(3-POINTS EACH)

1. The distance between the water surface and the top of the filtering media in a conventional water treatment plant filter is called?
   a. effluent
   b. head loss
   c. submergence
   d. detention time distance
   e. schmultzdeke

2. The Nephelometric Turbidity Unit (NTU) is a(n) ____________ method based upon deflected light upon a photocell.
   a. instrumental
   b. flash
   c. sonic
   d. particle counting

3. Turbidity is defined as “the cloudy appearance of water caused by the presence of suspended and colloidal matter”. However, a turbidity reading cannot be directly equated to the amount of suspended solids because
   a. dark particles reflect more light than white particles
   b. large particles reflect more light than small particles
   c. small white particles reflect more light than large dark-colored particles
   d. dirt particles are dissolved thus do not reflect light

4. The approximate average size of filtering media where 10% of the total media grains are smaller while 90% are larger on a weighted basis is referred to as the
   a. effective size
   b. uniformity coefficient
   c. unit filter run volume
   d. true color of water
   e. interface range

5. Trihalomethanes are formed by reacting chlorine with which of the following?
   a. iron salts
   b. sodium salt
   c. natural organic matter (NOM)
   d. chloramines

6. The allowable maximum contamination level for Trihalomethanes in drinking water is which of the following?
   a. 80 parts per billion
   b. 30 parts per billion
   c. 100 parts per billion
   d. 80 parts per million
7. Chlorine and bromine are known as
   a. members of the Halogen family of elements
   b. weak, non-aggressive elements
   c. strong aggressive elements, but poor disinfectants
   d. members of the “noble gases”

8. To trap air-bubbles in water either through turbulence or chemically through reaction is referred to as?
   a. the amount of ozone trapped in water
   b. entrained air
   c. dissolved oxygen
   d. epilimnionic air

9. The “specific gravity” of water at 10°C (50°F) at sea level is
   a. 100
   b. 10
   c. 1.000
   d. 0.100

10. Short-circuiting of a flow of water in a tank or basin is most likely is due to
    a. breakthrough
    b. multiple baffles in the direct flow pattern
    c. lack of baffling in the flow pattern
    d. high turbidity and cold water

11. Natural organic matter (NOM) from decayed vegetation is generally a name or term given for which of the following acids?
    a. Sulfuric and hydrochloric acids
    b. humic and fulvic acids
    c. Trihalomethanes and nitric acid
    d. Hypochlorous and hydrochloric acids
    e. Murriactic and hypochlorous acids

12. The capacity of water to neutralize acids is often referred to as a water’s
    a. alkalinity
    b. hardness
    c. alkaline condition
    d. ability to coagulate fine suspended particles

13. The gathering together of fine particles after coagulation to form a cluster of larger particles by a process of gentle mixing is referred to as
    a. filtration
    b. sedimentation
    c. coagulation
    d. flocculation
    e. none of the above
14. The theoretical calculated time required for a small amount of water to pass through a tank or basin at a given rate of flow is referred to as
   a. jail time
   b. real time
   c. detention time
   d. T_{10} times
   e. all of the above

15. The gathering of substances on the surfaces of another material is called
   a. absorption
   b. adsorption
   c. filtration
   d. screening
   e. c & d, but not b

16. The actual amount of time a water particle is determined to flow through a basin based upon tracer studies is referred to as
   a. T_{10} times
   b. Golf starting times
   c. Detention times
   d. CT values
   e. C factor times

17. Partially or completely treated water flowing from a reservoir, basin, or treatment process is called
   a. an aquifer
   b. influent
   c. effluent
   d. inlet
   e. none of the above

18. A method of treating water that consists of the addition of coagulants, flash mixing, coagulation-flocculation, sedimentation, filtration, and called conventional filtration is also referred to as
   a. normal treatment
   b. partial treatment
   c. secondary treatment
   d. complete treatment

19. When a conventional (multi-barrier) treatment plant omits the sedimentation basin, it is referred to as a
   a. direct filtration plant
   b. secondary treatment plant
   c. ruffing plant
   d. multi-hurdle plant
20. Launders are typically located in
   a. flocculation zones
   b. clearwells
   c. football fields and dry cleaning establishments
   d. sedimentation basins upstream of filter inlet channels
   e. anywhere grass grows

21. The phrase, “surface loading rate” is also called
   a. absorption rate
   b. overflow rate
   c. filtration rate, in gpm/sq.ft.
   d. asphalt bearing weight

22. Tube settlers are sometimes installed in sedimentation basins to
   a. allow additional mixing of coagulants to occur
   b. prevent plug flows
   c. improve particle removal
   d. allow microorganisms to grow and breakdown organics in water

23. The term “Uniformity Coefficient (UC)” refers to the weight of filter media that passes through various screens (sieves). Which of the following is the proscribed ratio to determine the UC?
   a. 10% retained divided by 90% retained
   b. 50% retained divided by 25% retained
   c. 75% retained divided by 20% retained
   d. 60% retained divided by 10% retained

24. Activated carbon is made from heating carbon from
   a. peanut shells or clean wood products
   b. burnt silica products
   c. anthracite coal
   d. bituminous coal

25. To initiate a filter backwash after logging its length-of-run, an operator should __________ before opening the drain valve.
   a. Close the influent valve
   b. Close the effluent valve
   c. Start the surface wash system
   d. Have a smoke
   e. Bump the filter to extend its run
26. Which of the following represents a 4-log removal percentage?
   a. 0.0099%
   b. 90%
   c. 99%
   d. 99.99%

27. If a multi-media filter contained silica sand, anthracite coal, and garnet as filtering media, which of the three is the most dense and will settle on the bottom of the other two after backwashing?
   a. anthracite coal
   b. garnet
   c. silica sand
   d. none would be on the bottom alone, since they will intermix when properly selected

28. Which of the following terms refers to a crack in filter bed that allows the passage of particulate matter through a filter? When this happens, a noticeable increase in turbidity results.
   a. air binding
   b. submergence
   c. breakpoint
   d. fault line
   e. breakthrough

29. Which term relates to the taking in or soaking up of one substance into the body of another by molecular or chemical action?
   a. radiance
   b. septic
   c. anaerobic
   d. absorption
   e. adsorption

30. Which of the following organisms is mostly responsible for taste and odor outbreaks in public water supplies?
   a. *Escherichia coli*
   b. *Anabaena*
   c. diatoms
   d. *crypto*spiridium
   e. *Giardia* lamblia
31. What term describe what happens when a layer of schmultzdeke occurs on the top of a filter?
   a. hydraulic grade losses
   b. velocity loss
   c. energy grade loss
   d. head loss

32. The process in which bacteria reduce both the ammonia and organic nitrogen content in water into nitrites and nitrates is called
   a. aeration
   b. stratification
   c. evapotranspiration
   d. nitrification
   e. stabilization

33. Water that does not contain objectionable pollution, contamination, or infective agents and is considered satisfactory for drinking is called
   a. phenolic
   b. ambient
   c. heterotrophic
   d. potable

34. The greatest dilution of a sample with odor-free water that still yields a just-detectable odor is referred to as?
   a. Most probable number
   b. Threshold odor number
   c. The flavor profile odor number
   d. Volatile odor numbers
   e. Presumptive odor test numbers

35. Liquefied chlorine gas can expand how many times into a gas?
   a. 460
   b. 2.5
   c. 5
   d. 300

36. Chlorine gas is how many times heavier than breathing air?
   a. 460
   b. 2.5
   c. 5
   d. 300
37. A self contained breathing apparatus (SCBA) cannot be used in a chlorine atmosphere, if the person who uses it has
   a. facial hair
   b. brass buckles on pants
   c. neoprene gloves
   d. black belt in self defense

38. The molecular weight of a compound, in grams, is the ______ of the atomic weights of the elements in the compound.
   a. Sum  c. average
   b. Progression  d. summation divided by 2

39. The density of coliform-group bacteria per 100 mL of sample in a fermentation tube test is referred to as the _______ _______ _______ index.
   a. Most Probable Number (MPN)
   b. Fermentation Tube Test (FTT)
   c. Membrane Filter Test (MFT)
   d. presence-absence comparison (PAC)

40. The ambient temperature is defined as
   a. the temperatures encountered inside an ambulance
   b. the surrounding or outside air temperatures
   c. water temperatures at collection times
   d. the temperatures inside an incubator

41. The term “Aseptic” refers to
   a. non-sterile environments
   b. free from living organisms that cause diseases
   c. wastewater collection sites or tanks
   d. putrefaction locations where unsanitary conditions exist

42. Chemically, the opposite of reduction is
   a. oxidation
   b. absorbance
   c. transmittance
   d. conductance
   e. transformation

43. A substance that is capable of being evaporated or changed to a vapor at relatively low temperatures is called a _______ substance.
   a. volumetric
   b. oxidized
   c. reduced
   d. volatile
44. The removal or destruction of **all** microorganisms including bacterial spores is referred to as
   a. disinfection
   b. septic conditions
   c. volatile situations
   d. sterilization

45. Non-transient, non-community public water systems include which of the following?
   a. mobile home parks
   b. schools
   c. churches
   d. restaurants

(5-POINTS EACH)

46. A treatment plant had a flow of 5.5 mgd and the desired chlorine dosage is 3.5 mg/L. How many tons per week would be used, if the chlorine were 100% gas?
   (one ton = 2000 lbs)
   a. 0.56 tons
   b. 1123.8 tons
   c. 160.55 tons
   d. 56 tons

47. A 25-foot wide by 30-feet long rapid sand filter treats a flow of 2,000 gallons per minute. Calculate the filtration rate in gallons per minute per square foot of filtering surface area.
   a. 2.7 gpm/sq ft
   b. 27 gpm/sq ft
   c. 0.75 gpm/sq ft
   d. 75 gpm/sq ft

48. Calculate the amount of iron removed, in pounds per week, if the average influent iron concentration were 0.4 mg/L. The average flow during the period was 10 mgd and the iron removal efficiency at the plant were 90%.
   a. 30 lbs/week
   b. 120 lbs/week
   c. 210 lbs/week
   d. not enough information to solve

49. Find the ppm dosage when 650 pounds of 100% chlorine gas were used in 24-hours into a flow of 19.3 mgd.
   a. 4
   b. 5.5
   c. 6.1
   d. 10
50. What is the mg/L dosage, if 4 gph of a 3% chlorine solution were fed into a flow of 264 gpm?
   a. 2.2
   b. 4
   c. 7.6
   d. 9

51. Find the amount of 65% pure dry powder chlorine required, in pounds, to disinfect a new 12-inch well at a dose of 50 ppm, when the well casing is 400-feet deep and the distance from the ground to the static water level is 110-feet.
   a. 1.1 pounds
   b. 0.71 pounds
   c. 3.2 pounds
   d. 2.3 pounds

52. Calculate the detention time, in minutes, for a water droplet to travel through a rectangular basin 110-feet long, 40-feet wide, and 132-inches deep when the flow is 8.2 cfs.
   a. 166.7
   b. 5,902.4
   c. 129
   d. 98.4
   e. 219

53. Calculate the minutes of contact a disinfectant would have in a cylindrical tank, when the water level is 22-feet-9-inches high and the inside diameter is 26-feet. The flow through the tank is 5.5 cfs.
   a. 2,199
   b. 36.7
   c. 30.1
   d. 1,299
   e. 413
54. A total water hardness of 400 mg/L equals how many grains per gallon (gpg)? Round to the next higher whole number if a fraction is left.
   a. 21
   b. 24
   c. 26
   d. 6,840
   e. 6,850

55. A chemical is 19.3% in strength and needs to be diluted to a 2.1% strength. Determine the amount of gallons of the 19.3% required to place inside a 400-gallon day-tank to produce the desired percentage.
   a. 840
   b. 53.5
   c. 40.8
   d. 34.6
   e. 43.5