 to 55 feet
109. What type of pump has rotating impellers within a pump case?
    a. Axial-flow
    *b. Centrifugal
    c. Jet
    d. Mixed-flow
    Centrifugal
110. Which of the following is the best type of valve to use to dampen a water hammer?
    *a. Pressure-relief
    b. Needle
    c. Pressure-reducing
    d. Pinch
111. What type of motor requires no windings and has low starting torque?
    *a. Split-phase
    b. Squirrel cage
    c. Repulsion-induction
    d. Capacitor-start
112. What type of pump has high efficiencies (90-95%) at very high pressure, impellers that are very close fitting, and high maintenance costs?
    a. Jet
    b. Vertical turbine
    c. Mixed flow
    *d. Centrifugal
113. What type of motor has a start current seldom over the full-load operating current, has a stator, and the resistance of the rotor circuit can be controlled when the motor is running?
    a. Synchronous
    b. Squirrel cage
    c. Compound
    *d. Wound-rotor
114. Centrifugal, positive displacement, and turbine are all
    a. Types of valves
    b. Types of pipe
    c. Water plant chemicals
    *d. Types of pumps
115. 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

116. Pump seals can be classified as

a. Balanced or unbalanced

*b. Packing ring or mechanical

c. Flat and smooth faced or round faced

d. Factory or custom

117. What is the probable cause of pinging sound coming from a pump?

a. Descaling

*b. Cavitation

c. Corrosion

d. Hardness

118. Which of the following best describes the discharge rate of piston-type pump?

a. Constant as the speed changes

*b. Precise volume for each stroke

c. Varies inversely with head

d. Varies with the total dynamic head

119. What is the main purpose of priming?

a. Ensure the pump operates freely

b. Compress the air in the cylinder

*c. Replace air with water inside the pump

d. Wet the packing

120. Mechanical seals are more appropriate for pumps operating under which of the following conditions?

*a. High suction head

b. Low rpm's

c. High rpm's

d. High discharge head

121. The component of a centrifugal pump sometimes installed on the end of the suction pipe to hold the priming is called the

a. Casing

*b. Foot valve

c. Impeller

d. Lantern ring

122. What is the term used for the combined efficiency of a pump and a motor that is obtained by multiplying the pump efficiency by the motor efficiency?

a. Total system efficiency

b. Well efficiency

*c. Wire-to-water efficiency

d. Motor-to-pipe efficiency

123. Which of the following is the primary indicator of bearing failure?
    a. Leakage from packing
    b. Reduced pump discharge
    *c. Noise from pump
    d. Odor from discharge

124. What is the feet of head at the discharge side of a pump that is pumping against a pressure of 100 psi?
    a. 12.0 ft
    b. 14.5 ft
    c. 43.3 ft
    *d. 231 ft

125. Mechanical seals need replacement when leakage occurs from which of the following?
    a. Pump body
    *b. Around the shaft
    c. Volute
    d. Slinger ring

126. Which of the following parts in a centrifugal pump restricts flow between the impeller discharge and the suction areas?
    *a. Wear rings
    b. Shaft rings
    c. Packing rings
    d. Lantern rings

127. Packing should be replaced when tightening no longer controls the leakage from the
    a. Mechanical seal
    *b. Packing gland
    c. Stuffing box
    d. Shaft sleeve

128. During the routine inspection of a centrifugal pump, the operator notices that the bearings are excessively hot. Which of the following is the most likely cause?
    *a. Over lubrication
    b. Speed being too slow
    c. Worn impeller
    d. Worn packing

129. At a pumping station equipped with a centrifugal pump, which of the following can cause the discharge pressure to suddenly increase and the discharge quantity to suddenly decrease?
    *a. Pump control valve malfunctioned
    b. Suction valve was closed
    c. Pump amperage was decreased

d. Voltage was suddenly increased

130. 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
131. One horsepower is equal to how many foot-pounds per minute?
    a. 746
    b. 3300
    c. 7460
    *d. 33000
132. What is the pressure reading at the discharge side of a pump that is pumping against a total head of 100 ft?
    a. 2.3 psi
    b. 4.3 psi
    c. 23.1 psi
    *d. 43.3 psi
133. 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
134. What is the maximum theoretical suction lift of a centrifugal pump at sea level?
    a. 10 ft
    *b. 34 ft
    c. 52 ft
    d. 85 ft
135. If only two rings of packing are used in the stuffing box, the joints should be
    a. Aligned
    *b. Staggered
    c. Large
    d. Made of lead
136. If only two rings of packing are used in the stuffing box, how many degrees should the joints be staggered?
    a. 15-45 degrees
    b. 45-90 degrees
    *c. 90-180 degrees
    d. 180-225 degrees
137. What is primary function of couplings?

*a. Compensate for alignment changes
b. Control motor temperature
c. Reduce shaft wear
d. Lubricate motor

138. Unless water cooled, the operating temperature of a mechanical seal in a pump should never exceed
a. 95 degrees F (35 degrees C)
b. 120 degrees F (49 degrees C)
c. 140 degrees F (60 degrees C)
*d. 160 degrees F (71 degrees C)

139. After initial full-service operation, grease lubricated bearings should be re-greased at what interval?
a. Weekly
b. Monthly
*c. 3 to 6 months
d. Annually

140. What is the correct formula for determining watts?
*a. Watts= volts/amps
b. Watts= horsepower x ohms
c. Watts= resistance/volts
d. Watts= amps x volts

141. Electrical demand is
a. The same as horsepower
b. Opposition by a circuit to passage of electrons
*c. Amount of power in watts required during a certain time interval
d. The maximum kilowatt load during a billing period

142. The flow of electrical current is measured in
*a. Amperes
b. Ohms
c. Volts
d. Watts

143. The device that changes AC to DC by allowing current flow in only one direction is the
a. Inverter
b. Current transformer
*c. Rectifier
d. Voltage regulator

144. Which of the following is a measure of a materials opposition to the flow of electrical current?
*a. Ohms
b. Amps

c. Volts
d. Watts

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/1 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. $*25$mg/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 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
35. 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.

36. A nutating disc is found in certain:
    a. Centrifugal pumps
    b. Positive displacement pumps
    c. Main line valves
    d. Chemical feeder
    *e. Water meters
37. 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
38. 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
39. Check valves are used to prevent
    a. Excessive pump pressure
    b. Priming
    c. Water from flowing in two directions
    d. Water hammer
40. 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
41. 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
42. 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

43. 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
44. 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
45. 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
46. 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
47. 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
48. 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
49. What category of meters is exemplified by propeller and turbine types?
    a. Differential pressure

b. Positive displacement
c. Mass flow
d. Velocity

50. 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
51. 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
52. 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
53. 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
54. 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
55. 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
56. 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

57. 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

58. 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

59. 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

60. 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

61. "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

62. 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

63. 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
64. 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
65. 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
66. 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
67. From a sanitary standpoint. the pressure in a distribution system should never be allowed to fall to zero because:
    a. low pressure allows bacteria to multiply
    b. ground water may e:oter and back siphonage may occur
    c. the chlorine residual will drop faster
    d. the main may collapse
68. 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
69. 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

70. 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

71. 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

72. 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

73. 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

74. 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

75. 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

76. 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

77. 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
78. A completely fail-safe means of backflow prevention is
    a. Atmospheric vacunm breaker
    b. Pressure vacuum breaker
    c. Air gap
    d. Check valve
    e. Double check valve
79. 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.
80. 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.
81. A venturi meter measures flow of a fluid in a pipe based upon the:
    a. Difference in pressure between a constricted and a fill size portion of the pipe,
    b. Electronic measurement
    c. Velocity of the fluid past a given point.
    d. Weight of the fluid
82. 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.
83. 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

84. 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

85. 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

86. 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

87. 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)

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

a. High pressure

b. Looping

*c. Tuberculation

d. Vacuum breakers

89. 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

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

a. 45psi

a. 100psi

b. 35psi

c. 50psi

d. 15psi

91. Thrust blocks are installed to
    a. boost flexible joints.
    b. boost water pressure.
    c. minimize corrosion
    d. prevent movement of pipes & joints.
92. Distribution system pressure (even during fire fighting demands) should not be allowed to drop below psi.
    a. 0
    b. 5
    c. 20
    d. 40
93. Whenever possible the end of a distribution system should be to prevent taste and odor problems.
    a. inspected
    b. looped.
    c. plugged
    d. capped
94. 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
95. 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
96. 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
97. 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

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

a. Tank

b. Cathode

c. Rectifier

d. Sacrificial anode

99. 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

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

a. $1\text{ft}/\text{sec}$

b. $2.5\text{ft}/\text{sec}$

c. $10\text{ft}/\text{sec}$

d. $20\text{ft}/\text{sec}$

101. 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

102. 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

103. 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.

104. 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 1inch.

105. 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.
106. On a plan and profile drawing, what does the abbreviation EL mean? a. English language
    b. Estimated length
    c. Electric
    d. Elevation
107. What type of map is also referred to as a wall map?
    Comprehensive map
108. What type of map, commonly called a plat, is a series of maps covering sections of the water system?
109. 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.
110. 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
111. 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
112. 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
113. 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

114. The best cross connection device is

*a) air gap

b) double check

c) atmospheric vacuum breaker

d) barometric loop

115. _____corrosion is the corrosivity due to dissimilar metals.

a) saline

b) hydroxyl

c) excessive

*d) galvanic

116. The two types of backflow are

*a) backsiphonage and backpressure

b) backpressure and cavitation

c) air gap and rpz

d) dynamic and backsiphonage

117. 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

118. 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

119. An atmospheric vacuum breaker backflow prevention device protects against

a) backflow

b) backsiphonage and backpressure

c) neither

*d) backsiphonage

120. 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

121. Cathodic protection refers to

a) personal protective equipment

b) thermal electric protection

*c) corrosion

d) filtration

122. 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

123. 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

124. 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 potl!ble use

d. just before delivery to the site

125. 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

126. 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

127. _____corrosion is the corrosivity due to dissimilar metals.

a) saline

b) hydroxyl

c) excessive

*d) galvanic

128. 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%

129. 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

130. 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

131. 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

132. 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 $> 2,500$.

133. 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

134. Small and medium-size utilities are considered to have optimal corrosion control if they meet the lead and copper action levels for

a. One sampling period

b. Two consecutive sampling periods

c. Three consecutive sampling periods

d. Four consecutive sampling periods

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. Chorine 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 ii 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 ls caught in a room where ch1orine gas is leaking. He has no SCBA, he should

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

b. walk out of the room quickly

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

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

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

a. Rennove exçessive moisture

b. Equalize temperature and pressure

c. Eliminate foul odors

*d. Remove dangerous gasses

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 mote 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 vvith fhe employee clnriug 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 $1,500$gpd/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. $*49.5$cfs

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 $30-\text{ft.} x 54-\text{ft.}$

   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. $*0.65$lbs

    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 $\notin$ /1000 gallons for the first 10,000 gallons, 30 $\notin$ /1000 gallons for the next 10,000 gallons, 35ϕ/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?
$$526 \times 4 \times 5.5 = \frac{11,572\text{f}^3}{27} = 428$$
16. If exactly 100gal of polymer costs $19.50, what will $5,500$gal 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 gprax?
$$\frac{\frac{150}{6.35}}{\frac{675}{449}} = 15\text{cuft/s}$$
$$430\text{ft/s}$$
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.

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

9/23/19

21. Convert 8.0cfs to gpm.
    a. 1.07gpm
    b. 64.2gpm
    c. 480gpm 8×449
    e. 3,436gpm
22. Conyert $4,000$gpm to cfs.
    a. 8.91cfs
    b. 66.65cfs
    c. 499cfs
    d. 535cfs
    e. $32,076$cfs
23. Convert 12MGD to gpm.
    a. 0.00833gpm
    b. $7,200$gpm12×700
    d. $17,280$gpm
    e. $199,992$gpm
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 m/e = 25ft
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 2.1mgi1 and has a demand of 0.8mg/1

a. 0.8mg/1
b. 1mg/l
c. 2.1mg/ !
d. 2.9mg/1

32. What is the maximum amount of ch1orine gas that can be removed from a 150-lb cylinder in 24hrs ?
    a. 26 lbs.
    b. 40Jbs.
    c. 75lbs.
    d. there is no maxim.um
33. Bow many gallons would be contained in a circular tank that is 100ft. in diameter and 10ft deep?
    a. 587,0.00 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/1 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 orate of 2.1mg/1 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. 4.51bs./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 problen 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?

    $$\text{imi } = 5280 \text{ Ans. } 15,863 \text{ Gallons}$$

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

$$\frac{500 \text{ g}'}{1 \text{ m}} = \frac{500}{1/10h} = \text{ Ans } \frac{30\text{e}0\text{r}}{\text{gph}}$$

56. $30,000$gph 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?

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

58. A flow of $800,000$gpd is how many gpm? $\frac{800,000}{0.8MGD \times 700} = 560 \times 24 \times 60$ 555.55 0.80gpm
59. A flow of 150gpnn is how many MGD?

    700 (wm.

    Ans.

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

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

    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. Haw many gallons will be in the tank at the end of this time period?

    $6,000 \ldots$ Gal.

    Dose = 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 lewel 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: 1^{st} year $-976.3, 2^{\text{nd}}$ year $-1325.8, 3^{\text{rd}}$ year -2007.1 , and 4^{th} year -2371.4 . How many hours does the meter show the well ran during the 3^{rd} 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?

$$22/2.31 \quad 9.52$$

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

$$85 \times 2.31 \quad 196$$

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?

$$24 \times 2.31 \quad 55$$

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 gaige pressure at the hydirant?

$$20s/2.31$$

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

$$45 \times 2.31 \quad 104$$

73. How many galtons will the above cylinder hold?

$$100 \times 7.48 = 748$$

74. Calculate the area in square feet of a space 100ft. long and 75ft widie.
    Ans. 7500 Sq. Fit

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

76. Calculate the gallons the tauk 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. Caiculate 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 ciameter. Ans. $\frac{293590}{7850}$ Gallons
85. Caiculate the volume of a tank zwith a 100ft diameter that is 50 feet higl,

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

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: 1^{sl} year $-976.3, 2^{\text{td}}$ year $-1325.8, 3^{\text{rd}}$ year -20071 , and 4^{th} year -2371 . 4 . How many hours does the meter show the well ran during the 3^{rd} year?
    a. 349.5hrs
    b. 3364.3 his
    c. $\oint$ 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 95. 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

94. 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

95. What is the area of a circular tank pad in ft2, if it has a diameter of 102ft ?

a. 6,160ft2

b. $6,167 ft^2$

c. $8,170 ft^2$

d. $8,200 ft^2$

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 $5.5 ft^3/min$. 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. $18,605 gal/day$

b. $25,875 gal/day$

c. $30,355 gal/day$

d. $34,325 gal/day$

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 $20'' \times 60'' \times 15''$ 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 hydrofluosilisic 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 $= 0.11/\text{Kw} - \text{Hr}$

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 1 s the area of a trench that is 22.4ft Jong 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 ofa 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 pressm.e of 62 psi?
    a. 27ft
    b. 89ft
    c. 143ft
    d. 175ft
127. How many gallons are in a pipe that is 18 " in diameterand 216 feet long?
    a.1908 gallons
    b. 2246 gallons
    c. 2430 gallons

d. 2861 gallons

128. How many pounds of chlorine are required to u.eat 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 bas a chlorine dosage of 2.75mg/1anda chlorine demand of 1.93mg!1 ?
    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/1 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. $100,000 ft^3$

b. $200,000 ft^3$

c. $300,000 ft^3$

d. $400,000 ft^3$

138. A clearwell holds $314,000 ft^3$ 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 $10,000 \text{GPM}$. 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

0.15 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 1 $\text{b}/\text{ft}^2, 189 ft below a lake's surface if the lake is 386$ ft in depth?
   a. $11,789 \text{lb}/\text{ft}^2$
   b. $11,790 \text{lb}/\text{ft}^2$
   c. $11,793 \text{lb}/\text{ft}^2$
   *d. $11,800 \text{lb}/\text{ft}^2$
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 35.1cfs to gpm.
   a. 14,200gpm
   *b. 15,800gpm
   c. 17,600gpm
   d. 18,300gpm
7. Convert 7.7 million gallons a day (mgd) into cubic feet per second (cfs).
   a. 11cfs
   *b. 12cfs
   c. 15cfs

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 ft^2, with a diameter of 411 ft.
    a. $108,000 ft^2$
    b. $112,000 ft^2$
    c. $125,000 ft^2$
    *d. $133,000 ft^2$
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 CaCO3 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 CaCO3
    b. 3.6 mg/l as CaCO3
    *c. 18 mg/l as CaCO3
    d. mg/l as CaCO3
17. How many gallons are there in 28.65 acre-ft?
    a. $9,354,282$gal
    b. $9,322,137$gal
    *c. $9,335,000$gal
    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 ft^3

    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 $11.87 lb/gal$.

    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 $3,250 gpm$.

    a. $4.4 gpm/ft^2$

    *b. $4.8 gpm/ft^2$

    c. $5.0 gpm/ft^2$

    d. $5.1 gpm/ft^2$

25. Determine the backwash rate in gpm/ft^2 given the following:
    - Backwash flow of $13 cfs \left(ft^3/sec\right)$
    - 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 $18 gpm/ft^2$ and the filter is 20.0 ft by 24.0 ft.

    a. $8,600 gpm$

    *b. $8,640 gpm$

    c. $8,700 gpm$

    d. $8,780 gpm$

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/ft^3 of a solution, if it weighs $112.7 lb/ft^3$.

    *a. $13.5 gal/ft^3$

    b. $16.2 gal/ft^3$

    c. $18.0 gal/ft^3$

    d. $19.9 gal/ft^3$

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. $3,700 ft^3$

    b. $4,000 ft^3$

    c. $4,200 ft^3$

    *d. $4,300 ft^3$

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?
    a. 2.3 ft
    *b. 2.5 ft
    c. 2.6 ft
    d. 2.7 ft
34. A lake is 107 ft deep. Which is the psi on the bottom?
    a. 44.8psi
    b. 45.2psi
    c. 45.6psi
    *d. 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 ?
    a. 17,100,000gal/ day
    *b. 18,800,000gal/ day
    c. 19,700,000gal/ day
    d. 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?
    a. 27.7hr
    b. 28.6hr
    *c. 29.5hr
    d. 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 .
    *a. 2.9 mL/min of ZOP
    b. 3.2 mL/min of ZOP
    c. 3.5 mL/min of ZOP
    d. 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

    a. 1,250 mL/min
    b. 1,270 mL/min
    *c. 1,330 mL/min
    d. 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

0.16 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/ft^2. If the plant flow is 32.7cfs, what is the filtration area of each filter?
   *a. 375ft^2/ filter
   b. 398ft^2/ filter
   c. 400ft^2/ filter
   d. 410ft^2/ 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. $26,859 lb/yr$ of Fe removed
   *b. $27,000 lb/yr$ of Fe removed
   c. $31,975 lb/yr$ of Fe removed
   d. $32,000 lb/yr$ of Fe removed
7. Determine the percent mineral rejection from a reverse osmosis plant if the feedwater contains $1,230 mg/l TDS and the product water contains$ 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, $Ca(OH)_2$	74.1
Magnesium, Mg^{2+}	24.3
Magnesium Hydroxide$_{Mg(OH)_2}$	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 CaCO3	39 mg/l
Total Hardness, mg/l	248 mg/l as CaCO3	76 mg/l
CO2, 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. $190 mg/L, Ca(OH)_2$

b. $194 mg/L, Ca(OH)_2$

c. $195 mg/L, Ca(OH)_2$

d. $200 mg/L, Ca(OH)_2$

15. What is the flow through a membrane unit in gpd/ft^2, if the water flux of the unit is $4.75 \times 10^{-4} gm/cm^2/s$?

a. $10 gpd/ft^2$

*b. $10.1 gpd/ft^2$

c. $100 gpd/ft^2$

d. $101 gpd/ft^2$

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	$\mathbf{T^{10}}$ 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 $3,225$gpm, what is the polymer dosage in mg/l ? Give answer to three significant figures.

a. $1.74 mg/l polymeraid$

*b. $2.19 mg/l polymeraid$

c. $10.94 mg/l polymeraid$

d. $15.12 mg/l polymeraid$

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. $1,040 ft^3$
    b. $5,510 ft^3$
    *c. $5,650 ft^3$
    d. $7,060 ft^3$
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. $4,190 milgal/year$
    c. $25,400 milgal/$ year
    d. 50,300 mil gal/year
20. A softener unit has $118 ft^3$ of resin with a capacity of 25.5 kilograins $/ft^3$. 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 $11.32 lb/gal$.
    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 $3,280$gpm ?

    a. $6.63 mg/l$

    b. $6.72 mg/l$

    *c. $6.87 mg/l$

    d. $6.99 mg/l$

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 he test uses 2-liter jars and the dosage needed is 6 mg/l ? Give result to nearest tenth of a microliter.t

    *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 $2,575$gpm 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 $21.5 ft^3/s$. Give answer to three significant

figures.

a. $5.11 gpm/ft^2$

b. $5.21 gpm/ft^2$

*c. $5.36 gpm/ft^2$

d. $5.58 gpm/ft^2$

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 ft^2, if a filter has an area of $620 ft^2$ with a backwash rate of 13.5cfs.

a. $9.1 gpm/ft^2$

b. $9.4 gpm/ft^2$

c. $9.6 gpm/ft^2$

*d. $9.8 gpm/ft^2$

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. $1.2 gpm/ft^2$

b. $1.3 gpm/ft^2$

*c. $1.5 gpm/ft^2$

d. $1.9 gpm/ft^2$

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. $8,000 lb/yr$

b. $8,200 lb/yr$

*c. 8,600lb/yr
d. 9,000lb/yr

0.17 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 ft^2, if it has a diameter of 102 ft ?
   a. $6,160ft^2$
   b. $6,167ft^2$
   *c. $8,170ft^2$
   d. $8,200ft^2$
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. $12,477$gpm

    b. $12,700$gpm

    c. $12,880$gpm

    *d. $12,900$gpm
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. $18,605$gal/day

    b. $25,875$gal/day

    *c. $30,355$gal/day

    d. $34,325$gal/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. $4,970 ft^2$

b. $5,670 ft^2$

c. $7,820 ft^2$

d. $9,940 ft^2$

18. Determine the specific gravity (SG) of an unknown liquid, if the density of the liquid is $70.9 lb/ft^3$.

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 $283 ft long, if the dosage required is 50.0$ 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. $10,800 ft^2$

b. $10,900 ft^2$

c. $11,000 ft^2$

*d. $11,100 ft^2$

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 $5.5 ft^3/min$. 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 7.0lb 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 8.95lb/gal. The well is pumping water at 260gpm. 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. 10.5lb/ day chlorine

b. 11.2lb/ day chlorine

c. 12.0lb/ day chlorine

d. 13.1lb/ 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. 115gpm

*b. 910gpm

c. 17,000gpm

d. 63,000gpm

44. A water plant serves 23,210 people. If it treats a yearly average of 2.98mgd, 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

0.18 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 $= 5.85\text{ft}\,(b_1)$
- Top width $= 10.6\text{ft}\,(b_2)$

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. $1,150$gpm

    b. 1200gpm

    c. $1,250$gpm

    d. $1,680$gpm

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 $1.11\text{ft}/\text{in.}$ of Hg.

    - Atmospheric pressure =29.8 in Hg
    - Static suction lift =15.1 ft
    - Friction headloss = 0.61 ft
    - Vapor pressure at $12^{\circ}\text{F}(\text{VP}) = 0.50ft$

    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