Wastewater Cert 10-19-07

Indigo Water Group

Name: _____

Date: _____ Period: _____

1. 36D. _____(which can be used for disinfection) may be mechanically produced by photochemical or electrical methods resembling the natural processes.
    (A) Hypochlorite
    (B) Chlorine
    (C) Ozone
    (D) Bromide

2. 20MW. Sulfide precipitation generates more sludge per volume of metal waste being treated than hydroxide precipitation.
    (A) True
    (B) False

3. 50IN. A treatment plant that receives wastewater from a large canning industry may expect what problems to occur in the secondary treatment process?
    (A) Nutrient deficiency
    (B) Increased grit
    (C) Higher pH
    (D) Increased metal levels

4. 31S. The temperature of an anaerobic digester should be changed as slowly as possible to:
    (A) Avoid overloading the heat exchanger
    (B) Allow digester walls time to adjust
    (C) Allow bacteria time to adjust
    (D) Avoid excess heat loss

5. 53L. This term refers to the material remaining on the filter paper after a sample has been filtered. It is also dried.
    (A) Settleable Solids
    (B) Total Dissolved Solids
    (C) Total Suspended Solids
    (D) Volatile Solids

6. 15M. The volume of a primary anaerobic digester is 40,000 cubic feet. The raw sludge feed rate is 6000 lbs dry sludge per day and the volatile solids content is 78%. What is the organic loading rate in lbs VS/cubic foot/day?
    (A) 8.5
    (B) 6.2
    (C) 0.305
    (D) 0.117

7. 43M. How many lbs. of solids are in a 400,000 gallon aeration tank if the suspended solids concentration is 1200 mg/l?
    (A) 4800
    (B) 5200
    (C) 3000
    (D) 4000
    (E) 4400

8. 32IN._____ is the principal waste from oil production.
    (A) Water
    (B) Brine
    (C) Chrome oxide
    (D) Sludge

9. 29L. Another term for a sampling and analysis "plan of attack" or the guidelines we set up for collecting a particular sample are also known as _____.
    (A) Data Quality Objectives
    (B) Organizational Objectives
    (C) Sampling Plan
    (D) Work Plan

10. 89L. Hardness is defined as the sum of the _____ and ____ ions, although any divalent metal ion can contribute to hardness.
    (A) Calcium and Sulfate
    (B) Calcium and Magnesium
    (C) Struvite
    (D) Magnesium and Sodium

11. 74S. Anaerobic digesters are generally operated at a temperature of about ___deg. C. The bacteria that prefer this temperature are referred to as _____.
    (A) 95, thermophilic
    (B) 95, facultative
    (C) 35, mesophilic
    (D) 35, thermophilic

12. 19C. When cadmium cyanide complexes are oxidized, the cadmium precipitates out of solution in this form.
    (A) Cadmium oxide
    (B) Cadmium bromide
    (C) Cadmium metal
    (D) Cadmium chloride

13. 31A. This is an expression of the average time that a microorganism will spend in the activated sludge process.
    (A) Return activated sludge rate
    (B) Space loading
    (C) MCRT
    (D) F/M ratio

14. 41R. What types of wastes generally are prohibited from discharge to wastewater treatment plants?
    (A) Corrosives with a pH lower than 5.0
    (B) All of these answers are correct
    (C) Organic
    (D) Anaerobic

15. 81M. If a gravity sludge thickener receives 20 gpm of primary sludge at a concentration of 3.0% total solids, and the thickener overflow solids concentration is 0.15% total solids, what is the solids removal efficiency?
    (A) 97
    (B) 95
    (C) 92
    (D) 93

16. 40R. If you arrive at an accident scene, which step should you take first?
    (A) Care for the victim
    (B) Call 911 or the local emergency number
    (C) Check the scene for safety
    (D) Interview witnesses to determine what is wrong

17. 92S. Primary sludge is produced at a rate of 25,000 gallons per day and contains 6% solids. After dewatering, the primary sludge contains 17% solids. How many gallons of sludge remain after dewatering?
    (A) 10510 gallons per day
    (B) 8823 gallons per day
    (C) 7500 gallons per day
    (D) 70833 gallons per day

18. 84S. A condition where clear supernatant is pumped through the sludge blanket of a gravity thickener into its underflow is referred to as?
    (A) Hydraulic overload
    (B) Coning/rat-holing
    (C) Solids overflow
    (D) Denitrification

19. 29A. In _____ _____ aeration primary effluent enters the aeration tank at several point along the length of the tank rather than all the primary effluent entering the head of the tank.
    (A) Kraus process
    (B) Contact stabilization
    (C) Step feed
    (D) On/off aeration

20. 22IN. Slaughterhouse and packinghouse wastes tend to be high in BOD, TSS, and these other two constitu
    (A) Salt
    (B) Blood
    (C) Phosphorus
    (D) Grease
    (E) Nitrogen

21. 30N. Biological phosphorus conditioning occurs in what zone?
    (A) Fermentation
    (B) Reaeration
    (C) Aerobic
    (D) Anoxic

22. 24C. In practice, the control devices on a cyanide oxidation process are set to control the pH within the ranges of 10.5 and 11.5 for the first stage reaction (cyanide to cyanate) and _____ for the second stage reaction (cyanate to CO2 and N2).
    (A) 9.0 to 10.0
    (B) 7.0 to 8.5
    (C) None of these answers is correct.
    (D) 8.5 to 9.0

23. 110G. Most circuit breakers are rated at what percentage of motor amperage?
    (A) 10%
    (B) 25%
    (C) 100%
    (D) 125%
    (E) None of these answers are correct

24. 35IN. A point source discharge is a discharge that comes out of the end of a pipe or other clearly identifiable conveyance.
    (A) False
    (B) True

25. 74M. One hundred mgd of secondary influent to a treatment plant contains 110 mg/l of suspended solids. A side-stream from a 1-mgd dewatering plant with 1200 mg/l suspended solids is returned. What is the total suspended solids load on the secondary treatment plant, in pounds?
    (A) 101,750 lb
    (B) 10,008 lb
    (C) 91,740 lb

26. 104S. A gravity thickener has a relatively thin underflow sludge concentration, however, the effluent or supernatant is clear. The operator should
    (A) Nothing, the thickener is operating correctly
    (B) Decrease the withdrawal rate to increase sludge thickness
    (C) Increase the feed rate
    (D) Check the chemical feed system for malfunction

27. 3S. Which mechanical dewatering devise consists of a: polymer conditioning zone, gravity drainage zone, low-pressure zone, and high pressure zone?
    (A) Vacuum filter
    (B) Solid bowl centrifuge
    (C) Bowl centrifuge
    (D) Belt filter press

28. 42L. BOD bottles are stored in the dark to avoid this potential problem.
    (A) Stimulation of nitrifiers
    (B) Accidental breakage
    (C) Temperature increases due to sunlight
    (D) Algae growth

29. 67L. Fecal colonies take on a blue appearance from drawing up this component from the MFC media.
    (A) Rosalic Acid
    (B) Aniline Blue Dye
    (C) Lactose

30. 19G. The saturation level for oxygen in water _____ when temperature increases.
    (A) Increases
    (B) Decreases
    (C) Stays about the same

31. 44S. What is the most critical control parameter for an aerobic digester?
    (A) Dissolved oxygen
    (B) Nitrate concentration
    (C) Temperature
    (D) pH
    (E) Alkalinity

32. 12C. The critical factor in chlorine oxidation of cyanide compounds is:
    (A) pH
    (B) Dissociation energy
    (C) Temperature
    (D) Chlorine concentration

33. 52M. If the influent flow to the aeration basin is 5 MGD with a BOD concentration of 200 mg/L, how much sludge will need to be wasted if the yield is 0.7 lb/lb?
    (A) 5480 lbs
    (B) 5840 lbs
    (C) 4088 lbs
    (D) 5237 lbs

34. 66G. Control is:
    (A) Looking forward
    (B) Concentrating on the present
    (C) Not connected to other managerial functions
    (D) Looking backward

35. 161G. In a circular clarifier, what is the function of the centrally located drive unit?
    (A) To adjust the height of the effluent weirs
    (B) To rotate the sludge collection mechanism
    (C) To operate the RAS/WAS pumps
    (D) To rotate the catwalk to a desired location

36. 15N. While BOD removal requires 1.5 lbs of oxygen per lb of BOD, nitrification requires this many lbs per lb of ammonia nitrogen.

    _____

37. 43MW. This much hydraulic retention time is needed to reduce Cr+6 to Cr+3 when using sulfur dioxide at pH less than 2
    (A) 15 to 30 minutes
    (B) 45 to 60 minutes
    (C) 30 to 45 minutes
    (D) 2 to 8 minutes

38. 52G. Scraper boards used to remove settled sludge to collection hopper are called _____.
    (A) Doohickeys
    (B) Scrapers
    (C) Trenchers
    (D) Flights

39. 19R. Employee hazards include:
    (A) Noxious or toxic gasses or vapors
    (B) Oxygen deficiency
    (C) Physical injuries
    (D) All of these answers are correct.

40. 4G. Tube settlers are used to:
    (A) Aid coagulation
    (B) Remove COD
    (C) Improve suspended solids removal
    (D) Remove odors

41. 130L. The results of a 5-day BOD test should be reported as CBOD5 when ____ is used.
    (A) An amperometric titration
    (B) An organic filter
    (C) A nitrification inhibitor
    (D) The Winkler method

42. 12MW. Hexavalent chromium must be removed from the wastestream before metal precipitation can be done for this reason:
    (A) Hexavalent chromium is not removed by hydroxide precipitation
    (B) The presence of hexavalent chromium in the common metal sludge makes it a hazardous waste
    (C) Precipitation of hexavalent chromium requires an excessive amount of chemical addition which makes the process too expensive
    (D) Hexavalent chromium forms complexes with other metals, thereby preventing their removal

43. 51MW. Anion exchangers used for chromium removal are regenerated with this chemical
    (A) Sodium chloride
    (B) Hydrochloric acid
    (C) Sulfuric acid
    (D) Sodium hydroxide

44. 8IN. Dairy wastes are often _____ limited.

_____

45. 24G. A manometer measures:
    (A) Gas volume
    (B) Liquid levels
    (C) Pressure

46. 3M. If a sludge draw off of 8000 gallons contains 6% solids, how many lbs. were pumped?
    (A) 4003 lbs.
    (B) 2916 lbs.
    (C) 2842 lbs.
    (D) 16091 lbs.

47. 45L. Control charts are used to help minimize process _____.
    (A) Variability
    (B) Troubleshooting
    (C) Changes
    (D) Control

48. 55A. Air requirements in an activated sludge tank are governed by
    (A) BOD and the desired removal efficiency
    (B) Volatile suspended solids concentration in the aerator
    (C) Suspended solids concentrations of the primary effluent
    (D) All of these answers are correct
    (E) None of these answers are correct

49. 112G. Venturi flowmeters can measure flow when partially full of liquid.
    (A) True
    (B) False

50. 21A. Settled activated sludge is generally _____ than unsettled sludge.
    (A) Thicker
    (B) Thinner
    (C) Less Dense
    (D) Saltier

51. 37R. Because actual conditions vary from one worksite to another, the selection of an appropriate respirator weighs heavily on all of these variables
    (A) The odor threshold value of the ambient air
    (B) Comfort of the person wearing the equipment
    (C) The size of the particles to be filtered
    (D) The presence or absence of sufficient oxygen

52. 86L. Alkalinity and hardness are both expressed analytically as this.

_____

53. 45G. The most abundant source of pollutants entering natural water bodies is:
    (A) Food-processing waste
    (B) Hospital waste
    (C) Nonpoint source waste
    (D) Domestic waste

54. 64S. What is the solids recovery rate of a belt filter press with the following operational data? Hours of operation = 10; solids filtered = 80,000 gal; solids content = 5%; cake solids = 22%; cake produced = 68 wet tons.
    (A) 90%
    (B) 20%
    (C) 82%
    (D) 63%

55. 9G. The weight of a chemical compound is 1/8 of the total weight of a chemical solution. The percent by weight, of the chemical in solution is:
    (A) 10.5
    (B) 6.4
    (C) 12.5
    (D) 8.3

56. 12S. A well established anaerobic digester has a total alkalinity of
    (A) 50 - 300mg/L
    (B) 3000 - 4000mg/L
    (C) 2000 - 5000mg/L
    (D) 50 - 700mg/l

57. 8MW. When converting cyanide to cyanate with chlorine gas, the following ratio of chlorine to cyanide should be used.
    (A) 1 to 1
    (B) 3.5 to 1
    (C) 2.5 to 1
    (D) 8 to 1

58. 131L. How long should samples be refluxed before COD analysis?
    (A) 30 minutes
    (B) 2 hours
    (C) 15 minutes
    (D) 1 hour

59. 13C. If the pH drops below 7 when sodium cyanate is reacting with sodium hypochlorite, these undesirable byproducts are produced.
    (A) Cyanide gas
    (B) Hypochlorous acid
    (C) Chlorine gas
    (D) Ammonia compounds

60. 107G. In-plant measurements are much more important than receiving-water measurements because they measure the efficiency of the plant.
    (A) False
    (B) True

61. 84L. Counted plates should have at least this many colonies, but no more than this.
    (A) 2 and 80
    (B) 20 and 60
    (C) 2 and 60
    (D) 20 and 80

62. 24FF. A trickling filter receiving 15 million gal/ac/d would be classified as which of the following?
    (A) High-rate filter
    (B) Low-rate filter
    (C) Second-stage filter
    (D) Polishing filter

63. 10MP. A water seal on a pump serves a dual purpose. It acts as a lubricant and it also:
    (A) Keeps the pump primed
    (B) Acts as a coolant to keep the bearing from overheating
    (C) Is a reserve water supply
    (D) Keeps gritty material from entering the packing box

64. 80G. What does cfs stand for?

_____

65. 56G. A potential problem at an industrial treatment plant that can be remedied with chemical addition is ___ fluctuations.
    (A) BOD
    (B) pH
    (C) Nutrient
    (D) TSS
    (E) Ammonia

66. 70M. A plant runs blowers for 24 hours at 100,000 ft3/min to aerate 100 mgd of flow containing 250 mg/l of BOD. Ninety percent of BOD was removed. How many cubic feet of air was required for each pound of BOD removed?
    (A) 770
    (B) 1000
    (C) 1200
    (D) 595

67. 99G. Which one of the following statements is true in regard to the concept of pH?
    (A) A raw sludge sample with a pH of 6.5 is slightly basic.
    (B) Bacteria in wastewater generally function well at a pH near 7.0
    (C) A pH meter gives the percent hydrogen ion concentration as its direct readout value.
    (D) Accurate pH measurements on raw wastewater require that a 24-hour flow-proporational sample be collected.
    (E) pH indicates the amount of total alkalinity available.

68. 26C. In order to have sufficient chlorine present for the cyanide oxidation reactions in both the batch and continuous processes, at least _____ mg/L of free chlorine must be present as analyzed by the DPD method.
    (A) 20 mg/L
    (B) 15 mg/L
    (C) 25 mg/L
    (D) 10 mg/L

69. 107L. What is the maximum recommended holding time for a properly preserved sample for BOD analysis?
    (A) 24 hours
    (B) 14 days
    (C) 48 hours
    (D) 28 days

70. 70A. In addition to high energy costs, excess DO levels can cause
    (A) Filamentous growth in activated sludge
    (B) Damage to floc particles due to turbulence
    (C) Solids to float in the aeration tank
    (D) Excess ammonia nitrogen in the effluent

71. 15S. The 3 types of digester covers are:
    (A) Gas holding
    (B) Open
    (C) Fixed
    (D) Gas releasing
    (E) Bolted
    (F) Floating

72. 151G. The slope of a sewer line is equal to the length of pipe divided by the vertical elevation difference.
    (A) False
    (B) True

73. 88A. If fine-bubble diffusers are used to introduce air into a biological reactor, the surface of the tank will typically have what type of appearance?
    (A) Mildly agitated, partially covered with light foam
    (B) Splashing, violent
    (C) Calm
    (D) Turbulent, large bubbles

74. 62L. Control limits are meaningless unless these are also in place.
    (A) Corrective Actions
    (B) Update frequencies
    (C) Data quality objectives
    (D) Trend considerations

75. 86A. The mixed liquor suspended solids (MLSS) concentration range for a conventional activated sludge process is
    (A) 8000-10,000 mg/L
    (B) 1500-3000 mg/L
    (C) 5000-7500 mg/L
    (D) 500-1000 mg/L

76. 57R. When using portable electric tools in damp areas or around standing water, be sure to plug them into a
    (A) Ground fault circuit interrupter
    (B) Three-prong outlet
    (C) Three-wire to two-wire adapter
    (D) Portable power supply

77. 76G. 1 gallon = _____ liters
    (A) 4.546
    (B) 2.08
    (C) 3.785

78. 58G. The percent of oxygen in air at sea level is _____%
    (A) 33 1/3
    (B) 78
    (C) 21
    (D) 65

79. 32M. Calculate the lbs of BOD entering the trickling filter. Raw wastewater flow = 1.5 MGD, Raw wastewater BOD = 150 mg/l, 30% reduction in BOD through primary treatment.
    (A) 1310 lb/day
    (B) 1880 lb/day
    (C) 870 lb/day
    (D) 560 lb/day

80. 50L. This term refers to a false positive caused by dirty glassware or sampling equipment.
    (A) Contamination
    (B) Dry-labbing
    (C) Interference
    (D) High baseline

81. 79MP. What is an acceptable variation in input voltage for most electric motors?
    (A) +/- 5%
    (B) +/- 20%
    (C) +/- 10%
    (D) +/- 50%

82. 1FF. The rotational speed of the air driven RBC is controlled by:
    (A) Air velocity
    (B) Air pressure
    (C) Air volume
    (D) Diffuser head setting

83. 16R. Mechanical ventilation of a lift station is required to:
    (A) Reduce chlorine demand
    (B) Increase DO in the raw wastewater
    (C) Eliminate the presence of harmful gases
    (D) Lower the temperature

84. 97S. Gravity thickeners work best on this type of sludge because it has relatively little bound water.
    (A) Secondary
    (B) Chemical
    (C) Primary
    (D) A blend of primary and secondary

85. 15L. _____ solids will settle from the liquid portion under quiescent conditions.
    (A) Settleable
    (B) Suspended
    (C) Colloidal
    (D) Dissolved

86. 22D. Which of the following would be the safest action to take in the event of a major chlorine container leak?
    (A) Call the fire department
    (B) Roll the container so that liquid escapes rather than gas.
    (C) Submerge the container in a basin or stream
    (D) Notify local police or sheriff

87. 144G. One method used to minimize odor generation in sewer lines is to prevent solids deposition by designing a system with a high-flow velocity. What is the recommended design flow velocity to minimize odors?
    (A) Greater than 3.0 ft/sec
    (B) Greater than 5.0 ft/sec
    (C) Greater than 1.0 ft/sec
    (D) Greater than 2.0 ft/sec

88. 68S. Which mechanical dewatering process most requires polymer dosage optimization as a function of solids characteristics?
    (A) A belt filter press
    (B) Vacuum filtration
    (C) A centrifuge

89. 42C. In ion exchange, an anion exchanger contains a resin with this type of charge
    (A) Negative
    (B) Positive
    (C) Neutral

90. 38N. Nitrogen and phosphorus must be removed from the effluent before farmers can irrigate with the treated effluent.
    (A) True
    (B) False

91. 10R. The recommended procedure for mixing concentrated acid with water is:
    (A) Slowly add acid to water and mix gently.
    (B) Slowly add water to acid and mix gently.
    (C) Rapidly add water to acid and mix vigorously.
    (D) Rapidly add acid to water and mix vigorously.

92. 39D. Under normal conditions, when an operator needs to clean a single module of a sleeve in the UV system, the disinfection process must be stopped.
    (A) False
    (B) True

93. 65S. Which polymer has an ionic charge that may vary with the pH of the solids being conditioned?
    (A) Nonionic
    (B) Anionic
    (C) Cationic
    (D) Polyelectrolyte

94. 18MW. When using sulfide to precipitate metals, the operator must be careful to keep the pH above 8 for this reason.
    (A) Below pH 8, the precipitated metals will redissolve back into solution
    (B) All of these answers are correct
    (C) Below pH 8, too much sulfide remains unreacted and leaves in the final effluent
    (D) Below pH 8, toxic hydrogen sulfide gas can be produced and released to the atmosphere
    (E) None of these answers is correct

95. 54L. Total Dissolved Solids are dried at this temperature.
    (A) 103oC
    (B) 180oC
    (C) 105oC
    (D) 550oC

96. 50D. Under normal conditions, the maximum amount of chlorine gas that can be drawn from a 150-lb cylinder is
    (A) 40 lb/d
    (B) 30 lb/d
    (C) 50 lb/d
    (D) 10 lb/d
    (E) 20 lb/d

97. 25C. This is the reason that an upper pH limit is set for cyanide oxidation processes.
(A) Excessive alkali results in suppression of ORP values which may result in a run-away process.
(B) This is just basic waste minimization and process control at the source.
(C) High pH values are a safety concern because hydrogen cyanide gas may be evolved.
(D) At pH>11, the precipitated cyanide metal complexes tend to resolubilize.

98. 5G. The precipitate formed by coagulation with alum is aluminum _____.
(A) Hydroxide
(B) Sulfate
(C) Bicarbonate
(D) Carbonate

99. 12IN. Tannery waste is high in BOD, TSS, and this:
(A) Grease
(B) Hair
(C) Salt
(D) Draino

100.27R. If water is added to concentrated acid instead of acid into water,
(A) Temperature decreases and the mixture tends to form ice
(B) There is no difference
(C) Water will sink to the bottom immediately
(D) Heat is generated and the mixture tends to splash acid
(E) Dilution is faster

101.58A. In an aeration tank, the MLSS is 2500 mg/l, and the recorded 30-minute settling test indicates 230 ml. What is the sludge volume index (SVI)?
(A) 83
(B) 92
(C) 65
(D) 101

102.60S. One of the reasons that air should be excluded from anaerobic digesters is because
(A) Harmful bacteria may be brought in with the air
(B) It interferes with action of the aerobic bacteria
(C) It lowers the temperature of the digester
(D) The entrance of air mixed with gas produced in the digester could create an explosive mixture
(E) Gas storage capacity is reduced

103.80L. This type of quality control sample is used to check for interferences.
(A) Duplicate
(B) Spikes
(C) Blanks
(D) Standards

104.38R. The Hazard Communication Standard (HazCom)
(A) Affects everyone using chemicals in the workplace
(B) Requires employers to develop a written HazCom program
(C) Requires the posting of Material Safety Data Sheets
(D) Two of these answers are correct
(E) All of these answers are correct

105.21FF. Compared with activated sludge, trickling filters are not easily upset by shock loads, perform consistently, and are capable of taking considerable abuse.
(A) False
(B) True

106.85G. A thermocouple measures what?
(A) Vibration
(B) Temperature
(C) Pressure

107.38L. This common material may be used for marking the crucibles used in VSS and VS analysis. You don't even have to etch the crucibles before its application.
(A) Lipstick
(B) Nail Polish
(C) Peanut Butter
(D) Crucible Paint

108.91A. If mixed liquor is black in color and the level of DO is extremely low, this typically indicates that the mixed liquor is _____.
(A) Healthy
(B) Reversing
(C) Septic
(D) Recycling

109.6MW. When reducing cyanide to cyanate, why is the pH maintained at greater than 11?
(A) A pH > 11 is a natural consequence of the chemical reaction
(B) To prevent the formation of toxic gas
(C) To maximize the efficiency of the chemical reaction

110.43N. This much alkalinity is regained for every mg/L of nitrate denitrified to nitrogen gas.
(A) 7.14 mg/L
(B) Alkalinity is not regained in this reaction.
(C) 3.57 mg/L
(D) 2.00 mg/L

111.80S. The agronomic rate for biosolids application concerns the amount of phosphorus required by crops or vegetation and the excess that may enter groundwater.
(A) False
(B) True

112.13MW. When treating wastewaters with two or more common metals with different optimal pH levels, this approach should be used.
(A) Precipitation of lowest optimal pH metal followed by next higher pH metal
(B) None of these answers is correct
(C) Precipitation of all of the metals at the average pH value
(D) Precipitation of highest optimal pH metal followed by next lower pH metal

113.91L. Total inorganic nitrogen consists of these nitrogen species.
(A) TKN, ammonia, nitrate, and nitrite
(B) Nitrate and nitrite
(C) TKN and ammonia
(D) Ammonia, nitrate, and nitrite.

114.19N. This is the primary reason for limiting nitrate concentrations in receiving waters.
(A) Excess nitrate causes odor problems downstream
(B) Excess nitrate stimulates algae blooms
(C) Drinking water standard of 10 mg/L NO3-N.
(D) Nitrate is toxic to aquatic life and exerts a large oxygen demand.

115.35C. Treatment processes used to remove toxic organics from wastestreams include: Check all that apply.
(A) Alkaline cleaning
(B) Screening
(C) Settling and volatilization
(D) Dual-media filtration
(E) Aeration
(F) Carbon adsorption

116.42D. Ultraviolet lamps contain which of the following hazardous substances?
(A) Mercury vapor
(B) Methane
(C) Chlorine gas
(D) Hydrogen sulfide

117.28L. Another word for the average is the _____?

_____

118.131G. Photosynthesis is the conversion of ____ to _____ by algae using sunlight for energy.
(A) Carbon dioxide to ammonia
(B) Carbon dioxide to water
(C) Carbon dioxide to methane
(D) Carbon dioxide to oxygen

119.150G. Surface aerators are designed to serve two purposes:
(A) Mixing and provide dissolved oxygen
(B) Stop odors and mixing
(C) Warm incoming water and mixing
(D) Mixing and increasing digestion rate

120.48MP. A positive-displacement pump is capable of pumping a maximum of 50 gal/min and a minimum of 12.5 gal/min. A Venturi flowmeter can be used to measure flow from this pump.
(A) False
(B) True

121.9C. This compound is formed by the reaction of sodium hypochlorite with cyanide.
(A) Sodium cyanate
(B) Sodium chloride
(C) Sodium thiocyanate
(D) Hypocyanous acid

122.44G. Under snow and ice cover, BOD levels in ponds will normally:
(A) Remain the same
(B) Increase slowly
(C) Decrease rapidly
(D) Decrease slowly

123.1N. Name the two nitrifying bacteria.
(A) Methanogens and acid formers
(B) Pfisteria and nitrobacter
(C) Nitrosomonas and pfisteria
(D) Nitrosomonas and nitrobacter

124.40M. Calculate the F:M ratio. Influent flow volume is 1 MG, Average BOD to aeration tank = 140mg/L, Aeration tank capacity = 250,000 gal, MLSS concentration = 2000 mg/L
(A) 0.30
(B) 0.25
(C) 0.28
(D) D. 0.32

125.65A. The activated sludge process removes soluble BOD from wastewater by
(A) Adsorption
(B) Coagulation
(C) Absorption

126.63R. Pulmonary capacity tests are required before operators can be cleared for using respiratory equipment. These tests should be performed at a minimum of once every
(A) 3 years
(B) 1 year
(C) 6 months
(D) 5 years

127.35D. The UV dose represents the product of the rate of energy emission (lamp intensity) and the time the organisms are exposed to the germicidal energy at 254 nm. This can be expressed by the equation:

_____

128.102G. ORP = _____ _____ _____.
(A) Odor reduction potential
(B) Oxidation reduction potential
(C) Oxygen reducing potentiometer

129.31C. Cyanide wastes may be treated by the use of
(A) Ozone
(B) Chlorine
(C) Ferrous sulfate
(D) Hydrogen peroxide
(E) Sulfur dioxide

130.39A. As a toxic waste load moves into and through an aeration basin the DO level will do what?
(A) Stay about the same.
(B) Decrease
(C) Increase

131.2C. Cyanide may be present as the simple alkali cyanides of sodium or potassium, or complexed with heavy metals such as zinc, cadmium, silver, gold, copper, nickel, or iron.
(A) False
(B) True

132.103G. A _____pH will increase the rate of release of dissolved hydrogen sulfide from wastewater.
(A) Low
(B) High

133.23A. Control of sludge wasting by constant MLVSS concentration involves maintaining a certain concentration of:
(A) Volatile suspended solids in the waste sludge
(B) Suspended solids in the aeration tank
(C) Volatile suspended solids in the aeration tank
(D) Volatile suspended solids in the return sludge

134.39G. A major characteristic of a metal plating waste is high:
(A) BOD
(B) Toxicity
(C) Organic matter
(D) Suspended solids

135.55D. Calculate the chlorine demand given: flow rate = 120 mgd; chlorine feed rate = 8000 lb/d; chlorine residual = 1.0 mg/l after contact time.
(A) 8 mg/L
(B) 6 mg/L
(C) 5 mg/L
(D) 7 mg/L

136.73A. Which is the less energy-intensive oxygen source for facultative bacteria?
(A) Nitrate
(B) Sulfate
(C) Borate

137.16S. Two criteria determine a digester's capacity: the hydraulic detention time and the _____ loading rate
(A) Polymer
(B) Volatile suspended solids (VSS)
(C) Biological Oxygen Demand (BOD)

138.23MW. High pH wastewaters can be neutralized by: There may be more than one correct answer. Check all that apply before submitting your answer.
(A) Sodium hydroxide
(B) Carbon dioxide
(C) Lime
(D) Sulfur dioxide
(E) Hydrochloric acid

139.19M. Determine the required chlorinator setting in lb/day given: Steady flow rate of 5.5 MGD, Target chlorine residual = 2.5 mg/l, Average chlorine demand = 2.5 mg/l
(A) 229 lbs/day
(B) 251 lbs/day
(C) 195 lbs/day
(D) 213 lbs/day

140.6G. The correct amount of chemical used to remove turbidity is known as the:
(A) Combination dosage
(B) Optimum range
(C) Efficiency range
(D) Coagulation range
(E) None, I just made this up

141.53IN. Which of the following wastewater sources contains the least amount of organic material?
(A) Tannery waste
(B) Dairy waste
(C) Cooling tower water from fruit and vegetable processing
(D) Domestic wastewater

142.48MW. In order to recover chromium from the anion exchanger, the exchanger must be regenerated with this chemical
(A) Hydrochloric acid
(B) Sodium chloride
(C) Sodium hydroxide
(D) Sulfuric acid

143.11G. One mL is what fraction of a L?
(A) 1/10
(B) 1/1000
(C) 1/100000
(D) 1/100

144.13G. The conductivity of the wastewater indicates the quantity of dissolved material present.
(A) True
(B) False

145.63MP. What device(s) can be used as an emergency shut-off for the drive unit of a circular clarifier?
(A) Pressure sensors
(B) Gear compression system
(C) Gear reducers
(D) Shear pins

146.18N. What happens when denitrification takes place in the clarifier blanket?

_____

147.48D. If you need a chlorine residual of 1 mg/l, how many pounds of chlorine must be applied each day if the flow is 2.5 mgd and the chlorine demand is 15 mg/l?
(A) 312 lb/d
(B) 419 lb/d
(C) 516 lb/d
(D) 334 lb/d
(E) 291 lb/d

148.104G. The "Desulfovibrio" sp. of bacteria produces hydrogen sulfide under anaerobic conditions. What principal sulfur compound does the bacteria reduce to create H2S?
(A) Proteins
(B) Dimethyl sulfide
(C) Sulfamethoxazole
(D) Sulfate

149.59L. COD results will always be higher or lower than BOD results for the same sample?
(A) About the same
(B) Higher
(C) Lower

150.20A. In an activated sludge process bacteria release chemicals called _____ that break down the food particles that are adsorbed to the cell wall so that they can be absorbed by the microorganism.
(A) Plasma
(B) Proteins
(C) Ciliates
(D) Enzymes

151.34M. How many lbs/day chlorine will be used if the flow is 7,000,000 gpd and a uniform dose of 1.2 mg/l is applied?
(A) 15 lb
(B) 70 lb
(C) 26 lb
(D) 22 lb

152.27S. Methane forming bacteria are inhibited when the pH _____.
(A) Drops to 6.8
(B) Rises to 7.4
(C) Rises to 7.6
(D) Drops to 6.2

153.1MP. The primary cause of motor failure is:
(A) Dirt
(B) Moisture
(C) Friction
(D) Vibration and overload
(E) All of these
(F) B && C
(G) B && D

154.66L. All of the following reasons explain why the percent recovery on a TSS standard might be low EXCEPT
(A) Standard compromised.
(B) Standard not well mixed.
(C) Analyst not paying attention
(D) Standard not poured fast enough.
(E) Filter papers not allowed to dry completely before weighing
(F) Hole in filter paper.

155.23C. The formation of Silver chloride dominates over the formation of Silver oxide when oxidizing silver cyanide complexes with chlorine under these conditions:
(A) Higher oxidizing conditions
(B) Both products form at an equal rate regardless of the conditions
(C) Higher pH
(D) Lower pH
(E) Lower oxidizing conditions

156.1MW. When treating metal wastes, these constituents must be treated separately before other metals can be removed.
(A) Cyanide and chromium VI
(B) Chromium VI and arsenic
(C) Chromium III and cyanide
(D) Arsenic and chromium III
(E) Arsenic and cyanide

157.56M. What is the volume of water (in gallons) in an upright 25 foot diameter cylindrical tank with a water depth of 22 feet?
(A) 102,850
(B) 80,737
(C) 10,794
(D) 90,022
(E) 13,750

158.22MP. If the pump bearings on horizontal pumps are over lubricated, the most important effect is that the extra lubricant:
(A) Will result in smoother and more efficient operation
(B) May cause overheating and possible failure of the bearings
(C) Will not make any difference in the operation of the pump
(D) Will be wasted

159.79M. A centrifugal pump is pumping 200 gal/min against a 40-foot total pumping head. What is the approximate output power of the pump?
(A) 2 hp
(B) 8 hp
(C) 3 hp
(D) 1 hp

160.15FF. More uniform sloughing of filter growth (biofilm) occurs from high-rate filters than standard-rate filters.
(A) True
(B) False

161.76S. What is the solids recovery rate of this vacuum filter given the following information? Filter area = 500 ft2, Hours of operation = 10, Sludge filtered = 80,000 gal, Solids concentration = 5%, Volatile solids = 70%, Cake solids = 22%, Cake produced = 68 wet tons
(A) 93%
(B) 90%
(C) 97%
(D) 87%

162.132L. Organic nitrogen is determined using _____.
(A) Nessler tubes
(B) The total kjeldahl method
(C) An ammonia selective electrode
(D) A cadmium reduction column

163.58MW. Electrolytic recovery of metals uses an electrical charge to force metals to plate out or precipitate onto a cathode.
(A) True
(B) False

164.77L. This is the technical term for the process of converting one unit to another is called.
(A) Dimensional analysis
(B) Unit conversion
(C) Dimensional conversion
(D) Algebraic recriprocals

165.17R. Three waterborne diseases are:
(A) Scarlett fever, pneumonia, hay fever.
(B) Tuberculosis, diptheria, chickenpox
(C) Typhoid fever, dysentary, cholera.
(D) Mumps, measles, colds.

166.99A. The target DO level in a biological reactor (aeration tank) of an efficiently operated activated sludge process should fall within the range of _____.
(A) 0.0 to 1.0 mg/l
(B) 8.0 to 12.0 mg/l
(C) 2.0 to 3.0 mg/l
(D) 4.0 to 6.0 mg/l

167.26G. One BTU is the unit of measure required to raise the temperature 0f 1 lb. of water by 1 degree f.
(A) False
(B) True

168.76A. In the endogenous respiration phase, the mass of activated sludge bacteria
(A) Fluctuates
(B) Decreases
(C) Remains the same
(D) Increases

169.75M. A wet well level transmitter says 56% on a scale of 0% to 100%. The full depth of the wet well is 35 ft. How many feet of water are in the wet well?
(A) 19.6 ft
(B) 17.8 ft
(C) 15.2 ft
(D) 20.3 ft

170.26N. Nitrosomonas bacteria obtain their energy by oxidizing ammonia nitrogen to _____ nitrogen.
(A) Nitrite
(B) Nitrate
(C) Ammonia
(D) Nitrogen gas

171.77S. If solids have a cadmium concentration of 20 mg/kg dry weight, and the allowable biosolids land-spreading limit is 10 lb/ac of cadmium, what is the maximum application rate of biosolids in tons per acre?
(A) 223 ton/ac
(B) 250 ton/ac
(C) 100 ton/ac
(D) 187 ton/ac

172.50M. Calculate the percent reduction in flows achieved by an industrial water conservation program if wastewater flows are reduced from 350 gpm to 220 gpm
(A) 37%
(B) 59%
(C) 63%
(D) 31%
(E) 44%

173.136L. In the BOD test, sample pH should be within this range to ensure that the seed bacteria are able to live, thrive, and survive.
(A) 7.5 to 9.0
(B) 6.0 to 8.0
(C) 6.5 to 7.5
(D) Near neutral

174.18M. Compute the detention time in hours in a final clarifier given: Diameter = 95' Depth = 11' Flow rate = 7.0 MGD
(A) 1 hr. 55 min
(B) 2 hrs. 10 min
(C) 2.0 hrs

175.4L. _____ can interfere with a turbidity meter measurement.
(A) pH
(B) Color
(C) SS concentration
(D) Temperature

176.19D. Coliform bacteria are:
(A) Indicators
(B) Coagulant aids
(C) Sequestering agents
(D) Algae

177.58R. You are the operator-on-duty. The alarm for the fire detector in the Belt Filter Press Control Room goes off. What type of fire extinguisher would you take to respond to this alarm?
(A) Class B
(B) Class C
(C) Type A
(D) Type D

178.53MP. Which of the following is a type of positive-displacement pump?
(A) Axial
(B) Eductor
(C) Turbine
(D) Gear

179.155G. Weather reports show a large storm event heading to your area. In order to prevent biomass washout from occurring in your activated sludge process, you should _____.
(A) Bypass the excess flow directly to the receiving stream.
(B) Prepare the equalization tank (if there is one) or out-of-service tanks for alternate storage.
(C) Increase the wasting rate to reduce the current amount of biomass.
(D) Switch from step-feed mode to plug flow mode (if available).

180.10N. All of these requirements must be met before denitrification can take place. Check all that apply.
(A) Presence of nitrate.
(B) Absence of a carbon source.
(C) Presence of food (BOD)
(D) Absence of oxygen.
(E) Methanol addition.

181.26S. Anaerobic digester off gas has approximately ____% of the heat value of natural gas.
(A) 40 %
(B) 80%
(C) 60%
(D) About the same

182.89A. Which of the following terms refers to a hydraulic condition, typically indicated by billowing solids flowing over the effluent weir, where a portion of the flow through a clarifier experiences a much shorter detention time than the rest of the wastewater in the tank?
(A) Short-circuiting
(B) Overload
(C) Dispersion
(D) Surging

183.31IN. Fruit and vegetable processing wastes are difficult to treat biologically because they are generated seasonally and because they are often nutrient limited
(A) False
(B) True

184.60R. When mixing dry sodium hydroxide and water in an enclosed vessel or area, be sure that
(A) The vessel or area is properly heated
(B) You add the water rapidly
(C) Mix the solution by agitation only
(D) The vessel or area is properly vented

185.130G. Typically, primary treatment has a BOD removal efficiency in the range of what?
(A) 20% to 50%
(B) 10% to 15%
(C) 40% to 60%
(D) 50% to 75%

186.36L. Sample sizes for TSS should leave at least ___ mg of residue on the filter and no more than ____ mg of residue.
(A) 10 and 200
(B) 10 and 500
(C) 20 and 300
(D) 50 and 200

187.29IN. Tannery waste flows are highly variable for this reason.
(A) OSHA regulations don't allow tanneries to work more than one eight hour shift per day.
(B) Each step of the hide curing process uses a different amount of water.
(C) All of the equipment must be rinsed at shift change which increases flows.
(D) Curing hides is a batch process.

188.90S. The influent flow to an activated sludge process is 2 MGD and has a BOD concentration of 250 mg/L. Assuming a sludge yield of 0.7 lbs of VSS per lb of BOD, how many pounds of VSS will be produced?
(A) 1251 ppd
(B) 2618 ppd
(C) 2919 ppd
(D) 4170 ppd

189.45N. This much COD is needed for every mg/L of nitrate that must be denitrified to nitrogen gas. The COD source could be primary effluent or methanol.
(A) 4.33 mg/L
(B) 3.57 mg/L
(C) 1.90 mg/L
(D) 2.86 mg/L

190.52MP. Daily maintenance procedures for a rectangular secondary clarifier include
(A) Inspecting all oil baths
(B) Lubricating the drive unit
(C) Inspecting the drive unit and the chain-and-flight system
(D) Inspecting the stilling well

191.11FF. Trickling filters may be filled with any of the following except:
(A) Redwood beams
(B) River rock
(C) Charcoal
(D) Plastic vertical-flow media
(E) Dump media
(F) Plastic cross-flow media

192.44A. These are the samples you need to calculate the MCRT. Select all that apply.
(A) WAS flow rate
(B) Aeration basin grabs for suspended solids
(C) Clarifier cores for suspended solids
(D) RAS flow rate
(E) RAS total suspended solids
(F) WAS total suspended solids

193.4C. Sodium and potassium cyanides are readily oxidized by chlorination. Name the other two metal cyanides that are also easily oxidized this way.
(A) Cadmium and Silver
(B) Silver and Zinc
(C) Gold and Silver
(D) Cadmium and Zinc

194.16IN. Chromic sulfate, which is used in the tanning process, must be removed prior to discharging the wastewater to a POTW for this reason.
(A) Chromic sulfate produces toxic gas when reacting with hydrogen sulfide in the sewer lines
(B) Chromic sulfate can interfere with sludge digestion
(C) Chromic sulfate, when discharged in high doses, can turn the POTW effluent bright orange
(D) Chromic sulfate can cause the POTW to fail their WET testing

195.14A. When doing a 30-minute activated sludge settleability test, a 1000ml Imhoff cone should be used.
(A) True
(B) False

196.67MP. The formation and collapse of gas pockets or bubbles on the blade of a centrifugal pump's impeller is known as what?
(A) Cavitation
(B) Compression
(C) Entrainment
(D) Combustion

197.59MP. A water-filled mechanical pump seal not only helps to prevent leaks, but also
(A) Cools the material being pumped
(B) Keeps the pump primed
(C) Acts as a reserve water supply
(D) Acts as a lubricant for the pump shaft

198.9FF. Air flow through a trickling filter when the influent is warmer than the air temperature is:
(A) Upward through the filter
(B) Downward through the filter
(C) Inadequate and may require forced ventilation
(D) Improved by decreasing the recirculation

199.75A. The total removal of nitrogen in an activated sludge process includes denitrification followed by nitrification.
(A) True
(B) False

200.21S. Temperature stress in a digester occurs when the temperature changes rapidly by more than __ to ___ degrees F in 10 days.
(A) 3-7
(B) 5-10
(C) 2-3
(D) 6-8

201.4MW. Hexavalent chromium can be reduced to the trivalent form (Cr+3) using sulfur dioxide at a pH between 3.0 and 3.5. What is the correct ratio of sulfur dioxide to hexavalent chromium?
(A) 2.5 to 1
(B) 1.5 to 1
(C) 8 to 1
(D) 1 to 1

202.100L. A BOD sample is incubated 5 days at __ degrees C.
(A) 20 oF
(B) 40 oC
(C) 25 oC
(D) 20 oC

203.88L. Alkalinity is defined as the _____ capacity of a water.

_____

204.48R. When working in an area with two or more floor coverings (for example, grating and checker-plate), be sure that they are always _____.
(A) At the entrances and exits only
(B) Secured together
(C) Overlapping one another
(D) Separated from one another

205.108L. What is the most common preservation method?
(A) Cooling to 4 deg. C
(B) Acidification
(C) Dechlorination
(D) Reduction

206.12D. One volume of liquid chlorine will yield about ____ volumes of chlorine gas.
(A) 500
(B) 800
(C) 360
(D) 450

207.55S. The volatile acid-alkalinity ratio in a digester should be about
(A) 0.5
(B) 0.1
(C) 1.0
(D) 0.01
(E) 3.0

208.14M. The effluent chlorine demand is 12 mg/l, the target chlorine residual is 1.2 mg/l, and the plant flow is 5.6 MGD. How many lbs/day of 65% hypochlorite solution will be required?
(A) 948 lbs/day
(B) 776 lbs/day
(C) 113 lbs/day

209.27A. Which activated sludge process could handle shock loads of dairy waste most effectively?
(A) Tapered aeration
(B) High-rate activated sludge
(C) Step feed
(D) Conventional activated sludge

210.123L. The temperature of a drying oven used for TSS analysis must be kept at _____.
(A) 104 +/- 1 deg. F
(B) 500 +/- 50 deg. C
(C) 180 +/- 2 deg. C
(D) 104 +/- 1 deg. C

211.53R. When working in confined spaces where flammable gases may be present, use only tools made of
(A) Iron
(B) Lead
(C) Stainless steel
(D) A non-sparking alloy

212.94S. These variable control the mass of primary sludge produced at a particular WWTP. Check all that apply.
(A) Efficiency of the secondary clarifier
(B) Growth of activated sludge bacteria
(C) Influent dissolved solids concentration
(D) Influent flow
(E) Influent settleable solids concentration
(F) Primary sedimentation basin efficiency

213.8A. An oxygen uptake rate (OUR) determines what type of microorganisms are present.
(A) True
(B) False

214.114G. The difference in pressure between high- and low-pressure taps is proportional to the square of the flow rate through the Venturi. Therefore, a differential-pressure sensor with a square root output signal can be used to indicate flow.
(A) False
(B) True

215.16G. Wastewater originates from either ____ or _____ sources.
(A) Domestic, industrial
(B) Industrial, sewer
(C) Municipal, sewer
(D) Agricultural, municipal

216.119L. The recommended holding time for a fecal coliform sample prior to analysis is 24 hours or less at 4 deg. C.
(A) True
(B) False

217.32N. The biomass of a conventional activated sludge process contains about 2% phosphorus on a dry weight basis.
(A) True
(B) False

218.17C. When oxidizing cyanide compounds with chlorine, the ORP must be at _____ mV when the pH is between 10.5 and 11.0 SU
(A) +650
(B) +550
(C) +400
(D) +700

219.24IN. Anaerobic lagoons, which are commonly used to treat meat packing wastes, are typically this deep.
(A) 12 to 18 feet
(B) 8 to 10 feet
(C) More than 18 feet deep
(D) 3 to 6 feet

220.67S. What is the most important factor when conditioning solids for dewatering?
(A) Nitrification
(B) Filamentous bacteria
(C) Particle size
(D) Sludge temperature

221.2G. What conditions determine the backwash rate for a pressure filter?
(A) Largest media size
(B) Suspended solids concentrations in the water applied to the filter
(C) Quality of the backwash water
(D) Settleability of solids in the secondary clarifier

222.53MW. When a cation exchanger is regenerated, the metals released are in this form
(A) Hydroxides
(B) Sulfates
(C) Oxides
(D) Phosphates

223.2S. What will NOT affect the vacuum produced in a vacuum filter system?
(A) Poor filtrate pump performance
(B) Drum speed
(C) Seal water flow to the vacuum pump
(D) Clogged silencer drain

224.32MP. If bearings on a centrifugal pump are running hot, over- or under lubrication should be checked. If lubrication is satisfactory, the next preventative maintenance check would be to
(A) Recheck the total dynamic head
(B) Replace the bearings
(C) Operate the pump only when needed
(D) Clean the pump
(E) Inspect the alignment of the pump and motor

225.43G. Which of the following is not biologically active in a lagoon?
(A) Aerobic bacteria
(B) Anaerobic bacteria
(C) Algae
(D) Fungi

226.109S. Coning in a gravity thickener can be corrected by following these steps. Drag and drop them into the correct order.
(A) Increase the sludge collector speed
(B) Monitor blanket depth with time
(C) Increase the sludge withdrawal rate
(D) Decrease the feed rate to the thickener

Arrange in proper sequence: _____

227.115L. The BOD in wastewater determines the concentration of oxygen required
(A) To stabilize decomposable organic matter by aerobic bacteria
(B) To oxidize sulfites and convert thiosulfates to sulfates
(C) To unite chemically with inorganic matter in a sample
(D) To bring oxygen levels in wastewater and atmospheric oxygen to equilibrium

228.21G. A flow measuring device for an open conduit that consists of a contracting length, a throat, and an expanding length is known as a?

_____

229.45S. The major components of anaerobic digester gas are methane and hydrogen sulfide.
(A) True
(B) False

230.24A. Not supplying enough air to the aeration tank will cause:
(A) Effluent quality to improve
(B) Turbidity of final effluent to increase
(C) Slick spots to show up on the aeration tank walkway
(D) Excessive turbulence to occur on the aeration compartment surface

231.35MP. A treatment plant should have a valve exercise program in which all plant valves are exercised (opened and closed)
(A) Once a year
(B) Once every 10 years
(C) Once every 20 years
(D) Once every 2 years

232.32D. What compound is first formed when chlorine is applied to water?
(A) Chloramines
(B) Hydrochloric acid
(C) Free chlorine ions
(D) Hypochlorous acid

233.20R. "Combustible" liquids have a flash point _____ 100 degrees F
(A) Below
(B) Above
(C) Approximately equal to

234.49A. Three filamentous organisms that can cause activated sludge foaming are:
(A) Nocardia, Microthrix, Type 1863
(B) Nocardia, Type 1910, Microthrix
(C) Nocardia, Rotifers, Type 1863

235.51L. This type of quality control sample is used to determine if contaminants are present.
(A) Duplicate
(B) Standard
(C) Blank
(D) Spike

236.59G. In general, the smaller the collection, system the _____ the diurnal flow variations.
(A) Greater
(B) Lesser

237.27MW. Limitations of the hydroxide precipitation process for treating common heavy metals include:
(A) A dense heavy floc is formed
(B) Hexavalent chromium is not removed
(C) Toxic hydrogen sulfide is produced

238.44IN. Equalization should be the first operation in an industrial wastewater treatment system in order to
(A) Increase the treatment mixing requirements.
(B) Volatilize the solvents in the wastestream.
(C) Reduce the size of all remaining unit processes.
(D) Remove high concentrations of solids.

239.13A. CCSS stands for:
(A) Clarifier core suspended solids
(B) Cubic centimeters of sludge solids
(C) Compacted clarifier sludge solids

240.143G. Chlorine is primarily used to
(A) Raise pH
(B) Prevent corrosion
(C) Stabilize organics
(D) Disinfect

241.42IN. Chelating agents are used in electroless plating processes to
(A) Reduce the acidity of the wastestream
(B) Ensure a permanent bonding of the plating metal
(C) Brighten the finished surface
(D) Prevent precipitation of the plating metal ions

242.49R. When manually lifting any object, be sure to _____.
(A) Keep it close to your body and use leg strength
(B) Hold it at arm's length
(C) Keep your knees locked and bend at the waist
(D) Keep your back bent and hold it low

243.46M. You have a 60' diameter clarifier which receives a flow of 2.0 MGD. What is the surface overflow rate?
(A) 10,638 gpd/ft2
(B) 13,245 gpd/ft2
(C) 707 gpd/ft2
(D) 450 gpd/ft2

244.26A. Why is the sludge returned from the secondary clarifier to the aeration tank in activated sludge used for nitrification?
(A) To digest the sludge aerobically
(B) To provide microorganisms
(C) To reduce the mixed liquor SS concentration
(D) To dilute the primary effluent

245.58MP. What equipment is typically used to control positive displacement blowers?
(A) Diffusers
(B) Air inlet piping
(C) Inlet valves and variable frequency drives
(D) Multi-speed motors and variable frequency drives

246.117L. Calculate the biochemical oxygen demand (BOD) for the following unseeded analysis of untreated wastewater. Bottle volume = 300 ml, Sample volume = 6.0 ml, Initial dissolved oxygen = 9.0 mg/l, Final dissolved oxygen = 4.0 mg/l
(A) 250 mg/l
(B) 350 mg/l
(C) 370 mg/l
(D) 200 mg/l

247.116G. Operating a pond with a detention time of 3 days would provide treatment comparable to
(A) Primary sedimentation
(B) Trickle filtration
(C) Sand filtration
(D) Vacuum filtration
(E) Activated sludge

248.59S. Solids stabilization in the anaerobic digestion process is accomplished during which stage?
(A) Acid formation
(B) Solids draw off
(C) Volatile acid reduction
(D) Time on drying beds
(E) Supernatant removal

249.5MP. If packing is not maintained properly,
(A) There will be a loss of suction from air being allowed to enter the pipe.
(B) The shaft or shaft sleeve will be damaged
(C) Cavitation damage will result
(D) The impeller will corrode

250.140G. Hydrogen sulfide formation typically occurs under aerobic conditions.
(A) False
(B) True

251.10IN. For a Dissolved Air Floatation Thickener to work optimally on fats and greases, the pH should be maintained in this range to minimize solubility.
(A) Near neutral
(B) Above pH 8
(C) Below pH 4
(D) Below pH 8

252.61A. Which of the following is not a method used to control filamentous organisms?
(A) Add hydrogen peroxide to the RAS at a concentration upwards of 100 mg/l
(B) Chlorinate the RAS
(C) Change the wasting rate of activated sludge
(D) Increase return activated sludge (RAS) rate

253.46MP. A device that causes the wastewater in a vertical riser pipe to rise to an outlet using compressed air is called an
(A) Draft tube
(B) Suction pump
(C) Air lift pump

254.11R. Three properties of H2S include:
(A) Explosive, corrosive, toxic
(B) Soluble in water, explosive, toxic
(C) Soluble in water, corrosive, toxic

255.79S. One of the biosolids vector attraction reduction requirements is that the mass of volatile solids be reduced by at least _____%
(A) 38%
(B) 25%
(C) 47%
(D) 60%

256.60MP. If your facility cannot tolerate power loss even for short periods, then you need an emergency generator that can _____.
(A) Automatically switch over when power goes down
(B) Power the entire facility
(C) Manually switch over
(D) Switch on after a specific time between power losses

257.82A. Given the following data, determine the excess solids (in lbs) that should be wasted from this activated sludge system. Target F:M = 0.6 per day, MLVSS = 2500 mg/L, BOD loading = 18,140 lb/day, Volume of aeration basin = 2 million gallons
(A) 11,467 lb
(B) 8921 lb
(C) 10,650 lb
(D) 7877 lb

258.43MP. A positive-displacement sludge pump should never be placed into operation
(A) Without being primed
(B) With the discharge valve open
(C) None of these answers are correct
(D) With the discharge valve closed

259.101G. The total solids in wastewater would be a combination of:
(A) Suspended solids and fixed solids
(B) Fixed solids and settleable solids
(C) Fixed solids and dissolved solids
(D) Dissolved solids and suspended solids
(E) Dissolved solids and volatile solids

260.7A. In activated sludge, the Kraus process involves using:
(A) RAS chlorination
(B) High rate diffusers
(C) Anaerobic digested supernatant

261.19A. The condition where activated sludge floc settles poorly is called _____. Most often caused by excessive filamentous growth.
(A) Bulking
(B) Feathering
(C) Hindered settling

262.17L. A single sample of wastewater taken at one time from one place is called a _____ sample.
(A) Grab
(B) Composite
(C) Flow proportional composite
(D) Mini-composite

263.37N. Within wastewater, nitrogen does not occur in which basic forms.
(A) Nitrate
(B) Organic Nitrogen
(C) Ammonia
(D) Nitrite
(E) Nitrogen gas

264.27L. The organic nitrogen level is determined by performing a _____ nitrogen analysis and then subtracting the ammonia nitrogen concentration.
(A) Total
(B) Nitrite
(C) Kjeldahl
(D) Nitrate

265.86S. Using digester gases to power equipment for your facility is known as _____.
(A) Incineration
(B) Heat exchange
(C) Cogeneration
(D) Thermal actuation

266.96G. Hydraulic loading to a pond is generally expresses as gal/day/ft2
(A) True
(B) False

267.47G. A _____ sample consists of a collection of individual samples collected at regular intervals throughout the day
(A) Final effluent
(B) Composite
(C) Weighted average
(D) Grab

268.22MW. Batch processes are used to treat metal wastes because they are: There may be more than one correct answer. Check all that apply before submitting you answer.
(A) Simple
(B) Easy to control
(C) Regulated until the wastewater being treated receives satisfactory treatment
(D) Dependable
(E) Effective for treating large flows

269.61MP. Besides throttling the inlet valve, what type of control is used for a centrifugal pump?
(A) Pipe material
(B) Variable frequency drives
(C) Pipe length
(D) Outlet backpressure

270.31R. In a confined space entry, the entry supervisor must ensure that all confined space entry permit provisions have been fulfilled and certify the same by signing the permit.
(A) True
(B) False

271.26MW. Common metals can be removed from wastestreams by _____ precipitation.
(A) Acid
(B) Cyanide
(C) Chlorine
(D) Hydroxide
(E) Chloride

272.72M. Two 50-ft diameter, 10-ft deep secondary clarifiers operating in parallel handle a flow of 2 mgd. What is the detention time in hours (assume the clarifier has a flat floor)?
(A) 7.0 hrs
(B) 6.7 hrs
(C) 3.5 hrs

273.102L. The pH is a measure of the concentration of _____ ____ in a solution.
(A) Hydroxide ions
(B) Hydrogen molecules
(C) Hydrogen ions
(D) Alkalinity equivalents

274.42R. Hydrogen sulfide gas is released most rapidly from wastewater at what pH range?
(A) Greater than 9
(B) 7 to 9
(C) 5 to 7
(D) Less than 5

275.21MW. Metal finishing wastestreams that contain _____ must be treated separately before metals removal by hydroxide precipitation and sedimentation. There is more than one correct answer. Check all that apply before submitting your answer.
(A) Trivalent chromium
(B) Gold
(C) Cyanide
(D) Complexed metals
(E) Oily wastes

276.14S. For healthy methane forming micro-organisms in an anaerobic digester, the pH should be maintained between:
(A) 6-8
(B) 7-8
(C) 7-9

277.71M. The secondary influent flow to a treatment plant consists of 100 mgd of primary effluent with 110 mg/l total suspended solids. What percentage of the suspended solids loading does a 1-mgd sidestream containing 1200 mg/l TSS represent?
(A) 9.8%
(B) 10.5%
(C) 8.5%

278.4FF. The slime layer on a trickling filter is called:
(A) Smuckstucken
(B) Microbial mat
(C) Zooglea
(D) Biofilm

279.71D. Remote vacuum chlorine injectors use this type of injector:
(A) Genoa fine tip
(B) Centrifugal
(C) Cardinal
(D) Venturi

280.127G. An example of a “single-use” plan is a(n)
(A) Chronological sequence of performance acts
(B) Regulating principle or directive
(C) Indication of exactly how each step is to be carried out
(D) Budget

281.8D. Chlorine gas is _____ times heavier than air.
(A) 3.5
(B) 2.0
(C) 2.5
(D) 1.5

282.10FF. The flow of air through a trickling filter is _____ during cold weather.
(A) Upward
(B) Downward

283.103L. Alkalinity is reported as:
(A) mg/l of calcium carbonate
(B) Softness
(C) The reciprocal of pH
(D) Hardness

284.10C. The reaction rate for cyanide oxidation by chlorination
(A) Increases with increasing pH
(B) Is relatively insensitive to pH
(C) Decreases with increasing pH
(D) Is highest at pH 8.5

285.100G. Which one of the following statements regarding facultative ponds is true?
(A) Facultative ponds are operated only in series, never in parallel.
(B) A facultative pond has no anaerobic layer and no aerobic layer.
(C) DO concentrations may often exceed 10 mg/L during the afternoon of a warm and sunny day.
(D) The pH may fall as carbon dioxide is consumed by algae.

286.15MP. The pressure against which a pump must operate is measured in terms of:
(A) psi
(B) ft-lb
(C) head
(D) hp

287.100A. Which of the following types of solids most accurately represent the microorganisms in the activated sludge process?
(A) Mixed liquor volatile suspended solids
(B) Mixed liquor suspended solids
(C) Total dissolved solids
(D) Total suspended solids

288.21D. As water temperatures decrease, the disinfecting action of chlorine:
(A) Remains the same
(B) Decreases
(C) Depends on the altitude
(D) Increases

289.80M. If a 1-mgd plant has an effluent chlorine demand of 4.5 mg/l and maintains a residual of 1.0 mg/l, what is the estimated required chlorine feed rate in pounds per day?
(A) 51
(B) 46
(C) 38
(D) 68

290.114L. Temperature does not affect pH measurement.
(A) False
(B) True

291.57S. How many pounds of solids are pumped to a digester each day if the digester receives a 10,000 gal/d load containing 5% total solids?
(A) 864,000 lb/d
(B) 5250 lb/d
(C) 4170 lb/d
(D) 1,668,000 lb/d

292.38MP. You need to maintain digester temperature at 98.8 deg. F +/- 1 deg. F. The temperature indicator on the digester recirculation pipe reads 37.0 deg. C. The temperature is within acceptable limits.
(A) False
(B) True

293.83M. The flow velocity in a 6-in. diameter pipe is twice that in a 12-in diameter pipe if both are carrying 50 gal/min of wastewater.
(A) True
(B) False

294.105S. A gravity thickener has a relatively thin underflow sludge concentration, however, the effluent has a lot of solids and solids carryover. A visual inspection does not show any gas bubbles rising to the surface. The operator should
(A) Check the chemical feed system for proper operation
(B) Increase the feed rate
(C) Monitor for septic feed
(D) Decrease the sludge withdrawal rate to increase sludge thickness

295.94L. When testing for total phosphorus instead of orthophosphorus, this pretreatment step is required.
(A) Acidify samples to pH < 2 with hydrochloric acid
(B) Persulfate digestion
(C) Filtration of samples
(D) Permanganate digestion

296.6IN. Many industrial wastes contain high concentrations of BOD, but not enough of these two essential elements.
(A) Magnesium and Sulfate
(B) Iron and Phosphorus
(C) Nitrogen and Iron
(D) Nitrogen and Phosphorus

297.18G. _____ is the measure of how much acid can be added to a liquid, without causing a great change in pH.
(A) Alkalinity
(B) pH
(C) Acidity
(D) Hardness

298.46L. Control charts are only effective if they are _____ and _____.
(A) Current and available
(B) Current and computerized
(C) Maintained and locked up
(D) Computerized and available

299.26D. A chlorine demand test will show the:
(A) Number of lbs required to kill 100% of coliforms
(B) Amount of chlorine required to satisfy the biochemical oxygen demand
(C) Safe amount of chlorine that may be fed without killing fish
(D) Amount of chlorine required to give a desired residual after a given time

300.79L. Calculate the standard percent recovery if the analytical result is 35 mg/L and the certified true value is 39.5 mg/L
(A) 13.2%
(B) 92.0%
(C) 112.8%
(D) 88.6%

301.125L. Assume that the typical pH of the influent at your treatment plant is about 7.2. As you are reviewing new laboratory data, you notice that the pH in the influent this morning was measured to be 6.1. This decrease is most likely caused by:
(A) Too much alkalinity in the influent
(B) A corrosive (acidic) substance in the influent
(C) A caustic substance in the influent
(D) A change in outside temperature

302.7FF. Trickling filter hydraulic loadings are expressed in:
(A) Gallons per minute per square foot of cross-sectional area
(B) Gallons per day per square foot of media area
(C) Gallons per minute per cubic feet of media
(D) Gallons per day per square foot of cross-sectional area

303.23FF. A recirculation of 1:1 means which of the following:
(A) Total flow to a trickling filter is twice that of incoming WWTP flow
(B) 50% dilution in the biochemical oxygen demand test
(C) Total flow to a trickling filter is 2.0 mgd

304.39L. The BOD test originated in this country.
(A) Poland
(B) Canada
(C) Spain
(D) England

305.25IN. Effluents from anaerobic lagoons typically contain about this much ammonia.
(A) 100 mg/L
(B) 1000 mg/L
(C) 20 mg/L
(D) 2 mg/L

306.29N. Denitrification occurs in what zone?
(A) Fermentation
(B) Anoxic
(C) Reaeration
(D) Aerobic

307.53A. During plant rounds, an operator notices that the secondary effluent is cloudy. The operator should
(A) Check the dissolved oxygen level in the aeration tank
(B) Reduce the chlorine feed rate
(C) Take no action because everything is fine
(D) Remove some primary tanks from service

308.61M. The flow to a trickling filter is 2.5 mgd. The filter has a diameter of 100 ft and a media depth of 4 ft. The recirculation rate is 0.75:1. Calculate the hydraulic loading rate in gallons per day per square foot.
(A) 438 gal/d/ft2
(B) 995 gal/d/ft2
(C) 557 gal/d/ft2
(D) 785 gal/d/ft2

309.30R. An occupied trench excavation that is 4 ft or deeper must have exits (ladders) at intervals of ___ ft.
(A) 25
(B) 5
(C) 50
(D) 18

310.30D. Invisible light waves used for disinfection are called what?
(A) ROY G BIV
(B) Infrared
(C) Ultraviolet
(D) Visible

311.43IN. Waste discharge requirements issued on a mass basis depend on pollutant
(A) Concentration and flow rate
(B) Concentration
(C) Mass per liter of water
(D) Mass per unit volume

312.81G. What is an in-stream process of cutting and screening solids contained in wastewater flow?
(A) Communition
(B) Grinding
(C) Barscreen

313.46R. An oxygen-enriched atmosphere contains more than 21% oxygen.
(A) False
(B) True

314.3C. For waste treatment control purposes, cyanides may be classified as those amenable to _____ and _____ cyanides.
(A) Destruction and resistant
(B) Chlorination and refractory
(C) Destruction and refractory
(D) Chlorination and resistant

315.99S. The maximum solids concentration acheivable by a gravity thickener can be impacted by the presence of excessive quanitities of these types of organisms
(A) Stalked ciliates
(B) Anaerobic bacteria
(C) Filaments
(D) Denitrifying bacteria

316.56MP. How often should inactive valves be exercised?
(A) Monthly
(B) Daily
(C) Weekly
(D) Quarterly

317.41N. Assuming good mixing conditions, where is the optimal chemical feed point for phosphorus removal with minimal chemical sludge production?
(A) Before primary clarification
(B) Before secondary treatment
(C) At or near the end of biological treatment

318.4N. Theoretically, ____lbs. of alkalinity is consumed per lb. of ammonia
(A) 3.12
(B) 6.55
(C) 8.34
(D) 7.14

319.17FF. Decreasing the recirculation rate swill help eliminate filter flies.
(A) False
(B) True

320.78MP. Why should standby generators be exercised regularly?
(A) To train new operators on generator operation
(B) To supply extra power when needed
(C) To save money on plant electrical costs
(D) To test the system under actual conditions

321.11L. In making BOD dilution water,1 ml of Magnesium sulfate, ferric chloride, phosphate buffer, and calcium chloride are added per liter of DI. What are these four reagents utilized as?
(A) Source of oxygen
(B) Nutrients
(C) Bacteria
(D) Growth inhibitors

322.84G. Agglomeration of colloidal and finely divided suspended matter after coagulation by gentle mixing is called what?
(A) Sedimentation
(B) Flocculation
(C) Destabilization
(D) Flash mixing

323.38C. How many pounds of chlorine are in a 30-gallon container full of hypochlorite solution containing 5% chlorine?
(A) 50 lbs
(B) 125 lbs
(C) 18 lbs
(D) 12.5 lbs
(E) 1.25 lbs

324.10S. The new sludge regulations categorize most sludge produced for land application as Class _.
(A) B
(B) D
(C) C
(D) A

325.46G. A process in which a tank or reactor is filled, the water treated, then the tank is emptied, and the process repeated is called_____.
(A) Batch process
(B) Continuous process
(C) Intermittent process
(D) Industrial process

326.128L. Before performing a membrane electrode DO test, the equipment should be calibrated to zero by taking a reading on a sample containing an excess of _____ and a trace of cobalt chloride, $CoCl_2$.
(A) Hydrogen chloride, HCl
(B) Calcium carbonate, $CaCO_3$
(C) Sodium sulfite, Na_2SO_3
(D) Sodium hydroxide, NaOH

327.32FF. The Sk or SpülKraft factor is a measure of this:
(A) Hydraulic loading rate
(B) Trickling filter distributor arm rotation speed
(C) Flushing intensity
(D) Trickling filter media density

328.152G. A force main is a section of gravity-flow pipeline leading from a lift station.
(A) False
(B) True

329.36R. For hearing protection, workers should wear either safety plugs or safety earmuffs, but never both simultaneously.
(A) False
(B) True

330.25M. Your pump ran continuously for 24 hrs and delivered 288,000 gal. The capacity of the pump is _____ gpm.
(A) 12000
(B) 200
(C) 100
(D) 1000

331.23L. What is the Normality (N) of the sodium thiosulfate solution used in the BOD test?
(A) 0.25N
(B) 0.05N
(C) 0.025N
(D) 0.125N

332.59R. In confined space entry, LFL stands for
(A) Lower flammability limit
(B) Lifeline/flotation locations
(C) Low floor level
(D) Lighting factor limitations

333.58S. From the standpoint of public health, biosolids used for soil conditioning purposes should be
(A) Produced from vacuum filtration
(B) Digested and in liquid form
(C) Heat dried
(D) Dried on beds

334.65M. Primary sludge containing 5% solids is pumped to a digester continuously at a rate of 25 gal/min. How many pounds of volatile solids are added to the digester each day if total solids are 73% volatile solids?
(A) 10,960 lb/d
(B) 1310 lb/d
(C) 1800 lb/d
(D) 9830 lb/d
(E) 15,010 lb/d

335.30M. Calculate the weir loading for a sedimentation tank that has an outlet weir 480 ft long and a flow of 5MGD.
(A) 9,600 gpd/ft
(B) 9,920 gpd/ft
(C) 10,420 gpd/ft
(D) 9,220 gpd/ft

336.38IN. It is usually easier and cheaper to treat a small amount of concentrated waste than a large volume of dilute waste.
(A) True
(B) False

337.71S. Solids gas-handling systems are kept under positive pressure to prevent atmospheric air from entering the system and creating a possible explosion.
(A) False
(B) True

338.108S. Coning can occur in gravity thickeners under these conditions
(A) Sludge pump operated at too high a speed
(B) Blanket depth too shallow
(C) Vertical picket rotation too slow
(D) Very thick sludge that can't be pumped

339.48A. It is not necessary to be a skilled microbiologist or to be able to identify or count individual species. Rather the operator needs only to recognize major groups of organisms such as:
(A) Rotifers, filamentous bacteria, flagellates
(B) Protozoa, ciliates, rotifers
(C) Filamentous bacteria, rotifers, protozoa
(D) Flagellates, rotifers, protozoa

340.132G. Preliminary treatment of wastewater does not include
(A) Odor control
(B) Sludge sedimentation
(C) Grit removal
(D) Flow measurement

341.45IN. Following coagulation, the next step in a physical-chemical treatment is called
(A) Precipitation
(B) Brownian
(C) Destabilization
(D) Flocculation

342.46A. This term refers to the number of pounds of BOD per 1000 square feet of aeration basin.
(A) Volume loading
(B) Food to microorganism ratio
(C) Mean food residence time
(D) Space loading

343.93S. Generally speaking, primary sludge is _____ dense than secondary sludge.
(A) More
(B) Equally
(C) Less

344.18R. Immediate first aid for burns is to
(A) Flood with cold water
(B) Bandage tightly
(C) Immerse in warm water
(D) Cover liberally with a salve

345.81A. Which of the following is a likely cause of the appearance of small, light-colored floating solids on the surface of a clarifier?
(A) Excessive turbulence shearing of the floc (causing pin floc)
(B) Surfactants in the plant influent
(C) Nocardia problems
(D) Excessive wasting

346.68G. Disaster plans should be developed in case of:
(A) Broken sewers
(B) Floods
(C) Power outages
(D) Pump stoppages

347.66R. If your facility stores _____ or more of chlorine, you must develop a Risk Management Program in compliance with the USEPA's Chemical Accidental Release Prevention Regulations.
(A) 500 lb
(B) 2500 lb
(C) 1000 lb
(D) 5000 lb

348.24R. Combustible gas detectors measure gases and vapors in percent
(A) Upper explosive limit
(B) Lower explosive limit
(C) Carbon dioxide
(D) Hydrogen sulfide

349.85A. Healthy activated sludge has what type of smell?
(A) Mild, musty
(B) Antiseptic
(C) Sharp, acidic
(D) Rotten egg

350.97A. Taking samples at different locations along the length and the width of a reactor (aeration tank) as well as at different depths and analyzing them for solids concentration will verify whether or not you have _____.
(A) A variety of microorganisms in the mixed liquor
(B) Proper mixing in the tank
(C) Sufficient tank volume
(D) Adequate alkalinity to buffer pH

351.29G. The pressure exerted by a column of water one inch square when at rest, is the _____ pressure. It is usually measured in psi.
(A) Theoretical
(B) Static
(C) Dynamic

352.48M. There are two influent lines entering a treatment plant. One line carries a flow rate of 500 gal/min with a BOD concentration of 1500 mg/l, and the other has a flow rate of 6 MGD with a 250 mg/l BOD. What is the actual combined BOD concentration entering the plant? Round off answer to nearest full unit.
(A) 420 mg/l
(B) 1200 mg/L
(C) 384 mg/l
(D) 700 mg/l

353.17D. The fusible plug on a chlorine cylinder melts at about _____ degrees.
(A) 165 - 172
(B) 158 - 165
(C) 135 - 158

354.35L. After drying, filter papers and crucibles should be stored in a _____ to prevent moisture uptake from the atmosphere.

_____

355.87A. The surface of a healthy activated sludge reactor (aeration tank) should have what type of foam?
(A) Thick, greasy, dark tan foam
(B) Very dark or black foam
(C) A thin layer of light tan foam
(D) Stiff, white foam

356.127L. What is the standard sample volume when measuring chlorine levels by an amperometric titration?
(A) 50 ml
(B) 200 ml
(C) 100 ml
(D) 150 ml

357.44L. If the residue remaining on a filter paper is the suspended solids, these are the solids that pass through the filter.
(A) Dissolved (TDS)
(B) Non-volatile
(C) Volatile
(D) Settleable

358.49S. The volatile acid-alkalinity ratio in an anaerobic digester is an indication of the contents' buffering capacity. When the ratio starts to increase, it indicates
(A) A decrease in alkalinity
(B) A decrease in volatile acids
(C) An increase in pH
(D) Excellent digester operation
(E) Better methane production

359.57G. The programming or instructions that a computer uses to do its job is called _____.
(A) Mumbo-jumbo
(B) Hardware
(C) Software
(D) Windows

360.66M. A plant has a 90-ft diameter sludge tank with a sidewall depth of 20 ft. The tank also has a conical bottom that is 8 ft deep. The tank has a sludge liquid level of 15 ft (sidewater depth). How many gallons of sludge liquid are in the tank?
(A) 713,424
(B) 840,255
(C) 586,593
(D) 1,093,936

361.8L. _____ pollutants is a general term applied originally to a list of chemical compounds identified by the EPA as being of significant concern because of their wide spread use and toxicity.
(A) Domestic
(B) Big time
(C) Priority
(D) Significant
(E) Industrial

362.37S. Increases of volatile acid to alkalinity ratios above 0.3 indicate what is occuring in an anaerobic digester?
(A) Methane formers are in balance with acid formers
(B) Upset
(C) Methane formers are outpacing acid formers

363.10M. What is the average detention time in a clarifier given the following: diameter = 80' depth = 12.2' flow = 5 MGD
(A) 1.68 hrs.
(B) 2.4 hrs.
(C) 2.2 hrs.

364.14FF. Industrial wastewaters with an excessive concentration of toxic wastes, such as pesticide residues, can be successfully treated with trickling filters.
(A) False
(B) True

365.68A. In a conventional activated sludge plant, oxygen demand is highest
(A) At the head end of the tank
(B) In the middle of the tank
(C) At the outlet of the tank
(D) Nowhere, oxygen demand is uniform throughout the tank

366.58M. Calculate the percentage reduction of BOD through the plant, given the following data: Wastewater entering the plant has a BOD of 275 mg/l; Plant effluent has a BOD of 30 mg/l
(A) 89%
(B) 30%
(C) 11%
(D) 45%

367.49D. The destruction of the larger portion of microorganisms with the probability that all pathogens are killed is called
(A) Sterilization
(B) Disinfection
(C) Dilution
(D) Digestion
(E) Disposal

368.28MP. E=I x R or Voltage = Amperage x Resistance is:
(A) Ohm's law
(B) Ampere
(C) Theory of relativity
(D) Resistance formula

369.95G. Hydrogen Sulfide has a _____ ____ odor.

_____

370.33M. A plant ran blowers for 24 hrs/day at 5000 cu.ft/min. How many cu.ft/min of air were required to remove a pound of BOD per day if the activated sludge system removed 6000 lbs/day?
(A) 660
(B) 1200
(C) 1100
(D) 595

371.8S. For "vector attraction reduction," the new sludge rules require a __ reduction in volatile solids across a digester process before land application.
(A) 38%
(B) 35%
(C) 40%
(D) 32%

372.6M. The formula for calculating the volume of a wet well is:
(A) V = W X L X H
(B) V = L X W X C
(C) V = W X A X P
(D) V = W X H X D

373.21R. "Flammable" liquids have a flash point _____ 100 degrees F.
(A) Above
(B) Below
(C) Approximately equal to

374.47MW. This form of chromium passes through the cation exchanger and is subsequently removed by the anion exchanger
(A) Hexavalent chromium, Cr+6
(B) Chromium oxide, CrO2
(C) Trivalent chromium, Cr+3
(D) Chromate ion, CrO4-2

375.5M. What is the approximate volume of flow (MGD) treated in a 7' wide, 4'deep grit chamber, if a floating stick moves 24' in 30 seconds.
(A) 16.7 MGD
(B) 14.52 MGD
(C) 13.65 MGD
(D) 15.42 MGD

376.52L. Both of these quality control samples can be used to measure accuracy and precision.
(A) Blanks and Standards
(B) Standards and Spikes
(C) Duplicates and Blanks
(D) Standards and Duplicates

377.28C. When using an ORP meter to control the chlorine residual in a cyanide oxidation process, you should know that for every one unit of pH increase, the ORP potential decreases by approximately _____ mV.
(A) 75 mV
(B) 50 mV
(C) 15 V
(D) 60 mV

378.89G. The formation of layers of different temperatures in a body of water is called what?
(A) Turnover
(B) Limnology
(C) Surging
(D) Thermal stratification

379.28IN. Fermentation wastes usually have a pH that is
(A) Easily Adjusted
(B) Above 8
(C) Between 2 and 4
(D) Below 7
(E) Highly alkaline

380.48L. Samples should only be collected where the wastewater is _____ _____.
(A) Entering processes
(B) Overflowing weirs
(C) Well mixed
(D) Exiting processes

381.57M. What is the percent of BOD removed in a plant when the influent BOD is 245 mg/L and the effluent BOD is 22 mg/L?
(A) 86%
(B) 9%
(C) 92%
(D) 13%
(E) 35%

382.69M. If primary treatment can be expected to remove 30% of BOD and secondary treatment can remove 85% of BOD, then the expected overall BOD removal will be
(A) 95%
(B) 77.5%
(C) 89.5%

383.42N. Without mineral additions for phosphorus removal, the expected percent phosphorus removal in an activated sludge system is
(A) 10% to 30%
(B) 30% to 40%
(C) 40% to 60%

384.61L. Tracking data is only the first step in control charting. These need to be set next.
(A) Control Limits
(B) Data quality objectives
(C) Update frequencies

385.32A. _____ = BOD, lbs/day / MLVSS, lbs
(A) Sludge age
(B) F/M ratio
(C) BOD5
(D) MCRT

386.40G. A wet well probe is usually used for _____ determination(s) of level.
(A) Single-point
(B) Dual-point
(C) Continuous
(D) Approximate

387.83S. Which type of polymer has the most active product per unit weight?
(A) Solution polymer
(B) Mannich polymer
(C) Emulsion polymer
(D) Dry polymer

388.128G. Which of the following flow measuring devices is the most accurate?
(A) Parshall flume
(B) Magnetic meter
(C) Weir
(D) Venturi tube

389.34L. To analyze for volatile solids, crucibles are placed into a _____ _____ at 550oC.
(A) Muffle Furnace
(B) Drying Oven
(C) Heated Desiccator
(D) Microwave Oven

390.34S. In an anaerobic digester, digestion almost ceases at approximately __ degrees F.
(A) 50
(B) 70
(C) 80
(D) 60

391.9A. Waste activated sludge wasting rates should not be altered more than _____ percent on a daily basis?
(A) 50 - 60
(B) 10 - 20
(C) 30 - 40
(D) 1 - 5

392.25A. When a high organic waste load reaches an activated sludge plant, the operators first indicator is a decrease in:
(A) DO residual in the aeration tank
(B) Floatables in the primary clarifiers
(C) COD in the plant influent
(D) Flow to the treatment plant

393.12M. What is the flow rate (gpm) from a pump with a discharge diameter of 6" and a velocity of 5 ft/sec?
(A) 198 gpm
(B) 441 gpm
(C) 44 gpm
(D) 338.5 gpm

394.104L. If dissolved oxygen is present in a biochemical oxygen demand (BOD) sample, the floc will turn brown after the alkaline iodide-sodium azide solution is added.
(A) True
(B) False

395.71G. When an employee seems to have made an error, a supervisor should first;
(A) Keep a written record of events.
(B) Obtain all the relevant facts.
(C) Have the employee admit the error.
(D) Have a pleasant discussion with the employee.

396.82L. Fecal coliforms are a subset of this larger group of bacteria.
(A) Beta subgroup proteobacteria
(B) Total coliforms
(C) Indicator organisms
(D) Escherichia coliform
(E) Pathogenic bacteria

397.34MW. Hexavalent chromium reduction to the trivalent form is typically done at this pH level
(A) 8
(B) 4
(C) 10
(D) 6
(E) 2

398.135G. Primary sedimentation does not include
(A) Equalization of sidestream flows
(B) Separation of floatable solids
(C) Removal of soluble biochemical oxygen demand
(D) Separation of readily settleable solids

399.91S. Primary sludge is produced at a rate of 40,000 pounds per day. If the sludge contains 6% solids, how many gallons of sludge will need to be pumped out of the primary clarifiers?
(A) 79936 gallons per day
(B) 7993605 gallons per day
(C) 89126 gallons per day
(D) 60012 gallons per day

400.36G. _____ is the term that describes a normally aerobic system from which the oxygen has temporarily been depleted.
(A) Anoxic
(B) Anaerobic
(C) Heterotrophic
(D) Facultative

401.42M. At what rate in gpm must wash water be delivered to a mixed media filter to attain a backwash rate of 15 gpm/sq ft if the filter is 20' wide and 30' long.
(A) 600
(B) 9000
(C) 3000
(D) 2400

402.33A. Very fine floc particles with poor settling characteristics are called what?
(A) Resume sludge
(B) Pin floc
(C) Straggler floc
(D) Dispersed growth

403.19L. What is the element found in Mercaptans that has an atomic weight of 16?
(A) Sulfur
(B) Carbon
(C) Lead
(D) Arsenic
(E) Phosphorus

404.34R. If you need to raise your voice to be heard by someone less than 2 ft away, chances are you should be wearing hearing protection.
(A) False
(B) True

405.97L. The purpose of adding sodium thiosulfate to a microbiological sample botle is to:
(A) Ensure sterilization of the sample bottle
(B) React with nitrates that interfere with the MPN test
(C) Extend the allowable holding time from 6 - 30 hours.
(D) Remove any chlorine residual present

406.15R. When a fire hydrant is operated, it should be:
(A) Opened fully
(B) Regulated to flow required
(C) Opened halfway
(D) Opened enough to have flow

407.142G. What effect does temperature have on oxygen solubility?
(A) As temperature increases, dissolved oxygen levels decrease
(B) As temperature decreases, dissolved oxygen levels decrease
(C) No effect

408.30G. Which word does not refer to conditions of respiration?
(A) Aerobic
(B) Parasitic
(C) Anaerobic
(D) Facultative aerobic
(E) Facultative

409.64R. According to Article 250 of the US National Electric Code (NEC), what color should ground wires be?
(A) Yellow
(B) Green
(C) Blue
(D) Red

410.21MP. Which of the following causes the greatest pipe friction loss?
(A) Decreasing the rate of flow
(B) Decreasing the pressure
(C) Increasing the temperature of the wastewater
(D) Increasing the velocity of wastewater

411.77M. The pressure gauge on the bottom of a water holding tank reads 15 psi. The tank is 15 ft in diameter and 40 ft high. How many feet of water are in the tank?
(A) 25.0 ft
(B) 34.6 ft
(C) 11.8 ft
(D) 38.9 ft

412.50G. A high molecular weight substance that is formed by either a natural or synthetic process. Can have either positive or negative charge.
(A) Enzyme
(B) Deoxyribonucleic acid
(C) Polymer
(D) Carbohydrate
(E) Protein

413.13M. Given the following, what is the digester detention time? Diameter = 80 ft Depth = 25 ft Sludge feed rate = 25000 gpd
(A) 37.6 days
(B) 47.8 days
(C) 25.2 days

414.15G. _____ constitute(s) one of the principal sources of nitrogen for microbial growth in domestic wastewaters.
(A) Carbohydrates
(B) Protein
(C) Industrial waste discharges
(D) Oxygen

415.26L. Total volatile solids represent the weight of material lost when burning the total solids component at ___ degrees C.
(A) 180 oC
(B) 103 oC
(C) 180 oF
(D) 550 oC

416.79G. An insect or other creature capable of transmitting diseases is called a _____.
(A) Vector
(B) Lacrymator
(C) Fecal coliform
(D) Indicator

417.7G. Required chemical coagulation doses are commonly determined by:
(A) Stoichiometric calculations
(B) Measurements of zeta potential
(C) Oxidation-reduction investigations
(D) Jar tests

418.38G. The main action of a mixed media filter is:
(A) Coagulating
(B) Straining
(C) Disinfecting
(D) None of the above

419.75MP. Which of the following causes leaking between the segment and body of a plug valve?
(A) New seal ring
(B) New seal seating itself
(C) Overgreased assembly
(D) Recently-cleaned segment

420.125G. The primary function of secondary clarifiers is to
(A) Provide dechlorination detention time
(B) Remove phosphorus and biochemical oxygen demand
(C) Remove grit carryover
(D) Remove solids produced during treatment

421.46IN. What is the one invariable requirement in all jar test procedures?
(A) Test conditions should match actual plant conditions.
(B) Chemicals of the highest possible purity should be used.
(C) Jar test apparatus must have at least 6 jars.
(D) pH of the samples must be within the range of 6.5 to 8.5/

422.9D. The _____ mean is the mathematical technique used to determine the average of several fecal coliform values.

_____

423.3IN. In processing facilities, the acronym CIP stands for what?

_____

424.99L. Sample refrigerators should be set at _____ degrees C plus or minus 2 degrees C for proper preservation.
(A) 2 oC
(B) 6 oC
(C) 4 oC
(D) 10 oC

425.30IN. The purpose of flow equalization is to prevent shock loads of wastes from reaching treatment processes.
(A) False
(B) True

426.52MW. The liquid that results from regenerating an ion exchange column is more concentrated than the original wastestream.
(A) True
(B) False

427.22N. Denitrification can be inhibited when the DO concentration is higher than this.
(A) 0.5 mg/L
(B) 1.0 mg/L
(C) 4.0 mg/L
(D) 2.0 mg/L

428.25R. A proper steel-toe safety shoe should be capable of resisting the impact of at least _____ft-lb
(A) 300
(B) 50
(C) 10
(D) 100

429.102S. Gravity thickeners are typically operated with a blanket depth, or sludge layer, of _____ feet. This depth ensures a layer of clear water at the surface and prevents excessive gasification due to high solids residence times.
(A) 5-8 ft
(B) 2-4 ft
(C) 12-15 ft
(D) 8-12 ft

430.84M. A pump delivers 240,000 gallons per day at a static head of 275 feet. Calculate the pressure equivalent to this head, expressed in pounds per square inch.
(A) 275 psi
(B) 119 psi
(C) 635 psi
(D) 550 psi

431.2D. A _____ residual is attained after breakpoint chlorination.
(A) Combined
(B) Breakpoint
(C) Total
(D) Free

432.14MW. Limitations of the hydroxide precipitation process for metals include:
(A) The presence of complexing ions (chelating agents) such as EDTA, phosphate, and ammonia can affect removal efficiencies
(B) Hydroxide precipitates tend to resolubilize if the solution pH is either increased or decreased from the optimum
(C) Different metals have different theoretical minimum solubilities at different pHs
(D) Both the presence of complexing ions and pH sensitivity
(E) All of these answers are correct

433.44M. What is the MLSS concentration in an activated sludge plant that has a 1 MG aeration basin and carries 16000 lbs of solids in the aeration basin?
(A) 1920
(B) 1800
(C) 1860
(D) 1760

434.15MW. Sulfide precipitation of common metals is sometimes preferred over hydroxide precipitation because
(A) Sulfide sludge may be disposed of through land application as fertilizer
(B) Sulfide compounds are safer and easier for operations staff to handle
(C) Sulfide precipitation is less sensitive to pH
(D) Sulfide precipitation is less expensive than hydroxide precipitation

435.64G. When a great deal of authority is delegated on many levels, an organization may be described as:
(A) Authoritarian
(B) Centralized
(C) Decentralized
(D) Unstructured

436.37C. Precious metal recovery may be achieved by these three metal waste treatment processes.
(A) Ion exchange
(B) Evaporation
(C) Electrolytic
(D) Alkaline chlorination
(E) Cyanide complexing
(F) Hydroxide precipitation

437.43R. At a pH of 6.0, 90% of the dissolved sulfides in wastewater can escape the solution as hydrogen sulfide, whereas, at a pH of 8.0, only 10% of the dissolved sulfides can escape as hydrogen sulfide.
(A) True
(B) False

438.56A. Which of the following conditions would least likely contribute to rising sludge in secondary clarifiers?
(A) Low mixed liquor suspended solids
(B) A long aeration tank detention time
(C) A long detention time in clarifier
(D) Nitrification in the aeration tank
(E) Clarifier hydraulic loading

439.61G. When purchased materials are received by the utility they should be:
(A) Assumed to be in working order
(B) Distributed as soon as possible
(C) Counted and checked against the purchase order
(D) Placed on shelves

440.21L. Fatty acids produced during anaerobic decomposition containing six or fewer carbon atoms are called what?

_____

441.17G. The solids which will not readily settle out of the wastewater are known as _____ solids.
(A) Dissolved
(B) Settleable
(C) Total
(D) Volatile
(E) Suspended

442.54R. In addition to the worker entering a confined space, what is the minimum number of people required to be present during a confined space entry?
(A) 2
(B) 3
(C) 4
(D) 1

443.69S. Solids must be adjusted to what pH for 72 hours to effectively reduce pathogens?
(A) 12
(B) 3
(C) 8

444.63G. Successful communication requires mutual:
(A) Confusion
(B) Understanding
(C) Agreement
(D) Transmission

445.78L. The following flows are mixed together. What is the new NH3-N concentration? Flow 1 = 10 MGD @ 50 mg/L NH3-N Flow 2 = 5 MGD @ 100 mg/L NH3-N
(A) 80 mg/L
(B) 67 mg/L
(C) 52 mg/L
(D) 75 mg/L

446.55R. Hearing protection must be made available to all employees exposed to noise levels above
(A) 85 decibels continuously for 8 working hours
(B) 85 decibels at any point in the 8-hour workday
(C) 85 decibels averaged over 8 working hours
(D) 850 decibels averaged over 8 working hours

447.26MP. An electrical system for prevention of rust, corrosion, and pitting of steel and iron surfaces in contact with water is called _____ protection.
(A) Cathodic
(B) Anodic
(C) Sputter
(D) Plating

448.39IN. Which of the following are considered conventional pollutants?
(A) Total Suspended Solids
(B) Oil and Grease
(C) Heavy Metals
(D) Pathogenic Organisms
(E) Adverse pH levels

449.2M. If the influent SS are 200 mg/l and the effluent SS are 16 mg/l what is the removal efficiency?
(A) 85%
(B) 93%
(C) 97%
(D) 92%

450.7MW. Which of these chemicals is NOT used to reduce cyanide to cyanate?
(A) Hydrochloric acid
(B) Calcium hypochlorite
(C) 15% Sodium hypochlorite
(D) Chlorine gas

451.23IN. Meat packing wastes are well suited for treatment by these types of processes.
(A) Anaerobic
(B) Aerobic
(C) Lagoons
(D) Activated Sludge

452.78G. 1 acre = _____ square feet.
(A) 43,560
(B) 62,500
(C) 34,650

453.31MW. Complexed metal wastestreams may be treated by all of the following:
(A) Low pH precipitation
(B) Chemical oxidation
(C) Hydroxide precipitation
(D) High pH precipitation
(E) Chemical reduction

454.14N. These microorganisms are responsible for the two step nitrification process.

_____

455.1IN. Dairy processing plants typically produce wastewater that is very high in _____ as well as TSS.
(A) pH
(B) Biochemical Oxygen Demand
(C) Fats
(D) Salts

456.33N. Which of the following forms of phosphorus are not available in wastewater?
(A) Lypophosphate
(B) Orthophosphate
(C) Organic phosphorus
(D) Polyphosphate

457.44MP. The total dynamic head against which a pump must operate:
(A) Is the sum of the static head and the head due to friction loss.
(B) Is the friction head.
(C) Is the static head.
(D) Must always be above the shutoff head.

458.40S. In lime stabilization of sludge the goal is to raise the pH to what level and hold it there for 2 hours?
(A) pH 8
(B) pH 10
(C) pH 12

459.92G. Rain or storm water that enters the sewer system through french drains, roof drains or similar sources is called what?
(A) Surging
(B) Inflow
(C) Infiltration
(D) Outflow

460.22S. Precipitation of magnesium ammonium phosphate in a digester is called _____.
(A) Stalactite
(B) Bauxite
(C) Struvite
(D) Calcite

461.24D. Which of the following conditions increases chlorine demand?
(A) Increase in organic matter
(B) Increase in alkalinity
(C) Increase in phosphate concentration
(D) Decrease in pH

462.34D. Ultraviolet light at a wavelength of ___nm has the ability to kill microorganisms without significantly altering the physical and chemical properties of the wastewater effluent.
(A) 415
(B) 254
(C) 125
(D) 440

463.4S. Which mechanical dewatering device operates in one of two modes; either countercurrent or continuous concurrent?
(A) Bowl centrifuge
(B) vacuum filter
(C) Belt filter press
(D) Scroll centrifuge

464.39MW. Some shops use sodium hydrosulfite for manual addition of chemicals to reduce hexavalent chromium. The advantage to this approach is that
(A) Sodium hydrosulfite is more efficient for continuous processes
(B) The resulting metal sludge is less toxic
(C) The reaction takes place at pH 4 instead of 2
(D) Sodium hydosulfite is much less expensive than sodium bisulfite

465.8G. The ash content is the same as the:
(A) Organic solids
(B) Volatile solids
(C) Difference in raw sludge after air drying
(D) Inorganic solids

466.4M. If two pumps will pump 120 gpm each, how long will it take to fill a tank 50' long, 20' wide, and 8' deep?
(A) 4 hours, 9 minutes
(B) 2 hours, 27 minutes
(C) 4 hours, 42 minutes
(D) 1 hour, 49 minutes

467.9N. This concentration of nitrite is typical for a wastewater treatment plant effluent.
(A) 5-10 mg/L NO2-N
(B) >10 mg/L NO2-N
(C) <0.5 mg/L NO2-N
(D) 1-3 mg/L NO2-N

468.3IN. When a large volume or high concentration of waste arrives in a short period of time, it is referred to as this type of load.

_____

469.36C. Metal sludge wastes may be dewatered by: Check all that apply.
(A) Vacuum filters
(B) Precipitation
(C) Incineration
(D) Plate and frame filter presses
(E) Belt presses

470.12MP. Friction in a pipeline causes:
(A) Overheating
(B) Aeration
(C) Loss of pressure
(D) Corrosion

471.74G. The growth of this organism is associated with longer SRT's, warmer temperatures, and high levels of grease, oil, and fat.
(A) Rotifers
(B) Type 21N
(C) Nocardia
(D) Bristleworms (Aeolosomas)

472.28R. In a lift station, oxygen deficiency in the atmosphere may be overcome by
(A) Lowering the temperature in the lift station
(B) Not overloading the pumps
(C) Providing adequate ventilation
(D) Increasing motor speed
(E) Sealing the vents

473.75L. Alkalinity is titrated to the Bromo cresol green methyl red indicator endpoint which is equivalent to this pH.
(A) 6.5
(B) 5.5
(C) 3.0
(D) 4.5

474.79A. Which of the following terms describes an activated sludge process mode in which aeration and clarification occur in the same tank?
(A) Step-feed system
(B) Sequencing batch reactor
(C) Complete-mix reactor
(D) Plug flow system

475.5D. _____ = flow, mgd x chlorine dosage, mg/L x 8.34 lb/gal.

_____

476.51G. The arrival at a plant of a waste which is toxic to organisms in sufficient quantity or strength to cause operating problems is called a _____ _____.
(A) Max day load
(B) Pretreatment violation
(C) Job security
(D) Shock load

477.73MP. Which of the following indicates that the impeller of a centrifugal pump may be worn or damaged?
(A) Pump is delivering too much flow
(B) Impeller speed is too low
(C) Pump is very cold
(D) Pump is not delivering the design flow

478.154G. The time it takes for a unit volume of wastewater to pass entirely through a primary clarifier is called
(A) Hydraulic loading rate
(B) Overflow time
(C) Detention time
(D) Weir loading rate

479.32R. Gas detectors used to test confined spaces should be “zeroed” at the edge of the manhole prior to entry.
(A) False
(B) True

480.54MP. 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) Dynamic head
(B) Velocity head
(C) Static head
(D) Discharge head

481.98G. In the wastewater field, mg/L and ppm are considered to be equivalent units.
(A) False
(B) True

482.1L. In the membrane filter method, the number of coliforms is estimated by the:
(A) Number of colonies grown
(B) Sum of positive and negative tubes
(C) Number of positive tubes
(D) Number of negative tubes

483.5L. Total solids can be divided into suspended solids and _____ solids.
(A) Dissolved
(B) Settleable
(C) Colloidal

484.64L. The blank plate for a fecal coliform test should have this many colonies growing on it.
(A) Zero
(B) Less than 20
(C) Less than 2
(D) Less than 10

485.6R. Sewer use ordinances are a mechanism used by municipalities to
(A) Assess sewer service charges
(B) Conduct inspections of industrial facilities
(C) Gather data base information about industrial dischargers
(D) Issue NPDES permits
(E) Prevent direct discharges of wastestreams to the environment
(F) All of these answers are correct

486.32C. Safety hazards that operators of metal waste treatment processes can be exposed to include all of the following.
(A) Chlorine gas
(B) Toxic sludges
(C) Cyanide gas
(D) Highly acidic and basic liquids
(E) Carbon dioxide

487.39N. With respect to natural systems, this element is most often the one that limits the growth of algae and other organisms.
(A) Iron
(B) Nitrogen
(C) Phosphorus
(D) Potassium
(E) Magnesium

488.113G. The maximum velocity a venturi flowmeter can measure is
(A) 1 ft/s
(B) 10 m/s
(C) 10 in/s
(D) 10 ft/s

489.41A. For most domestic wastewater, nitrification will increase the required oxygen supply and power requirements by __ to __ % of that required for carbonaceous BOD removal.
(A) 20 - 30
(B) 30 - 40
(C) 40 - 50
(D) 10 - 20

490.4D. For dechlorination 1 mg/L of SO2 is required for every _____ mg/L of chlorine residual to be removed.
(A) 1.5 mg/L
(B) 0.5 mg/L
(C) 2.0 mg/L
(D) 1 mg/L

491.3G. If your effluent turbidity changed from 200 NTU to 500 NTU and you do not want to change the pH, what chemical would you use?
(A) Ferric chloride
(B) Polymer
(C) Alum
(D) Sodium aluminate

492.83A. Healthy mixed liquor in an activated sludge process should have what appearance?
(A) Black with a gray foam
(B) Light brown and frothy
(C) Gray with no foam of any kind
(D) Dark brown, covered with a greasy tan foam

493.147G. A wastewater dissolved oxygen concentration greater than 1.0 mg/l usually ensures that hydrogen sulfide odors will not be released from a sewer line.
(A) True
(B) False

494.9M. What is the average detention time in a clarifier given the following: diameter = 30' depth = 15' flow = 700 gpm
(A) 1hr. 53min.
(B) 1hr. 47min.
(C) 1hr. 34min.

495.31L. The acronym RPD stands for what?
(A) Relative Percentile Differential
(B) Random Percentile Decay
(C) Relative Percent Decay
(D) Relative Percent Difference

496.12A. Given the following, determine the solids retention time (SRT) in days. Aeration tank volume = 1 MG, Final clarifier volume = 0.5 MG, Influent flow = 4.0 MGD, WAS flow= 75,000 gpd, MLSS= 2400 mg/L, Waste sludge TSS = 6200 mg/L, Final effluent TSS = 12 mg/L,
(A) 4.5 days
(B) 7.2 days
(C) 3.1 days
(D) 5.2 days

497.69L. E. Coli results must always be higher or lower than fecal coliform results?
(A) Lower
(B) Higher

498.1C. Cyanide toxicity in humans is caused by
(A) Cyanide gas displaces the available oxygen in the room resulting in death by asphyxiation
(B) Complexing of cyanide with the iron in hemoglobin resulting in death by asphyxiation
(C) Long term exposure to cyanide causes cancer
(D) Cyanide is a potent cardio toxin and can cause sudden heart attacks

499.6S. In a gravity thickener gravitational forces are used to thicken solids. What forces are used by a centrifuge?
(A) Gravitational forces
(B) centrifugal forces
(C) Sedimentation forces
(D) Mechanical pressure forces

500.3N. Nitrosomonas & Nitrobacter are _____ _____, needing oxygen to survive.
(A) Finicky aerobes
(B) Facultative aerobes
(C) Obligate aerobes
(D) Aerobic bacteria

501.10A. Which microorganisms are most responsible for stabilization of organic material?
(A) Bacteria
(B) Stalked ciliates
(C) Rotifers
(D) Nematodes

502.21N. Recycle ratios of up to _____ % are necessary to achieve total inorganic nitrogen concentrations below 10 mg/L.
(A) 200%
(B) 400%
(C) 800%
(D) 100%

503.27N. Nitrobacter bacteria obtain their energy by oxidizing nitrite nitrogen to _____ nitrogen.
(A) Nitrate
(B) Nitrogen gas
(C) Ammonia
(D) Nitrite

504.11C. The chemical formula for sodium cyanate is:
(A) NaCN
(B) NaCnO
(C) NaCNO
(D) NaHCN

505.61D. Chloramines are ____?
(A) Combined chlorine
(B) Free chlorine
(C) Found in polluted water
(D) Enzymes

506.15S. A digester operated in a temperature range of 115-125 degrees F is in the _____ range
(A) Mesophilic
(B) Phsycrophilic
(C) Thermophilic

507.14R. Ten states' standards recommends that wet wells be continuosly ventilated at a rate of ___ air changes per hour, or ___ air changes per hour if ventilation is intermittent.
(A) 10, 20
(B) 5, 12
(C) 12, 30
(D) 16, 24

508.109L. Calculate the percentage of total solids, given the following data. Empty weight of dish = 30.75 g, Dish + wet sample weight = 55.15 g, Dish + dry sample weight = 31.89 g.
(A) 23.26%
(B) 1.14%
(C) 4.67%
(D) 11.56%

509.58L. To ensure that the maximum possible BOD result was obtained, at least this much dissolved oxygen must remain in the BOD bottle at the end of the five day test.
(A) 1.0 mg/L
(B) 0.5 mg/L
(C) 2.0 mg/L
(D) 0.2 mg/L

510.93L. Phosphorus results may be reported as _____ or _____. They differ by a factor of nearly 3.
(A) PO4-P or P
(B) Polyphosphate or ortho-phosphate
(C) P or ortho-phosphate
(D) Total phosphate or ortho-phosphate

511.38S. Anaerobic digester ammonia concentrations greater than 3000 mg/l are considered what?
(A) Toxic
(B) Normal
(C) Below Average

512.39M. If the sewer rate is $5.50 for the first 500 cu ft and all wastewater generated over the minimum is billed at a rate of $0.25 per 100 cu ft, how much would a customer generating 1200 cu ft be billed?
(A) $6.25
(B) $6.75
(C) $7.25
(D) $5.25

513.1A. Which one of these is not a modification of the activated sludge process.
(A) Contact stabilization
(B) Step feed
(C) Trickling Filter/Solids Contact
(D) High rate aeration
(E) Conventional
(F) Oxidation ditch

514.41IN. Categorical regulations apply to
(A) Dischargers to surface waters only
(B) Specific pollutants
(C) All industrial dischargers to POTWs
(D) Specific industrial groups

515.65R. If your 1 ton chlorine cylinder is leaking, what type of Chlorine Institute repair kit should be used?
(A) C
(B) B
(C) D
(D) A

516.85S. In order to maintain the temperature needed for anaerobic digestion, the sludge is typically pumped through a _____.
(A) Heat exchanger
(B) Cold-water bath
(C) Open channel
(D) Furnace

517.136G. The purpose of racks or screens is to remove which of the following?
(A) Grit particles
(B) Dissolved solids
(C) Settleable solids
(D) Large solids

518.2L. When conducting the fecal coliform membrane test, count all the colonies that are _____ in color.
(A) Red
(B) Orange
(C) Yellow
(D) Blue

519.64D. Name the two forms of hypochlorite (in alphabetical order) used for disinfection:

_____

520.58D. Which of the following methods is not used to determine chlorine residual?
(A) Photometric
(B) Iodometric
(C) Titrimetric
(D) Amperometric

521.107S. Gassification in gravity thickeners may be caused by all of the following. Check all that apply.
(A) Excessive solids retention time
(B) Vertical pickets moving too quickly
(C) Temperatures below 10oC
(D) Septic feed

522.126G. Which of the following is not a basic backflow prevention device?
(A) Reduced pressure principle device
(B) Corporation stop
(C) None of these answers are correct
(D) Double check-valve assembly

523.11MW. Cyanide must be removed from a wastestream before metal precipitation can be done for this reason:
(A) The chemicals used for metals removal can result in the generation of cyanide gas
(B) Metals that are co-precipitated with cyanide cannot be recycled or purified further
(C) Cyanide interferes with the precipitation processes' ability to remove the dissolved metals

524.31D. Unlike chlorine, UV does not leave what in treated water?
(A) Residual
(B) Dose
(C) Fecal coliforms
(D) Total suspended solids

525.40N. What form of phosphorus is the easiest to chemically precipitate?
(A) Orthophosphates
(B) Organic phosphorus compounds
(C) Polyphosphates

526.124L. Coliform bacteria and the procedures used to test for them are divided into the two categories of _____.
(A) LTB and BGB
(B) MF and MTF
(C) M-Endo and M-FC
(D) Total and fecal coliforms

527.17M. If chlorine costs $0.21/lb, what is the daily cost to chlorinate a 5 MGD flow rate at a chlorine dosage of 2.6 mg/l?
(A) $21.34
(B) $18.95
(C) $31.22
(D) $22.77

528.25S. The two major gasses found in digester gas are _____ and _____.
(A) Nitrogen and Methane
(B) Nitrogen and Carbon dioxide
(C) Methane and Carbon dioxide
(D) Methane and Carbon monoxide

529.137G. A device used to screen wastewater and cut up large solids is a
(A) Comminutor
(B) Bar cutter
(C) Imhoff emulsifier
(D) Screen-dicer

530.59M. Determine the percent of dissolved oxygen saturation in the receiving waters of an effluent discharge when the actual dissolved oxygen concentration is 8.2 mg/l and the saturation concentration of dissolved oxygen is 9.4 mg/l.
(A) 82%
(B) 94%
(C) 100%
(D) 87%

531.14L. _____ solids, extremely fine particles, will not settle from the liquid portion, but can usually be filtered from the liquid with a 0.45-um membrane filter.
(A) Colloidal
(B) Suspended
(C) Dissolved
(D) Settleable

532.88S. Secondary sludge, by definition, is produced by this type of process
(A) Biological
(B) Chemical
(C) Belt press
(D) Centrifuge

533.18S. The devices that set the minimum operating level on a floating cover are called_____.
(A) Stress pins
(B) Carmels
(C) Corbels
(D) Level indicators

534.65MP. Motor starters and breakers are usually located _____.
(A) In the control office
(B) At your local power utility
(C) In motor control centers (MCC)
(D) On each individual piece of equipment

535.12G. 9/5(degrees C) +32 = _____
(A) Fahrenheit
(B) Kelvin
(C) Celsius

536.45MP. The difference in water surface elevation between where the pump is pulling from and where it is discharging to is called the _____ head.
(A) Suction
(B) Static
(C) Dynamic
(D) Discharge

537.8FF. The rock in most trickle filters is placed:
(A) On system tile underdrains
(B) Directly in a concrete slab
(C) On a rubber tile floor
(D) Directly in the ground

538.51A. An operator examines mixed liquor through a microscope and sees red worms. These worms mean that the mixed liquor
(A) Contains young sludge
(B) Contains old sludge
(C) Is just right

539.23N. Nitrification consumes this many pounds of alkalinity for every pound of ammonia oxidized to nitrate.

_____

540.119G. The main difference between primary and secondary clarifiers is
(A) Detention period
(B) Type of outlet weir
(C) Flow distribution
(D) Overall dimension
(E) Solids density in the underflow

541.47IN. The purpose of air stripping in industrial wastewater treatment plants is to remove
(A) Volatile Organic Compounds
(B) Turbidity
(C) BOD
(D) Heavy Metals

542.12R. The acronym NPDES stands for National _____ _____ _____ _____.
(A) Pollutant discharge elimination service
(B) Pollutant discharge elimination system
(C) Permitted discharge elimination system
(D) Permitting for discharging effluent system

543.33IN. Metal finishing wastes are usually treated chemically rather than biologically because
(A) Chemical processes are less expensive.
(B) Few operators are needed.
(C) The contaminants are toxic to biological organisms.
(D) Wastestream volumes are relatively small.
(E) The contaminants are resistant to biological treatment.

544.77MP. What type of air filter would be preferable for a blower located in an area where there are very fine particles in the air?
(A) Hydrostatic
(B) Viscous impingement
(C) Electrostatic precipitators
(D) Dry barrier

545.36MW. The chemical formula for sulfurous acid is
(A) H2SO3
(B) H2SO4
(C) H2SO2*3H20
(D) H3SO3

546.103S. A gravity thickener has a clear layer of liquid over the sludge blanket, but pieces of sludge rising from the bottom of the thickener are being carried out over the weir. What is the most likely cause?
(A) Gassification
(B) Sludge withdrawal rate too high
(C) Chemical system inoperative
(D) Blanket depth too shallow

547.56R. Recommended personal hygiene practices to minimize the risk of being infected by wastewater pathogens include
(A) Washing your hands before the beginning of your shift
(B) Only rubbing your eyes while working if you are wearing impervious gloves
(C) Changing out of your work clothes and showering before leaving work
(D) Reading the material safety data sheets for all chemicals used at the plant

548.10G. Which of the following pH readings indicates an acidic wastewater?
(A) 12
(B) 7
(C) 3
(D) 9

549.62S. A jar test conducted on 1 liter of secondary sludge with 1.5% total solids requires 50 ml of a 0.10% solution of dry polymer for flocculation. Determine the polymer dosage in lb/ton of solids.
(A) 5.5
(B) 7.6
(C) 6.7

550.160G. It is important to regularly measure and record influent wastewater temperatures because _____.
(A) Flow measurement devices are very sensitive to temperature and must be recalibrated for different temperatures.
(B) Biological processes will slow as the temperature decreases; this may require process adjustme
(C) Disinfection is no longer needed at temperatures below 10 deg. C (50 deg. F).
(D) Chemical dosages must be recalculated depending on the temperature.

551.23MP. If packing is not maintained properly:
(A) Loss of suction will occur due to air entering the pump
(B) Cavitation damage will result
(C) Impeller will corrode
(D) Pump efficiency will increase

552.36MP. The manometer of an aeration blower inlet filter, which needs replacing if the pressure differential exceeds 2 inches of the water column, has a scale of 0 to 5 inches. The meniscus reads 1 inch of water column. The filter should be replaced.
(A) False
(B) True

553.73S. A device used on an anaerobic digester that allows air to enter the tank if solids are drawn out too rapidly or the level of solids changes suddenly in relation to the floating cover is called ___?
(A) Gate valve
(B) Check valve
(C) Vacuum breaker
(D) Comminutor

554.21M. How long must a grit chamber be to permit particle settling given the following: Flow velocity = 0.96 ft/sec, Water depth = 16", Particle settling rate = .075 ft/sec
(A) 17 ft.
(B) 22 ft.
(C) 19 ft.
(D) 18 ft.

555.22L. Both total and fecal coliforms are reported in units per 100 mL if the membrane filter technique is used, or as the _____ _____ _____ per 100 mL if the multiple tube method is used.

_____

556.47M. Given the following, what is the F/M ratio of this activated sludge process? Tank dimensions are 80 ft long x 20 ft wide x 12 ft deep. Average flow rate is 300 gpm. Plant influent BOD is 180 mg/l. Primary effluent BOD is 150 mg/l. MLSS is 1350 mg/l.
(A) 0.15
(B) 0.40
(C) 0.21
(D) 0.33

557.13R. What does SCBA stand for?
(A) Self contained breathing apparatus
(B) Self carried breathing appertunance
(C) Servicemen can't breath acetone
(D) Supplied-air containment breather apparatus

558.30MW. Practices which can help reduce the cost of treating metal wastestreams include all of the following:
(A) Good housekeeping
(B) Dilution of spills
(C) Wastestream segregation
(D) Water conservation
(E) Careful process control

559.17A. The majority of bacteria in activated sludge are:
(A) Strict aerobes
(B) Autotrophic
(C) Anaerobic
(D) Facultative

560.108G. Which of the following terms refers to the addition of chemicals to a sample in the field to prevent water quality indicators from changing before final measurements are performed?
(A) Titration
(B) Fixed
(C) Buffer
(D) Standardization

561.73M. A chemical feed pump has been rebuilt and must be calibrated for maximum pump rate. If it takes 1 hour and 15 minutes to fill a 10-ft X 5-ft X 10-ft rectangular tank, what is the maximum pump rate in gal/min?
(A) 67 gal/min
(B) 50 gal/min
(C) 45 gal/min

562.2IN. Dairy processing plants use these chemicals for their CIP. Check all that apply.
(A) Hydrochloric Acid
(B) Nitric Acid
(C) Sulfuric Acid
(D) Sodium Hydroxide
(E) Phosphoric Acid
(F) Calcium Phosphatase

563.7M. The diameter of a wet well is 10 ft. If filled to a depth of 10 ft. It will contain approximately:
(A) 10,602 gal.
(B) 6024 gal.
(C) 5875 gal.
(D) 2987 gal.

564.24L. Name the interference substance for the COD test.
(A) Magnesium
(B) Copper sulfate
(C) Ferrous iron

565.50S. In an on-line treatment facility with three aerobic digesters in series, which of the following statements is false?
(A) Sludge pumped to digester 3 must be thicker than sludge pumped to digester 2, and the sludge pumped to digester 2 must be thicker than sludge pumped to digester 1.
(B) Dissolved oxygen levels will be easier to maintain in tank 3 than tank 1
(C) It is not necessary to aerate all three digesters
(D) Supernatant should be drawn off tanks 2 and 3 only

566.45R. It is permitted to use a five-minute air escape capsule for entry or rescue in a confined space.
(A) True
(B) False

567.8C. The maximum concentrations permitted for discharge for amenable and total cyanides are:
(A) 0.005 mg/L and 0.028 mg/L
(B) 0.65 mg/L and 1.2 mg/L
(C) 0.10 mg/L and 0.56 mg/L
(D) 0.05 mg/L and 0.28 mg/L

568.88G. What does TDS stand for?

_____

569.72L. This acid may be added to MFC plates to make them even more selective - a good idea fr samples with high numbers of bacteria.
(A) Rosalic acid
(B) Bacteriophage
(C) Eucerin
(D) Lactic acid

570.6FF. Trickling filter organic loadings are expressed in:
(A) lbs BOD/week/cubic ft
(B) lbs BOD/gal/100 cubic ft
(C) lbs BOD/cubic ft
(D) lbs BOD/day/1000 cubic ft

571.57D. Chlorine applied minus ____ equals chlorine residual
(A) Total chlorine
(B) Combined chlorine
(C) Chlorine demand
(D) Chlorine dose
(E) Free chlorine

572.92A. If an activated sludge reactor (aeration tank) uses coarse-bubble diffusers, the surface of the tank typically has what type of appearance?
(A) Calm
(B) Wave-like, splashing
(C) Mild, consistent agitation
(D) Turbulent, bubbling

573.7S. What is the purpose of the plows on a gravity thickener.
(A) To cultivate the soil
(B) To aid mixing
(C) To aid in water separation

574.9S. A solids plan that includes the entire sequence of processes, starting with the raw sludge and ending with final disposal or utilization is called what?
(A) Beneficial use of solids
(B) Residual solids disposal management plan
(C) Biosolids
(D) Residuals management plan

575.72G. When hiring a new operator, a supervisor should select;
(A) The person whose knowledge, skills, and abilities best match the demands of the job.
(B) The best communicator.
(C) The person with the lowest salary requirement.
(D) The person with the highest level of education.

576.111L. pH sensors consist of
(A) A junction electrode and null electrode
(B) A pH electrode and temperature electrode
(C) A glass electrode and reference electrode

577.29R. Hydrogen sulfide has a specific gravity of ___?
(A) 1.0
(B) 1.2
(C) 0.5
(D) 2.5

578.18FF. What is the purpose of the splash plate on a trickling filter?
(A) Distributes flow from orifices evenly over filter media
(B) Collects filter effluent before it flows to the next process
(C) Drains filter effluent to outlet box
(D) Conveys filter effluent to next treatment process

579.18MP. Valves should be closed slowly to prevent:
(A) Water hammer
(B) Excessive head loss
(C) Injury to operator
(D) Excessive wear

580.134G. One of the major purposes of grit removal is
(A) Odor control
(B) Solids thickening
(C) Equipment protection
(D) None of these answers are correct

581.46MW. When removing hexavalent chromium from wastewater with ion exchange, the wastewater is first passed through a cation exchanger for this reason
(A) To filter out large particulates
(B) To remove complexed metals that might interfere with the next step
(C) To remove any cyanide compounds that might interfere with the next step
(D) To remove other metals such as iron, copper, zinc, nickel, and trivalent chromium

582.129G. Weirs are most often used to measure flows in
(A) Pipelines
(B) Treatment plant headworks
(C) Open channels

583.22C. This silver cyanide complex precipitation product is preferred over the other because it is denser and therefore more easily removed from the wastewater.
(A) Silver oxide
(B) Silver chloride
(C) Silver cyanate
(D) Silver methacyrlate

584.75S. Which gas produced in anaerobic digesters can be used as fuel?
(A) Propane
(B) Carbon dioxide
(C) Ethane
(D) Methane

585.32G. The height of water above a point measured in either pounds per square inch or height is called _____.

_____

586.23D. Chlorine residual may be determined using the reagent:
(A) Polychlorinated biphenyls
(B) Ethylene diamine tetraacetic acid
(C) Sodium thiosulfate
(D) Diethyl-p-phenylene diamine

587.52D. Which of the following is a correct set of characteristics for chlorine as used in pollution control?
(A) Chlorine gas is greenish-yellow (amber) in color, flammable, and lighter than air
(B) Chlorine gas is colorless, flammable, and lighter than air
(C) Chlorine gas in greenish-yellow (amber) in color, toxic, lighter than air, and noncorrosive
(D) Chlorine gas is colorless, flammable, and heavier than air
(E) Chlorine gas is toxic, corrosive, and heavier than air

588.63S. What will not affect the vacuum produced in a vacuum filter system?
(A) A clogged silencer drain
(B) Seal water flow to the vacuum pump
(C) Poor filter pump performance
(D) Drum speed

589.14MP. In a centrifugal pump, leakage is prevented by
(A) Volutes
(B) Wear rings
(C) Impellers
(D) Sleeves

590.118G. Proportional weirs usually are located at
(A) Stilling wells
(B) Magnetic flowmeters
(C) Water treatment plants
(D) Aerobic digester scum boxes
(E) Grit chambers

591.135L. In the BOD test, which three parameters should be checked for each sample prior to setting up the test?
(A) Salinity
(B) pH
(C) Residual chlorine
(D) Temperature
(E) Conductivity
(F) Color

592.28M. How many lbs of chlorine gas are required to treat 4,000,000 gal of wastewater at a dosage of 2 mg/l
(A) 65
(B) 69
(C) 61
(D) 67

593.10D. Total and fecal coliform are pathogenic.
(A) False
(B) True

594.2MP. The discharge of a centrifugal pump:
(A) Increases with the increase of head
(B) Increases with the head increase only at the start of pumping
(C) Decreases with the increase of head
(D) Is independent of the head

595.26M. Approximately how many gallons would 600 ft of 6" pipe hold?
(A) 880
(B) 900
(C) 740
(D) 930

596.24N. Which is not a chemical used to precipitate phosphorus from a wastewater effluent?
(A) Ferric chloride
(B) Lime
(C) Sulfur dioxide
(D) Alum

597.1M. Find how many gallons of liquid are in a tank which measures 40' long, 25' wide and 12' high.
(A) 90272
(B) 67859
(C) 79872
(D) 89772

598.1D. Chlorine demand = _____ - chlorine residual.
(A) Breakpoint
(B) Dose
(C) Combined chlorine
(D) Free chlorine

599.77A. Conventional activated sludge systems typically operate with a DO range of
(A) 4-7 mg/l
(B) 0-1 mg/l
(C) 2-5 mg/l
(D) 7-9 mg/l

600.134L. Most DO probes come with an electronic zero for calibration. What should be used to check the accuracy of this feature on a DO probe?
(A) Fresh water
(B) Sodium sulfite solution
(C) Winkler DO test
(D) Septic sludge

601.24M. If water weighs 8.34 lbs/gal, how much will 7.5 gal weigh?
(A) 50.8 lbs
(B) 62.5 lbs
(C) 75.6 lbs.
(D) 77.3 lbs

602.3MW. Hexavalent chromium is reduced to the trivalent form most efficiently at this pH.
(A) 5.0
(B) 3.0
(C) 6.5
(D) 1.0

603.4MP. A pump is delivering at a less than expected rate of discharge. Which of the following possible causes is incorrect?
(A) Clogged impeller
(B) Motor speed too low
(C) Pump not primed
(D) Discharge head too low

604.13L. In the BOD test a bottle is filled with dilution water only and incubated. This sample should exhibit a DO depletion of no more than _____mg/l.
(A) 0.5 mg/l
(B) 0.2 mg/l
(C) 1.0 mg/L
(D) 2.0 mg/L

605.33C. pH is a critical factor in successful cyanide oxidation by chlorination because pH governs the
(A) Chemical addition and adjustment sequence
(B) Chlorine contact times
(C) End products that are formed
(D) Production of toxic cyanide gases
(E) Rate of chemical reactions
(F) All of the above.

606.26IN. Water use in the brewery industry is exceptionally high averaging _____ gallons of water for every gallon of beer produced.
(A) 1-3
(B) 5-10
(C) 10-15
(D) None of these answers is correct.

607.20IN. Of the three types of meat packing wastes, which are suitable for land disposal?
(A) Slaughterhouse waste
(B) Stockyard waste
(C) Meat Packing waste
(D) Packinghouse waste

608.28FF. Rotating biological contactors may be used for nitrification as well as BOD removal.
(A) False
(B) True

609.56D. If a 100-mgd flow of wastewater is dosed at a rate of 12 mg/l, what should the chlorine-feed setting be to the nearest 100 lb/d?
(A) 10,000
(B) 12,000
(C) 1200
(D) 1000

610.19S. Digester heat requirements include: heat required to _____ the temperature of incoming feed sludge to the operating temperature, and heat required to _____ the digester operating temperature.
(A) Raise, maintain
(B) Maintain, raise
(C) Lower, maintain

611.60A. Which of the following characteristics are associated with quality activated sludge?
(A) Brown color, no dissolved oxygen content, and good gas production
(B) Brown color, some dissolved oxygen content, and good settling
(C) Black color, very small particles that do not settle, and musty odor

612.35N. The two technologies for biological phosphorus removal are _____ stream and _____ stream.

_____

613.41G. The most critical criterion for determining when a mixed filter should be backwashed is:
(A) Head loss
(B) Filter effluent quality
(C) Visual inspection of the filter surface
(D) Flow rate

614.2A. Which of the following are not key factors in activated sludge nitrification? Check all that apply.
(A) Temperature
(B) DO
(C) Sunlight
(D) Alkalinity and pH
(E) TKN loading
(F) MCRT

615.78S. The safe application of biosolids to land requires the control of disease-causing organisms called _____ and _____, such as mosquitoes and flies, that may carry these organisms.
(A) Pathogens and vermin
(B) Vectors and pathogens
(C) Indicator organisms and vermin
(D) Pathogens and vectors

616.31FF. Kaldnes is one example of an IFAS. Ringlace is another. IFAS stands for:
(A) Integrated fixed-film aerobic sludge
(B) Integrated fixed-film activated sludge
(C) Inter-tank fixed media activated sludge
(D) Integral fixed-film activated solids

617.55G. The oxygen transfer efficiency of a surface aerator increases as the submergence of the aerator is decreased.
(A) False
(B) True

618.5C. These metal-cyanide complexes are considered to be amenable to oxidation by chlorination, however, longer reaction times are necessary.
(A) Gold
(B) Copper
(C) Zinc
(D) Silver
(E) Cadmium
(F) Nickel

619.49L. The statistical calculation done to determine the spread of a set of measurements is called the _____.
(A) Geometric Mean
(B) Standard Deviation
(C) Average
(D) Geometric Deviation

620.8MP. The main function of a lubricant is to keep moving materials separate from each other.
(A) True
(B) False

621.9L. _____ of _____ is a legal term for an unbroken sequence of possession from sample collection through analysis.

_____

622.14D. All chlorine cylinders are required to contain at least one fusible metal safety device designed to melt at between ___ to___ degrees F.
(A) 100-120
(B) 158-165
(C) 200-212
(D) none of the above

623.9MP. A possible cause of electric motor failure is?
(A) Friction
(B) Dirt
(C) All of these
(D) Moisture

624.44MW. This much hydraulic retention time is needed to precipitate Cr+3 with hydroxide at the optimum pH.
(A) 5 to 10 minutes
(B) At least one hour
(C) 20 to 40 minutes
(D) 10 to 20 minutes

625.74MP. A ground fault interrupter on an electrical circuit system is used to _____.
(A) Divert power to a new circuit if the present circuit is damaged
(B) Disconnect power from the circuit if there is a faulty ground line
(C) Provide an extra ground line for a circuit
(D) Interrupt repairs if the circuit is live

626.73L. Distilled water must be used for dilutions in most analyses to prevent this problem.
(A) False negatives
(B) Contamination
(C) Complexing of reagents
(D) Interference

627.71MP. How often should the scraper arms and blades of a circular clarifier be inspected and replaced, if necessary?
(A) Annually
(B) Quarterly
(C) Monthly
(D) Weekly

628.122L. Given the following information, calculate the BOD of this sample. Choose the best answer. Initial sample DO = 8.5 mg/l, Final sample DO = 5.1 mg/l, Amount of sample used = 9 ml, Total sample volume = 300 ml
(A) 102 mg/l
(B) 85 mg/l
(C) 62 mg/L
(D) 113 mg/l

629.63L. Control charts allow us to look for _____ as well as out of limits conditions.

_____

630.57MP. When using a progressing cavity pump to pump sludge, in what condition must the pump intake be in order to insure safe operation?
(A) Submerged
(B) Hot
(C) Primed
(D) Dry

631.133L. Given the following data, determine the percent volatile suspended solids of this sample. Weight of dish = 21.01 g, Weight of dish and wet sample = 3.71 g, Weight of dish and dry sample = 21.48 g, Weight of dish and ash = 21.11 g
(A) 21%
(B) 52%
(C) 96%
(D) 79%

632.50A. MCRT refers to the average number of days that a "cell" remains in the activated sludge system.
(A) True
(B) False

633.55MW. Ion exchange is the process in which ions are exchanged for ions of the _____ charge from the solution in which the resin is submerged.
(A) Similar
(B) Positive
(C) Different
(D) Neutral
(E) Negative

634.129L. Coliform are used as indicator bacteria to verify the effectiveness of disinfection techniques because _____.
(A) They cause the worst diseases of any of the wastewater pathogens
(B) They are easier to detect and are harder to destroy than most pathogenic organisms
(C) They have a symbiotic relationship with pathogens; one cannot survive without the other.
(D) They are the most numerous of all wastewater pathogens

635.37M. Given the following data, calculate the average velocity in the channel. 2.5 ft wide channel, flow depth is 1.4 ft, flow rate is 7.2 MGD
(A) 32.2 ft/sec
(B) 1.2 ft.sec
(C) 3.2 ft/sec
(D) 11.2 ft/sec

636.63D. If chlorine costs $0.21/lb, what is the daily cost to chlorinate 5 mgd of wastewater to an initial concentration of 2.6 mg/l?
(A) $56.80
(B) $108.42
(C) $22.77
(D) $516.29

637.87S. Primary sludge includes solids that are removed from the wastewater
(A) By sedimentation tanks placed either before or after biological treatment processes
(B) Following a state caucus or other preliminary vote
(C) By sedimentation tanks following biological treatment processes
(D) By sedimentation tanks prior to biological treatment processes

638.7C. The average pretreatment limits for amenable and total cyanides are:
(A) 0.65 mg/L and 1.2 mg/L
(B) 0.005 mg/L and 0.028 mg/L
(C) 0.05 mg/L and 0.28 mg/L
(D) 0.10 mg/L and 0.56 mg/L

639.84A. A “dead” spot in an activated sludge biological reactor is typically identified visually as ____.
(A) An area where conditions are very calm and no mixing is taking place
(B) An area with only a small amount of foam on the surface
(C) An area with no foam on the surface
(D) An area where the sludge seems lighter than the rest of the reactor contents

640.90A. The typical range of suspended solids in domestic influent wastewater is _____.
(A) 700-900 mg/L
(B) 400-600 mg/L
(C) 1000-1200 mg/l
(D) 100-300 mg/L

641.123G. The term slaking refers to
(A) The addition of water to quick lime
(B) The production of a lime slurry of calcium hydroxide
(C) The addition of water to recalcined lime
(D) All of these answers are correct
(E) None of these answers are correct

642.31N. Chemical phosphorous removal can be accomplished by using either _____ or _____ salts.
(A) Magnesium or Aluminum
(B) Iron or Magnesium
(C) Aluminum or Iron
(D) Metal or Polymer

643.36N. In biological phosphorus removal processes, _____ is used as the oxygen source in the anaerobic zone.
(A) DO
(B) Nitrite
(C) CO2
(D) Nitrate
(E) None of the above

644.62M. A flow of 2500 gal/min is equal to how many million gallons per day?
(A) 5.0 mgd
(B) 2.5 mgd
(C) 3.6 mgd
(D) 7.2 mgd

645.75G. The solubility of air into water decreases with pressure.
(A) False
(B) True

646.35G. Convert 18 degrees Celsius to Fahrenheit
(A) 68.5
(B) 50
(C) 64

647.13FF. A trickling filter allows the flow to slowly trickle through a filtration bed in order to remove large particulates by screening them.
(A) False
(B) True

648.61S. Primary sludge usually is not
(A) Coarse and fibrous
(B) 40% to 80% volatile matter
(C) The same weight per unit volume of water.

649.47S. The primary purpose of a secondary digester is to
(A) Increase gas production
(B) None of these answers are correct
(C) Provide storage for detritus
(D) Stabilize volatile solids
(E) Allow for solids separation

650.40MW. There are several disadvantages to using sodium hydrosulfite to reduce hexavalent chromium. Check all that apply from the list below.
(A) It does not react with complexed hexavalent chromium.
(B) Sulfuric acid is not needed to lower the pH of the wastestream.
(C) It produces more chemical sludge than sulfur dioxide and sodium bisulfite.
(D) It is not suited to continuous processes and works well only for small batch processes.
(E) It is much more expensive than sulfur dioxide and sodium bisulfite.
(F) It is oxidized by air when stored in solution.

651.117G. The flow-through rate in grit channels is usually
(A) 20 seconds to 1 minute
(B) 2 ft/s
(C) 1 ft/s
(D) 30 days, depending on temperature
(E) None of these answers are correct

652.146G. When odors are emitted to the atmosphere, the area downwind of the release point that contains the odor is called the ____.
(A) Plume
(B) Eddie
(C) Wake
(D) Wind shear

653.5R. Toxic pollutants from industrial facilities must be controlled to prevent
(A) Contamination of POTW sludge
(B) Hazardous work conditions for collection system operators
(C) Inhibition of biological processes in a POTW
(D) Interference with the operation of a POTW
(E) Untreated pollutants from passing through a POTW
(F) All of these answers are correct

654.34A. The mixture of activated sludge and wastewater in the aeration tank is called what?
(A) Mixed liquor suspended solids
(B) Return activated sludge
(C) Waste activated sludge

655.1R. Toxic pollutants from industrial wastes must be controlled to prevent all of the following except
(A) Increased operational costs of the POTW receiving the waste
(B) Introduction of pollutants into a POTW that could interfere with its operation
(C) Contamination of POTW sludge which would limit its disposal practices or use
(D) Passage of untreated pollutants through a POTW which could result in NDPES permit violations

656.5FF. The tiny gnat sized fly found on a trickling filter is called the _____ fly.
(A) Bryozoa fly
(B) Psychoda
(C) Fauna
(D) Protochordata

657.37MW. The chemical formula for chromic acid is
(A) H3CrO2
(B) H2CrO4
(C) Cr2(OH)6

658.47L. The two basic types of samples are _____ and _____?

_____

659.82M. What is the average flow velocity in ft/sec in a 12-in diameter force main carrying a daily flow of 2.5 mgd?
(A) 18.85 ft/sec
(B) 18.0 ft/sec
(C) 4.9 ft/sec
(D) 5.3 ft/s

660.74A. Obligate aerobic bacteria can use free or combined oxygen.
(A) False
(B) True

661.2R. What is a sewer use ordinance?
(A) All of these answers are correct.
(B) Laws that control discharges of wastewater to the sewer system
(C) Laws that give authority to POTWs to require industrial pretreatment and to issue permits
(D) Laws that allow POTWs to conduct inspections of industrial users

662.78M. Feed solids to an anaerobic digester contain 80% volatile solids (VS) and the digested solids contain 50% VS. Compute the VS reduction.
(A) 23.1%
(B) 37.5%
(C) 40.0%
(D) 75.0%

663.81S. Typical components of grit removal systems include
(A) Comminutors
(B) Bar racks
(C) Belt presses
(D) Chain-and-flight scrapers

664.51S. Untreated sludge drawn from a primary sedimentation tank normally would contain 1000 to 3000 mg/l of settleable solids.
(A) False
(B) True

665.54M. A plastic float is dropped into a wastewater channel and is found to travel 10 feet in 4.2 seconds. The channel is 2.4 feet wide and is flowing 1.8 feet deep. Calculate the flow rate of this wastewater in cubic feet per second.
(A) 5.7 ft3/sec
(B) 1.0 ft3/sec
(C) 10.3 ft3/sec
(D) 4.2 ft3/sec
(E) 2.3 ft3/sec

666.3A. Secondary effluent clarity can be measured with a Secchi disc?
(A) True
(B) False

667.16N. Since nitrification is an acid generating process, it consumes _____.
(A) Alkalinity
(B) Chlorine
(C) pH units
(D) Biochemical oxygen demand

668.9IN. Wastewater from dairy processing plants usually has a BOD around _____, but can be as high as 10,000 mg/L.
(A) 100 mg/L
(B) 1,000 mg/L
(C) 5,000 mg/L
(D) 500 mg/L

669.26FF. When fixed film processes such as RBCs and trickling filters are placed after the secondary clarifiers, they are said to be this type of process:
(A) Nutrient removal
(B) Secondary
(C) Final
(D) Tertiary

670.156G. Which of the following is a typical piece of flow measuring equipment?
(A) Parshall flume
(B) Downward looking acoustic sensor
(C) Counterweighted float-level indicator
(D) Nephelometer

671.139G. The reverse-acting actuator on a control valve is pneumatic. The valve is 50% open. As you decrease the input signal to the valve, it opens 60%. The valve is functioning normally.
(A) True
(B) False

672.111G. Venturi flowmeters use differential pressure to measure flow. The high-pressure port is located on the throat of the Venturi.
(A) True
(B) False

673.69G. The best approach to complaints involving the operation of a wastewater plant is to:
(A) Never admit there is a problem or cause for the complaint
(B) Keep all persons except for operating personnel out
(C) Publicize the problem as much as possible
(D) Explain the problem and proposed solution and offer to conduct a tour of the plant for those complaining

674.36IN. Each chemical containment area should have a drain which diverts spills directly to the treatment facility.
(A) True
(B) False

675.62MP. What type of pump is typically used to feed ferric chloride for solids handling purposes?
(A) Progressing cavity pumps
(B) Metering pumps
(C) Gear pumps
(D) Rotary lobe pumps

676.3D. A total residual is also referred to as a _____ residual.
(A) Free
(B) Breakpoint
(C) Combined
(D) Dose

677.16D. In a conventional effluent chlorination system the chlorine residual measured is mostly in the form of _____.
(A) Free chlorine
(B) Tri-chloramine
(C) Mono-chloramine
(D) Di-chloramine

678.87L. Alkalinity and hardness are both analyzed by adding a known reagent to the sample. This process results in a _____ change.

_____

679.30A. Name the activated sludge process that uses 2 aeration tanks. One tank is for separate reaeration of the return sludge before it is permitted to flow to the other tank to mix with the primary effluent.
(A) Extended aeration
(B) Step feed
(C) Contact stabilization
(D) Side aeration

680.76MP. Which of the following is a likely benefit of a planned maintenance program?
(A) Extended equipment downtime
(B) Increased emergency repair efficiency
(C) Decreased health and safety violations
(D) Extended equipment “life”

681.42MP. Centrifugal pump parts include a(n)
(A) Rotor
(B) Piston
(C) Diaphragm
(D) Impeller

682.63A. Flow to secondary clarifiers after treatment in activated sludge aeration basins has been below the average design flow for several hours. Now flow to the clarifiers is greater than average design flow. No adjustment has been made either to waste sludge or RAS flow. Before flows increased, sludge blankets were consistently 10 ft deep below the clarifier surface. Given this information, what can be said about expected secondary clarifier effluent quality?
(A) Effluent quality will not change
(B) Effluent quality will improve
(C) None of these answers are correct
(D) Effluent quality will worsen

683.20D. Acids should never be added to chlorine solutions because they
(A) Decrease the disinfecting properties of chlorine
(B) Cause chlorine gas to be released
(C) Result in the formation of chlorine precipitate
(D) Corrode the solution tank

684.106G. There is a sudden drop in the dissolved oxygen level of a receiving stream downstream of the WWTP outfall. There is not a similar drop in the dissolved oxygen level upstream. This indicates a decrease in the plant's removal efficiency of biochemical oxygen demand.
(A) True
(B) False

685.40A. An activated sludge that settles poorly and has an SVI > 250 mL/g is described as what?
(A) Bulking
(B) Full of filaments
(C) Feathering
(D) Sliming

686.41L. BOD samples should be evaluated for these two parameters prior to setting up the analysis. Check all that apply.
(A) Total suspended solids
(B) Alkalinity
(C) Residual chlorine
(D) pH

687.25G. The cohesive force existing between particles of a fluid which causes the fluid to offer resistance to a relative sliding motion between particles is known as:
(A) Surface tension
(B) Van der Waals forces
(C) Viscosity
(D) Hydrogen bonding

688.68L. Select all of the qualities of an ideal indicator organism from the following list.
(A) More difficult to kill than target organism.
(B) Directly associated with target or pathogenic organism.
(C) Present in greater numbers.
(D) Pathogenic
(E) Not ubiquitous.
(F) Easy to analyze for.

689.95L. What test is not run on influent?
(A) pH
(B) Suspended solids
(C) Fecal coliform
(D) BOD

690.11N. It is advantageous to denitrify following nitrification as nearly half of this may be recovered.
(A) Suspended solids
(B) Nitrogen
(C) Alkalinity
(D) Phosphorus

691.120G. Which characteristic is least helpful when assessing the organic loading at a plant?
(A) Chemical oxygen demand
(B) Solids concentration
(C) pH
(D) Biochemical oxygen demand
(E) Nitrogen content

692.45D. In the process of UV disinfection, the final effluent is irradiated by light at a wavelength of
(A) 122 nm
(B) 377 nm
(C) 254 nm
(D) 486 nm

693.109G. Primary treatment units remove settleable solids from the wastewater stream through
(A) Gravity sedimentation
(B) Chemical addition
(C) Comminuting devices
(D) Biological treatment
(E) Biofiltration

694.70D. A chlorine injecter works by:
(A) Pumping liquid chlorine from the bottom of the cylinder into the wastewater
(B) Creating a vacuum that draws the chlorine out of the cylinder.
(C) Pumping gaseous chlorine from the top of the cylinder into the wastewater

695.73G. A ____ sample is a discrete sample that is collected manually.
(A) Flow proportional
(B) Grab
(C) Composite

696.51R. Which of the following provides safety information for potentially hazardous or toxic materials?
(A) MSDS
(B) CFR
(C) OSHA
(D) CERCLA

697.14IN. Screening is an essential pretreatment step for combined tannery wastes. It removes these substances and prevents clogging downstream.
(A) Hair and bits of hide
(B) Hair and Lime
(C) Hair, grit, and other large debris
(D) Lemon and Lime

698.5MW. Hexavalent chromium can be reduced to the trivalent form (Cr+3) using ferrous sulfate at a pH between 3.0 and 3.5. What is the correct ratio of ferrous sulfate to hexavalent chromium?
(A) 2.5 to 1
(B) 8 to 1
(C) 1 to 1
(D) 1.5 to 1

699.15A. For a conventional activated sludge plant the F:M ratio should be in the range of:
(A) 0.2 - 0.5
(B) 2.0 - 5.0
(C) 0.07 - 0.15
(D) 0.01 - 0.07

700.57A. Consider a conventional activated sludge treatment process with a desired F:M ratio of 0.8. If the plant flow is 5 mgd and BOD of the primary effluent is 150 mg/l, how many pounds of mixed liquor volatile suspended solids should be maintained in the aerator?
(A) 89587 lb
(B) 5402 lb
(C) 10,465 lb
(D) 7819 lb

701.89S. The quantity of sludge produced by a biological process depends on these factors. Check all that apply.
(A) Temperature
(B) Influent BOD concentration
(C) pH
(D) The amount of oxygen supplied
(E) Growth rate of bacteria
(F) Return sludge flow rate

702.4R. Under what conditions may an operator refuse to work with a hazardous substance?
(A) When the operator believes management is using the substance as a punishment
(B) When the operator is unfamiliar with the substance
(C) When the operator's employer has failed to provide or attempt to provide an MSDS sheet
(D) When the scheduled work time interferes with lunch or breaks

703.63M. Regardless of shape, 1 ac-ft of media in a trickle filter is equal to
(A) 33,000 ft3
(B) 43,560 ft3
(C) 55,560 ft3
(D) 77,840 ft3
(E) None of these answers are correct

704.22G. The adherence of a gas, liquid, or dissolved material on the surface of a solid is called:
(A) Absorption
(B) Adsorption
(C) Capillary action
(D) Surface tension

705.121G. Overloading a stabilization pond may lead to the loss of dissolved oxygen. One operation-oriented, short-term corrective measure is
(A) Adding Sodium nitrate
(B) Increasing the effluent weir height
(C) Decreasing the recirculation rate
(D) Building scum rafts
(E) Building a foam spray-system

706.42G. Treatment basin (tanks, clarifiers) drains:
(A) Must be lower than the receiving sump to allow for gravity flow out of the basin.
(B) Must be higher than the receiving sump to allow for gravity flow out of the basin.
(C) Need not be valved closed if the drain is higher than the receiving sump.
(D) Need not be maintained because it is faster to pump it out.

707.17N. How low does the influent sBOD to a trickling filter need to be for maximum nitrification rates?
(A) <10 mg/L
(B) <5 mg/L
(C) <50 mg/L
(D) <20 mg/L

708.82G. Destabilization of a sludge particle by decreasing the magnitude of the repulsive electrostatic interactions between particles is called what?
(A) Flocculation
(B) Sedimentation
(C) Coagulation
(D) Separation

709.28A. A 30 minute test for activated sludge that indicates a sludges settling characteristics is called a ___.
(A) Sludge volume index (SVI)
(B) Total suspended solids (TSS)
(C) Solids volume index (SVI)
(D) Bug hunt or microscopic exam

710.12L. _____ solids remain in liquid solution and are defined as the solids that will pass through a 0.45um membrane filter.
(A) Suspended
(B) Settleable
(C) Dissolved
(D) Colloidal

711.72S. A flotation thickener is best used for what type of solids?
(A) Primary
(B) Secondary

712.137L. In the BOD test, sample pHs should be within the range of 6.5 and 7.5, however, you aren't required to adjust the pH of a sample unless it falls outside of this range.
(A) pH below 6.0 or above 8.5
(B) pH below 4.0 or above 8.5
(C) pH below 6.0 or above 9.0
(D) You aren't required to adjust the pH.

713.53G. A thin plate with a hole in the middle used to measure flow is called _____.
(A) A pinhole weir
(B) An orifice plate
(C) A parshall flume
(D) A venturi restriction

714.49MW. When an anion exchanger used to remove chromium is regenerated, this compound is released
(A) Hexavalent chromium, Cr+6
(B) Sodium chromate, Na2CrO4
(C) Chromate ion, CrO4-2
(D) Chromic sulfate, CrSO4

715.43C. When an ion exchange resin loses its exchange capacity, the resin must be _____.
(A) Regenerated
(B) Thrown away
(C) Polished
(D) Exchanged

716.49G. A reduced level of respiration in which organisms break down compounds within their own cells to produce the oxygen they need is called _____.
(A) Endogenous Respiration
(B) Anoxic Respiration
(C) Aerobic Respiration
(D) Anaerobic Respiration

717.3R. Material Safety Data Sheets (MSDS) must contain the following information:
(A) CAS number, concentration, manufacturer name and address, and possible uses
(B) Chemical name, emergency procedures for spills, and necessary personal protective equipment
(C) Chemical name, manufacturer name, purchaser name, and disposal procedures
(D) Purchaser name, acute and chronic health effects, and storage requirements

718.67G. There are generally more limitations on authority the farther one:
(A) Descends
(B) Remains in the same position
(C) Moves horizontally
(D) Ascends

719.67M. What is the weir overflow rate of a 50-ft diameter clarifier if the daily plant flow is 1 mgd?
(A) 6021 gal/d per feet of weir
(B) 6369 gal/d per feet of weir
(C) 5840 gal/d per feet of weir
(D) 7458 gal/d per feet of weir

720.93A. What is a clear visual indication of a high F:M ratio (excessive loading/low biomass)?
(A) Stiff white foam
(B) Black foam
(C) Greasy dark tan foam
(D) Thick scummy dark foam

721.34N. What is the correct order of nitrification?
(A) Ammonium > Nitrite > Nitrate
(B) Nitrite > Ammonium > Nitrate
(C) Ammonium > Nitrate > Nitrite

722.64M. Process-unit efficiency can be determined if the operator knows
(A) None of these answers are correct
(B) Influent and effluent characteristics
(C) Loading and flow
(D) Length of the unit
(E) Pounds of solids removed

723.44R. To ensure a safe working atmosphere in a confined space you need a _____?
(A) Completed confined space entry permit
(B) Fan to provide ventilation
(C) Permission from immediate supervisor
(D) Canister respirator, gloves, and hard hat

724.13IN. Combined tannery wastes can average _____ mg/L of TSS and 1000 mg/L of BOD.
(A) 8,000 mg/L
(B) 20,000 mg/L
(C) 2,000 mg/L
(D) 500 mg/L

725.55MP. What is an air-gap device used for?
(A) Insulation
(B) To seal valves
(C) Backflow prevention
(D) To prime pumps

726.18D. Exhaust air from a chlorine tank room should be taken from where?
(A) Floor level
(B) Any location
(C) Near the entrance
(D) At the ceiling

727.55L. Solids are classified by their _____ and whether they are organic or inorganic.
(A) Drying temperature
(B) Size
(C) pH
(D) Seive rating

728.20G. Primary clarifiers are typically able to remove what % of suspended solids?
(A) 30-45%
(B) 90-95%
(C) 50-80%
(D) 40-60%

729.2MW. Hexavalent chromium can be reduced to the trivalent form (Cr+3) using sodium metabisulfite at a pH between 3.0 to 3.5 What is the correct ratio of sodium metabisulfite to hexavalent chromium?
(A) 1 to 1
(B) 1.5 to 1
(C) 3.5 to 1
(D) 8 to 1

730.41MP. Given the following data: wet well has increased flow because of rain; wet well unchanged at excessively high level; lead pump running; lag pump running; lead pump check valve lifting arm up; lag pump check valve lifting arm down; force main pressure remains at normal range for one pump; low-level pressure switch normal; high-level pressure switch normal; and electrical controls automatic. What is the most likely cause of the problem?
(A) Lag pump clogged
(B) Lead pump clogged
(C) Force main pressure too high
(D) Both pumps clogged

731.57MW. Regeneration flows from ion exchange columns may require one or more of these treatments prior to discharge into sewers
(A) pH adjustment
(B) Cooling
(C) Addition of a chelating agent
(D) Heating
(E) Removal of excess salts
(F) Removal of toxic substances

732.66A. Which of the following observations could indicate older activated sludge?
(A) Some rotifers and many community forms of stalked ciliates
(B) A large amount of free-swimming ciliates
(C) Filamentous bulking

733.124G. Bar screens must be cleaned frequently to prevent (choose the most correct answer)
(A) Excess head loss
(B) Dissolved oxygen depletion
(C) Solids from settling

734.62A. The amount of active biological mass in an aeration tank is best estimated by measuring
(A) Total suspended solids
(B) Dissolved organic matter
(C) Volatile acids
(D) Total volatile suspended solids
(E) Settleable solids

735.55M. What is the detention time in a stabilization pond if the influent flow rate is 0.785 MGD, the pond depth is 4.5 feet, and the pond covers 17 acres?
(A) 56 days
(B) 14 days
(C) 97 days
(D) 4.2 days
(E) 32 days

736.1G. "Uniformity coefficient" refers to:
(A) Measure of uniformity of filter media
(B) Quality of wastewater
(C) Running the test the same way each time
(D) Uniform floc formation

737.11A. A plant that is experiencing white foam on the aeration basins typically has a high MCRT.
(A) False
(B) True

738.26R. An atmosphere should be considered dangerous when oxygen content falls below ___%
(A) 19
(B) 20
(C) 21
(D) 25

739.60L. Control charting consists of _____ data and then _____ it on a graph.
(A) Collecting and Plotting
(B) Controlling and Tracking
(C) Controlling and Graphing
(D) Making up, Tracking

740.3MP. Cavitation is the formation and collapse of a gas pocket or bubble on the blade of a pump's impeller.
(A) False
(B) True

741.48G. A _____ is a device used to break the air stream from the blower system into fine bubbles in an aeration tank or reactor
(A) Diffuser
(B) Butterfly valve
(C) Sparger
(D) Screen

742.121L. What is the maximum recommended holding time for a sample that is to be analyzed for pH?
(A) 7 days
(B) 14 days
(C) 48 hours
(D) None; it must be analyzed immediately

743.3L. Given the following, calculate the BOD5 of an unseeded sample: Initial DO = 9.0 mg/L, Final DO = 5.0 mg/L, Bottle volume = 300 mL, Sample volume = 6.0 mL
(A) 225
(B) 150
(C) 175
(D) 200

744.20M. How many lbs/day of suspended solids are removed by a primary clarifier given the following: Flow rate = 2.7 MGD, Influent TSS = 230 mg/l, Primary effluent TSS = 110 mg/l
(A) 2702 lbs/day
(B) 3204 lbs/day
(C) 2683 lbs/day

745.60G. Disaster planning is:
(A) Having manuals ready so they can be read if a disaster occurs
(B) Something that, if properly done, will not need to be revised
(C) Useful in reducing confusion in the event of a disaster
(D) None of the above

746.13N. This common atmospheric gas is the end product of denitrification.
(A) Water vapor
(B) Nitrogen Gas
(C) Carbon Dioxide
(D) Oxygen

747.38A. When both oxygen and nitrate are absent the conditions are referred to as what?
(A) Anoxic
(B) Anaerobic
(C) Aerobic
(D) Oxic

748.32L. Interferences are substances in a sample that can cause false _____ and false _____

_____

749.40C. How many pounds of polymer are required to make up 250 gallons of 0.5 percent polymer solution?
(A) 10.4 lbs
(B) 1.04 lbs
(C) 1.3 lbs
(D) 15 lbs
(E) 6.6 lbs

750.27MP. What separates the impeller from the volute and prevents backflow in a centrifugal pump?
(A) Pump packing
(B) Wear rings
(C) Cross connection siphon
(D) Surge valve

751.11M. What is the weir overflow rate given the following: diameter = 80' flow = 5 MGD
(A) 995 gpd/ft
(B) 665 gpd/ft
(C) 1040 gpd/ft
(D) 19904 gpd/ft

752.70L. Fecal coliforms are incubated in a water bath at this temperature for 24 hours.
(A) 35.0 oC
(B) 103 oC
(C) 37.5 oC
(D) 44.5 oC

753.17MP. Why are check valves used in conjunction with centrifugal pumps?
(A) To prevent water in the discharge line from flowing back into the wetwell
(B) To regulate the rate of flow through the discharge pipe.
(C) To prevent water in the suction line from flowing back into the wetwell
(D) To equalize the pressure on both sides of the impeller

754.105L. The Winkler method is used to determine the level of ammonia.
(A) True
(B) False

755.16C. A lachrymator is a compound that causes a person to
(A) Fall asleep involuntarily
(B) Produce tears involuntarily
(C) Vomit
(D) Breathe rapidly

756.14G. Turbidity generally indicates the quantity of _____ material in a flow stream, particularly at low solids concentrations.
(A) Settleable
(B) Suspended
(C) Dispersed
(D) Colloidal
(E) Dissolved

757.43S. Organic, toxic, and hydraulic overloads are all causes of anaerobic digester failure. What is another cause?
(A) Gas buildup
(B) Excessive mixing
(C) Temperature stress
(D) Underaeration

758.29D. Sodium hypochlorite is manufactured by the reaction of gaseous or liquid chlorine with a solution of _____ _____ to produce a liquid containing NaOCl.
(A) Sea water
(B) Sodium perchlorate
(C) Sodium hydroxide
(D) Sodium cyanide

759.41S. In anaerobic digestion, tube in bath, tube in tube, and spiral plate are all types of what?
(A) Gas release valves
(B) Mixing devices
(C) Corbels
(D) Heat exchangers

760.12FF. Trickling filters and RBCs are _____ _____ processes. Activated sludge is a suspended growth process.

_____

761.40MP. A _____ is installed on pump discharge piping to prevent water from flowing back across a pump when it is off.
(A) Butterfly valve
(B) Backflow preventer
(C) Check valve
(D) Smaller diameter of piping

762.4A. In a conventional activated sludge process, how much oxygen is required per lb. of BOD removed?
(A) 0.8 to 1.2 lb oxygen /lb BOD
(B) 0.00 to 0.8 lb oxygen /lb BOD
(C) 1.2 to 2.0 lb oxygen /lb BOD

763.53S. Grit usually contains organic matter that decomposes and creates odors. To facilitate disposal without odor nuisance, the organic matter is removed through washing methods. A commonly used method is
(A) Vacuum filtration
(B) Elutriation
(C) Wet oxidation
(D) Aeration
(E) None of these answers are correct

764.54S. To prevent unsafe conditions, which flame trap assembly should be checked regularly for proper operation?
(A) The one between vacuum and pressure relief valves and digester cover
(B) The one after the sediment trap on the gas line from the digester
(C) The one at the waste gas burner
(D) The one before the boiler or furnace
(E) All of these answers are correct

765.36A. Most of the BOD that is removed during secondary treatment is consumed by what?
(A) Stalked ciliates
(B) Crawlers
(C) Bacteria
(D) Rotifers
(E) Free Swimmers

766.28S. If an anaerobic digester (100ft diameter by 20ft high) has 3' of grit on the bottom and 2' ft of scum on top, what fraction of the usable volume is lost?
(A) 25%
(B) 20%
(C) 50%
(D) Not enough data

767.33MW. The reduction rate for Cr+6 _____ with increasing pH.
(A) Increases
(B) Decreases
(C) Stays about the same

768.157G. What calibrated device developed for measuring flow in an open channel consists of a contracting length, a throat with a sill, and an expanding length?
(A) V-notch weir
(B) Magmeter
(C) Parshall flume
(D) Equalizing tank

769.122G. In tertiary treatment, activated carbon is used chiefly to remove
(A) Ammonia
(B) Organics
(C) Oxygen
(D) Minerals
(E) None of these answers are correct

770.15C. Cyanogen chloride, a gas which can escape from solution at pH<10, is classified as
(A) Lachrymator
(B) Toxic
(C) Asphyxiant
(D) Harmless

771.20N. For tertiary denitrification, this supplemental carbon source is often added.
(A) Corn syrup
(B) Dog food
(C) Beer
(D) Methanol

772.20FF. A two-stage trickling filtration system consists of:
(A) One filter with recirculation of secondary clarifier effluent to trickle filter influent
(B) Two filters used in parallel
(C) One filter with recirculation of filter effluent to filter influent for 100% of flow.
(D) One filter used without primary clarification
(E) Two filters used in series, either directly or with a clarifier in between

773.54D. Which of the following chemicals is not used in chlorination-dechlorination
(A) Ferrous chloride
(B) Sulfur dioxide
(C) Chlorine gas
(D) Sodium hypochlorite
(E) Chlorine dioxide

774.66MP. What is the first step in starting a pneumatic air injector?
(A) Close the discharge valve
(B) Hold down the counterweight system
(C) Close the air inlet valve
(D) Allow compressors to build required pressure

775.15D. Coliform bacteria are:
(A) More resistant to chlorination than pathogenic bacteria
(B) A group of pathogens causing hepatitis
(C) Less resistant to chlorination than pathogenic bacteria
(D) A group of pathogens causing cholera

776.83G. Racks, screens, communitors and grit removal are all examples of what type of treatment?

_____

777.92L. Phosphorus vials turn this color in the presence of phosphorus.
(A) Blue
(B) Red
(C) Yellow
(D) Violet

778.7MP. A straight ladder, when properly used, should have the base _____ from the supporting wall.
(A) 1/4 of its working length
(B) 5 ft
(C) 3 ft
(D) 1/4 of its length

779.158G. Magnetic flow meters work on which of the following principles of operation?
(A) Magnetic induction where voltage is generated in a magnetic field and converted to a velocity.
(B) The volume of water required to separate two magnets.
(C) The volume of water that can be moved by an electromagnet.
(D) The reduction in magnetic pull as the volume of water separates a magnet and plug.

780.48S. One reason that air should be excluded from anaerobic digesters is because
(A) Gas storage capacity is reduced
(B) Air mixed with gas produced in the digester could create an explosive combination
(C) Air interferes with aerobic bacteria action
(D) Harmful or pathogenic bacteria may be introduced with air
(E) None of these answers are correct

781.6N. The consumption of bicarbonate alkalinity by nitrifiers has the effect of raising the pH.
(A) False
(B) True

782.66S. Secondary sludge is more suitable for gravity thickening than primary sludge primarily because of its
(A) Bound Water
(B) Age
(C) Temperature

783.40L. To prevent measurement of nitrogenous oxygen demand, add this to the BOD bottle.
(A) Nitrification inhibitor
(B) Hydrochloric acid
(C) Seed solution
(D) Salt

784.34IN. In general, fuels and solvents are highly soluble in water and therefore are very difficult to remove.
(A) False
(B) True

785.38M. Calculate the percent volatile solids. 100mL of sample, crucible weight = 19.985 g, crucible + dry solids = 20.050 g, crucible plus ash = 20.006 g
(A) 33%
(B) 74%
(C) 50%
(D) 67%

786.85L. This is the special sugar that fecal coliform bacteria can metabolize.
(A) Fructose
(B) Rosalic acid
(C) Lactose
(D) Glucose

787.47D. In the application of chlorine for disinfection, which of the following is not normally an operational consideration?
(A) Mixing
(B) Contact time
(C) Dissolved oxygen
(D) pH
(E) None of these answers are correct

788.37MP. You need to increase the flow of biosolids to the digester from 100 to 175 gal/min. The biosolids pump has a capacity of 200 gal/min. When you open the butterfly valve to 100%, flow increases to only 125 gal/min. The most probable cause of the low flow is a malfunctioning valve operator.
(A) False
(B) True

789.68D. The chlorine demand at your plant suddenly increases significantly. This change is most likely due to _____.
(A) A sudden drop in ambient temperature
(B) Nitrification beginning to occur at the plant
(C) An industrial discharge upsetting the plant's pH balance
(D) Excessive mixing in the chlorine contact chamber

790.37A. Conditions in which oxygen is absent but nitrate is present are referred to as what?
(A) Anaerobic
(B) Anoxic
(C) Oxic
(D) Aerobic

791.70G. List one type of common management plan.

_____

792.100S. Gravity thickeners are typically operated with hydraulic loading rates in this range.
(A) 600 to 1000 gpd/sft
(B) 60 to 80 lbs/sft*day
(C) 400 to 800 gpd/sft
(D) 20 to 40 lbs/sft*day

793.82S. The mechanism used to remove dewatered sludge from the belt of a belt filter press is commonly referred to as a(n)
(A) Edge sensor
(B) Scum collector
(C) Doctor blade
(D) Pressure belt

794.18L. All those combinations of elements that do not include organic carbon are called what?
(A) Organics
(B) Alcohols
(C) Salts
(D) Inorganic

795.17MW. Sulfide precipitation may be used to directly precipitate hexavalent chromium.
(A) True
(B) False

796.37G. When organic wastes are discharged to receiving waters, oxygen is depleted by:
(A) Limestone rocks
(B) Ducks
(C) Algae during the day
(D) Bacteria

797.116L. Jar tests may be used to determine the optimum dosage of
(A) Polymer
(B) Oil and grease
(C) Biochemical oxygen demand
(D) Volatile acids

798.44N. This much methanol is needed for every mg/L of nitrate that must be denitrified to nitrogen gas. Assume no other carbon source is present.
(A) 1.90 mg/L
(B) 4.33 mg/L
(C) 3.57 mg/L
(D) 2.86 mg/L

799.81L. Duplicates should agree with their original samples by this margin.
(A) Plus or Minus 20% Relative Percent Difference
(B) Plus or Minus 10% Relative Percent Difference
(C) Plus or Minus 10%
(D) Plus or Minus 20%

800.2FF. What might cause a white filamentous growth in an RBC system, which will result in poor BOD removal efficiency?
(A) High pH in the wastewater
(B) Low BOD loading
(C) Septic wastewater
(D) Low pH in the wastewater

801.28N. An anoxic zone is primarily used to _____.
(A) Denitrify
(B) Remove BOD
(C) Nitrify
(D) Remove phosphorus

802.30FF. After a snowstorm, an operator notices patches of snow and ice on the top of their trickling filter. The proper course of action is to:
(A) Increase the ventilation or air flow to the filter.
(B) Do nothing. When the sun comes out, the incoming wastewater will melt the snow.
(C) Make a note of the covered areas because there may be blockages in the media below.
(D) Stop the rotation of the distributor arm and remove the snow as quickly as possible so that it doesn't crush the media.

803.70S. Natural gas mixing in an anaerobic digester due to rising gas bubbles and thermal convection currents is sufficient to ensure optimum process performance.
(A) True
(B) False

804.52S. For domestic wastewater, gas production in a well-operated anaerobic digester should be in the vicinity of
(A) 1 ft3/d of gas per pound of volatile matter destroyed
(B) 10 BTU per pound of dry solids at 70% solids
(C) 1 ft3/d of gas per capita
(D) 50 BTU/ft3
(E) All of these answers are correct

805.49IN. Oil removal from metal wastestreams can be achieved by
(A) Carbon adsorption
(B) Ion exchange
(C) Precipitation
(D) Skimming

806.33L. Quality control samples are analyzed for all of the following reasons EXCEPT:
(A) To boost the ego of the analyst.
(B) Determine if interferences are present.
(C) Check for Contamination
(D) Verify precision
(E) Verify accuracy

807.115G. Oxidation pond effluents are easily disinfected with chlorine because of the large amount of algae present.
(A) False
(B) True

808.22M. Determine the organic loading to an anaerobic digester given the following: Digester volume = 50,000 cubic feet, Feed sludge volume = 8000 lbs/day, %TS = 4.5%, %VS = 74%
(A) 0.11 lbs VS/cubic ft/day
(B) 0.05 lbs VS/cubic ft/day
(C) 0.08 lbs VS/cubic ft/day

809.37IN. The frequency of process monitoring should increase when abnormal indicators are present.
(A) False
(B) True

810.59D. The maximum rate for withdrawing gaseous chlorine from a 1-ton tank at room temperature is
(A) 15 lb/h
(B) 7 lb/h
(C) 10 lb/h
(D) 20 lb/h

811.27D. One ton chlorine cylinders:
(A) Have fusable plugs located at valves
(B) Must be stored in an upright position
(C) Remove liquid chlorine from the top valve
(D) Use the bottom valve only with chlorine evaporators

812.101S. Calculate the solids loading rate in ppd/sft for a gravity thickener given the following information: The thickener is 50 feet in diameter and 15 feet deep. Feed sludge contains 5% solids and enters at a flow rate of 130 gpm.
(A) 9.94 ppd/sft
(B) 45.3 ppd/sft
(C) 39.8 ppd/sft
(D) 35.7 ppd/sft

813.29S. What is the purpose of heating and mixing a primary digester?
(A) To keep methane gas in suspension
(B) To increase the digestion rate
(C) To prevent settling of grit onto the bottom of the tank possibly plugging the withdrawl line.
(D) To eliminate all oxygen present

814.50R. Oxygen deficiency becomes a concern when the oxygen level in a confined space is less than
(A) 28.5%
(B) 19.5%
(C) 25.5%
(D) 22.5%

815.7N. The reduction of nitrate ion to nitrogen gas by heterotrophic bacteria is called _____?
(A) Respiration
(B) Nitrification
(C) Anoxic zone
(D) Denitrification

816.34G. Which of the following is not an example of a flow measuring device?
(A) Weirs
(B) Magnetic meter
(C) Venturi
(D) Manometer
(E) Parshall flume

817.145G. The release of hydrogen sulfide in a sewer system can lead to manhole and crown corrosion because of hydrochloric acid formation.
(A) False
(B) True

818.39S. Besides the multiple-hearth incinerator what is the other most common type of sludge incinerator in the U.S.?
(A) Single-hearth
(B) Fluidized bed
(C) Compressed coal

819.37D. The amount of chlorine used per day from a 1 ton cylinder is normally determined by
(A) Pressure gauges
(B) Weighings
(C) Rotometers
(D) Chlorine residuals
(E) Ammonia equivalents

820.56MW. The biggest advantage to using ion exchange over chemical precipitation to remove metals is
(A) A specific metal ion can be recovered
(B) Operators don't have to handle corrosive chemicals
(C) All metal ions are recovered regardless of whether they are complexed
(D) The amount of sludge generated is much less

821.38D. In an ultraviolet (UV) system, solarization reduces the quartz sleeves' ability to transmit the necessary amount of UV radiation to the process.
(A) True
(B) False

822.50MP. A wet-well inlet has normal dry weather flow, but the wet well is empty with flow going directly to pump suction. The lead and lag pump are running, and both pumps' check-valve lifting arms are slightly above the closed position. The lead air compressor is running, and the low-level pressure switch is closed. Electrical controls are in automatic mode. What is the most likely cause of the lift station problem?
(A) A malfunctioning level control is causing pumps to run out of phase.
(B) A malfunctioning level control is causing pumps to run constantly.
(C) A malfunctioning level control is causing high wet-well levels.
(D) A malfunctioning level control is causing pressure switches to open too soon.

823.52IN. Which activated sludge process treats shock loads of dairy waste most efficiently?
(A) Conventional activated sludge
(B) Tapered aeration
(C) High-rate activated sludge
(D) Step feed

824.61R. Personnel should not work alone on energized equipment, for example, a magnetic starter, that operates at or above
(A) 240 V
(B) 60 V
(C) 480 V
(D) 120 V

825.8M. A sludge pump with a 6" bore and a 3" stroke pumps 60 cycles/minute. What is the pumping rate in gpm?
(A) 22.5 gpm
(B) 26.75 gpm
(C) 18 gpm

826.46S. Which of the following is not an example of a sludge stabilization method?
(A) Drying beds
(B) Lime
(C) Digestion
(D) Composting
(E) Heat drying

827.66D. At concentrations less than _____, chlorine gas is not detectable by the human sense of smell.
(A) 1 ppm
(B) 10 ppm
(C) 4 ppm
(D) 2 ppm

828.11S. The new federal sludge regulations require a 33 ft. separation distance from waters when land spreading.
(A) False
(B) True

829.51M. Determine the flow capacity of a pump in gpm if the pump lowers the wastewater in a six-foot square sump by 8 inches in 5 minutes.
(A) 430 gpm
(B) 92.4 gpm
(C) 35.9 gpm
(D) 179.5 gpm
(E) 57.6 gpm

830.31M. A settling basin 60' by 12' and 12' deep is used to treat a flow of 2.4 MGD. What is the detention time?
(A) 39 min.
(B) 1.1 hrs
(C) 15 min.
(D) 2.3 hrs

831.29MP. The ___ is the unit of electrical resistance; resistance to the flow of electrical current.
(A) Volt
(B) Ohm
(C) Ampere
(D) Watt

832.28MW. Advantages of the sulfide precipitation process for the removal of common metals include: Check all that apply.
(A) Most metal sulfides are more soluble than metal hydroxides and high pH.
(B) Very high metal removal efficiencies can be achieved.
(C) Toxic hydrogen sulfide is not produced in the process
(D) Both chromate and dichromate can be removed without preliminary reduction of hexavalent chromium to trivalent chromium.
(E) Most complexed metals can be precipitated

833.33D. The two qualities in a final effluent that most affect performance of ultraviolet disinfection system are UV transmission and _____.
(A) Voltage
(B) Suspended solids
(C) Temperature
(D) pH

834.39MP. The temperature indicator on a heat-transfer pump is mounted in a thermowell. The indicator needs to be replaced, but you cannot remove the indicator until the pump is out of service, locked out, and drained.
(A) True
(B) False

835.133G. The flow velocity of most grit removal systems is
(A) 1.0 ft/sec
(B) 5.0 ft/sec
(C) 2.5 ft/sec
(D) 0.50 ft/sec

836.52R The threshold limit value concentration for chlorine vapor is
(A) 0.5 ppm
(B) 1.0 ppm
(C) 0.1 ppm
(D) 0.3 ppm

837.45MW. Hexavalent chromium may be removed from waste streams using ion exchange. The first step of this process is to:
(A) Neutralize the pH of the wastewater
(B) Pass the wastewater through a cation exchanger
(C) Regenerate the ion exchange column
(D) Convert hexavalent chromium to the trivalent form

838.7R. CAS numbers identify
(A) Chemical analysis services
(B) Hazard levels of chemicals
(C) Abstract chemical reactions
(D) Specific chemical substances
(E) Reactivity levels of chemicals

839.65L. Generally, standard recoveries should be within +/- 10% of the true value. These limits apply to the BOD test.
(A) +/- 15%
(B) Standard? Who needs a standard for the BOD test?
(C) +/- 20%
(D) +/- 5%

840.20MP. In electrical circuits a(n) _____ is used to reduce voltage where needed.
(A) Voltmeter
(B) Thermal overload
(C) Transformer
(D) Ammeter

841.68MP. When planning to work on or near electrical equipment, be sure to always _____.
(A) Notify your electric power provider
(B) Remain grounded to metallic equipment
(C) Handle wires as necessary
(D) Lock and tag out the equipment

842.16FF. In a properly operating trickling filter plant, the final effluent commonly contains 1.25 to 2.0 mg/l of dissolved oxygen.
(A) True
(B) False

843.25N. The hydraulic loading for a phosphate stripper depends on the:
(A) pH of the wastewater being treated
(B) BOD loading of the unit
(C) Ability of the stripper to remain anaerobic
(D) Ability of the aerobic stripper to remain aerobic

844.5A. To lower the F:M ratio from 0.4 to 0.3 during the next week you should:
(A) Increase the WAS rate.
(B) Decrease the RAS rate.
(C) Decrease the WAS rate.
(D) Increase the RAS rate.

845.33G. A wall or plate placed in an open channel and used to measure flow:
(A) Baffle
(B) Weir
(C) Flume

846.54A. Which of the following is a modification of the activated sludge process?
(A) Rapid bloc system
(B) Contact stabilization
(C) Tapered aeration
(D) Kraus process
(E) All of these answers are correct

847.65D. After chlorine, what is the most common effluent wastewater disinfection technique or agent used in the US today?
(A) Ozone
(B) Ultraviolet radiation
(C) Chlorine dioxide
(D) Bromine chloride

848.11D. The least potent, but longest lasting form of chlorine residual is the _____ residual.

_____

849.30MP. The rate at which heat is produced is the _____ that the load dissipates.
(A) Resistance
(B) Current
(C) Voltage
(D) Power

850.16A. Denitrification in a final clarifier can cause clumps of sludge to rise to the surface. The sludge flocs attach to small sticky bubbles of _____ gas.
(A) Hydrogen sulfide
(B) Nitrogen
(C) Oxygen
(D) Oxygen
(E) Carbon dioxide

851.46D. Which of the following discharges would, in general, require the lowest chlorine dosage for adequate disinfection?
(A) Primary plant effluent
(B) Stabilization pond effluent
(C) Sand filter effluent
(D) Trickle filter plant effluent
(E) Activated sludge plant effluent

852.18A. A stiff white foam on the aeration tank indicates a:
(A) Young sludge
(B) Old sludge
(C) Surfactant dumping
(D) Washing day

853.72A. In an anoxic activated sludge process, oxygen for facultative bacteria is provided by nitrate-nit
(A) True
(B) False

854.118L. What chemical is added to an effluent fecal coliform sample to neutralize residual chlorine?
(A) Potassium chloride
(B) Sodium hydroxide
(C) Sodium azide
(D) Sodium thiosulfate

855.9R. When chlorine reacts with H2S gas, the H2S is
(A) Amplified and made worse
(B) Oxidized and made odorless
(C) Diluted
(D) Not affected by the chlorine

856.35A. A fill and draw activated sludge system in which aeration and clarification is achieved in the same tank is commonly referred to as what?
(A) Static Batch Reactor (SBR)
(B) Single Basin Activated Sludge (SBAS)
(C) Single Basin Extended Aeration (SBEA)
(D) Sequencing Batch Reactor (SBR)

857.69MP. What is your first course of action if you see a slow constant drip from a pump shaft packing seal?
(A) Change/adjust packing material
(B) Fill seal with more water as needed
(C) Loosen the gland nuts
(D) Make no adjustment

858.62R. Which of the following hazardous chemicals is a hydrocarbon?
(A) Phosphoric acid
(B) Sodium hydroxide
(C) Methane
(D) Ferric chloride

859.24S. In an anaerobic digester, gas production should be in the vicinity of ___ cu.ft per of gas/day per lb. of volatile matter destroyed.
(A) 10
(B) 8
(C) 15
(D) 12

860.64A. The following data describes conditions in a secondary clarifier tank: collector operating normally; drive mechanism alarm system functioning properly; collector speed (rev/min) normal; sedimentation tank level normal; discharge gates open; sludge depth in tank too low; RAS concentration too low. Select the problem that needs the most immediate attention
(A) None of these answers are correct
(B) Distribution of flow across the tank needs adjusting
(C) The RAS pumps are operating above normal speed
(D) Hydraulic load to sedimentation tank needs adjusting
(E) The untreated wastewater pump speed is below normal

861.138G. A caustic chemical pump has a pH controller for feed control. The controller needs to maintain a pH of 6.9. As the pH of the effluent discharge decreases, the speed of the pump decreases.
(A) True
(B) False

862.62D. How many pounds of chlorine will be used in one day if the flow is 700,000 gal/d and a uniform dose of 1.2 mg/l is applied?
(A) 70.1 lb
(B) 698.3 lb
(C) 7.0 lb
(D) 7005 lb

863.60M. The influent suspended solids concentration is 80 mg/l. The effluent suspended solids concentration is 20 mg/l. Calculate the treatment efficiency of the plant.
(A) 60%
(B) 40%
(C) 25%
(D) 75%

864.17IN. Pulp and paper wastes are difficult to treat biologically. Fortunately, most of the solids and a large fraction of the BOD can be removed by this method.
(A) Screening
(B) Grinding
(C) Aerating
(D) Settling

865.11IN. Tanning is the process of
(A) How am I supposed to know?
(B) Converting human skin into leather
(C) Converting animal hides into leather
(D) Beating insubordinate employees into submission

866.7D. In disinfection, compounds of organic or inorganic nitrogen and chlorine are called _____.
(A) Amino acids
(B) Chloramines
(C) Nitrosochlorides
(D) Chloroacetates

867.43D. Which of the following affects the UV system efficiency?
(A) Detention time
(B) Turbidity
(C) Water temperature
(D) pH

868.27M. Compute the lagoons detention time. Surface area = 6.0 acres, Average depth = 3.0 ft, Average daily flow = 0.25 MGD
(A) 24 days
(B) 8 days
(C) 29 days
(D) 3 days

869.2N. The optimum pH for nitrification is between.
(A) 7-8
(B) 7-9
(C) 4-6
(D) 8-9

870.90L. Total Kjeldahl Nitrogen includes these nitrogen species.
(A) Organically bound nitrogen, ammonia, and nitrate
(B) Organically bound nitrogen, nitrate, and nitrite
(C) Ammonia, nitrate, and nitrite
(D) Organically bound nitrogen and ammonia

871.39C. Determine the sulfonator setting for an industrial wastestream of 150 gpm that requires a sulfur dioxide dose of 12 mg/L
(A) 104 lbs/24 hr
(B) 2.6 lbs/24 hr
(C) 0.9 lbs/24 hr
(D) 60.4 lbs/24 hr
(E) 22.0 lbs/24 hr

872.20S. Digester gas is explosive at relatively low concentrations, approximately 1 volume of gas in as many as __ volumes of air.
(A) 10
(B) 15
(C) 5
(D) 20

873.42A. White, billowing foam on an aeration tank surface is an indication of an old, nitrifying sludge.
(A) True
(B) False

874.28G. A pound of water weighs_____lbs.
(A) None of the above
(B) 62.4
(C) 8.34
(D) 7.48

875.56S. For each pound of volatile solids digested in a properly operating digester, approximately how many cubic feet of gas are produced?
(A) 6 to 8 ft3
(B) 1.5 to 3.0 ft3
(C) 20 to 32 ft3
(D) 12 to 18 ft3
(E) 54 to 60 ft3

876.33R. Forklift accidents are particularly dangerous because of
(A) None of these answers are correct
(B) The tremendous weight of the forklift
(C) Forklift speed
(D) Toxic emissions generated by most forklifts

877.16L. A method of determining the possible toxic effects of a wastewater effluent to aquatic organisms, such as fathead minnows or daphnia, is called a _____.

_____

878.120L. What piece of laboratory glassware is used mainly to mix chemicals and measure approximate volumes?
(A) Beaker
(B) Buret
(C) Graduated cylinder
(D) Pipet

879.45M. A fluid with a specific gravity of 1.05 weighs _____ lb/gal.
(A) 8.7
(B) 7.2
(C) 8.5
(D) 8.4

880.25D. A malfunctioning gas chlorination system has normal gas pressure, no feed rate indicated on the rotometer, and no injector vacuum. What is the most likely cause of the problem?
(A) Pressure reducing valve diaphragm ruptured
(B) Gas line plugged
(C) Air leak upstream of the rotometer
(D) Injector clogged

881.29C. Oxidation of cyanide compounds with chlorine is a two step process. In the first step, _____ is converted to _____. In the second step, this compound is converted to sodium chloride, sodium hydroxide, carbon dioxide, and nitrogen gas.
(A) Cyanate, cyanide
(B) Cyanate, cyanuric acid
(C) Cyanide, cyanate
(D) Hypochlorous acid, chlorine gas

882.40D. The best cleaning solutions for a quartz sleeve are nitric acid and phosphoric acid.
(A) False
(B) True

883.110L. Some characteristics of water, such as pH and dissolved oxygen, change so quickly that they need to be measured immediately.
(A) True
(B) False

884.91G. Floats, ultrasonic devices and bubblers are all examples of what type of sensing equipment?

_____

885.21IN. Blood has the highest BOD of any liquid meat processing material at _____ mg/L.
(A) 25,000 mg/L
(B) 40,000 mg/L
(C) 4,000 mg/L
(D) 400,000 mg/L

886.36M. A 42" diameter pipe is flowing at a rate of 6.5 ft/sec. What is the flow rate in cu ft/sec?
(A) 17.86
(B) 62.50
(C) 35.71
(D) 521.25

887.39R. To prevent back injuries, follow all of these precautions
(A) Warm up before lifting
(B) Avoid being overweight
(C) Practice 12 ounce curls frequently
(D) Keep fit with exercise

888.49M. An activated sludge plant receives a flow rate of 2 MGD with a BOD of 240 mg/l. If the desired f/m ratio is 0.4 and the primary clarifiers remove about 30% of the influent BOD, how many pounds of MLVSS should be maintained in the process? Round to nearest unit.
(A) 7005 lbs
(B) 3503 lbs
(C) 4008 lbs
(D) 6000 lbs

889.54MW. The greatest limitation of using evaporation to recover precious metals is
(A) The length of time recovered
(B) The high energy cost
(C) The metal sludge generated requires additional processing
(D) The loss of precious metals to the atmosphere

890.71L. In the BOD test, the ring of water surrounding the stopper is referred to as the what?
(A) Overflow
(B) Standard leak
(C) Weep
(D) Water Seal

891.16MP. An air gap device is used to:
(A) Prevent excessive vibration in pipe joints
(B) Prevent cross connections
(C) Increase oxygen content in manholes
(D) Ventilate manholes

892.41D. Between 30% and 40% of the decrease in an ultraviolet disinfection lamp's output occurs during the first 7500 hours.
(A) False
(B) True

893.27G. A column of water 12" high and 1 square inch in surface area will produce a pressure of _____ lbs.
(A) 0.433 lbs
(B) 2.31 lbs
(C) 1.0 lb
(D) 62.4 lbs

894.30L. Select the two reasons why weirs are not good sampling locations.
(A) Wastewater is not well mixed at this point.
(B) Sampling from weirs can be extremely dangerous.
(C) Toxic gasses tend to build-up downstream of weirs.
(D) Solids collect upstream.
(E) Grease collects downstream.

895.76L. This is the titrant used for the Hardness analysis.
(A) EDTA - A Chelating Agent
(B) 0.125 N Hydrochloric acid
(C) Sodium hydroxide
(D) 0.03 N Sulfuric acid

896.6D. 4 mg/l of chlorine is added continuously to a water flow that averages 5 MGD. How many lbs. chlorine will be used in 30 days?
(A) 5000 lb.
(B) 3000 lb.
(C) 1500 lb.
(D) 15000 lb.

897.90G. Chlorine, sodium hypochlorite and ultraviolet are commonly used in what wastewater treatment process?

_____

898.6MP. The casing surrounding a pump impeller that collects the water discharged by the impeller is called a _____.
(A) Backflow casing
(B) Volute
(C) Discharge
(D) Wear rings
(E) Impeller housing

899.12N. While nitrification is carried out by specialized autotrophic bacteria, denitrification can be done by a variety of these.
(A) Heterotrophs
(B) Coliforms
(C) Anaerobes
(D) Obligate aerobes

900.13S. Typical volatile acids concentrations in a anaerobic digester range from:
(A) 2000-5000mg/L
(B) 3000-4000mg/L
(C) 50-700mg/l
(D) 50-300mg/L

901.5S. What is a GBT?
(A) Gravity belt tool
(B) General bacteria totalizer
(C) Gravity belt thickener
(D) General belt thickener

902.51D. A treatment plant uses sulfur dioxide to dechlorinate effluent. An operator needs to adjust the sulfonator so that the dosing concentration is 1.5 mg/l more than the chlorine residual. Based on the following information, what should the sulfonator feed rate be: design flow = 5 mgd; chlorine dosage rate = 4 mg/l; chlorine residual = 0.9 mg/l
(A) 100 lb/d
(B) 267 lb/d
(C) 25 lb/d
(D) 167 lb/d

903.23G. A common equation for efficiency is: ((in - out) / in) * 100
(A) True
(B) False

904.113L. pH sensors measure the activity of which ion?
(A) Hydrogen
(B) Sodium
(C) Caustic
(D) Chlorine

905.68M. A 20-ft diameter clarifier with a depth of 8.25 ft receives a flow of 0.314 mgd. What is the detention time?
(A) 2.25 hours
(B) 1.48 hours
(C) 1.22 hours
(D) 1.75 hours

906.6L. Suspended solids, also referred to as filterable residue, represent the weight of solids remaining on a glass fiber filter following filtration and drying at ___ degrees C.
(A) 20
(B) 65
(C) 103
(D) 44.5

907.19MW. Which of these precipitation methods is the most efficient when a wastestream contains complexed metals?
(A) Ion exchange
(B) Hydroxide precipitation
(C) Acid precipitation
(D) Sulfide precipitation

908.29MW. Complexed metals are metals with a: Check all that apply.
(A) Molecular weights greater than 100
(B) Facility to form organic complexes
(C) High reaction rate with other metals
(D) Lower level of toxicity than most metals
(E) Tendency to remain in solution

909.16M. What is the pumping rate in gpm of the following piston pump? Diameter = 10 inches, Stroke length = 6 inches, Strokes/min = 30
(A) 45.5 gpm
(B) 61.2 gpm
(C) 86.9 gpm
(D) 293.6 gpm

910.32S. The liquid between the sludge on the bottom and the scum on the top of a non-mixed digester is called _____.
(A) Interstitial layer
(B) Supernatant
(C) Decant
(D) Subnatant

911.126L. What is the minimum number of pH standards needed for calibration of a pH meter?
(A) 1
(B) 4
(C) 2
(D) 3

912.94G. A bed of sand through which water is passed to remove fine suspended particles is called what?
(A) Secondary clarifier blanket
(B) Grit filter
(C) Sand filter
(D) Percolation pond

913.23R. When used to ventilate a manhole, a portable blower should be at least _____ ft away.
(A) 7.0
(B) 1.0
(C) 3.0
(D) 4.0

914.16MW. Sulfide precipitation can achieve lower metals concentrations in the final effluent than hydroxide precipitation.
(A) False
(B) True

915.52A. An operator examines mixed liquor through a microscope and sees dispersed floc with very little to no filamentous microorganisms. The operator can conclude that
(A) The aeration tanks may be organically overloaded and corrective action is required
(B) The sludge volume index (SVI) is probably low and settling characteristics are good
(C) A decrease in the return activated sludge rate is needed
(D) The activated sludge is operating properly

916.47A. What microscopic organisms will be present in a stable activated sludge process?
(A) Flagellate and amoeboid organisms
(B) Ciliates and rotifers
(C) Free-swimming and stalked ciliates, some flagellates and rotifers
(D) Flagellate and free-swimming ciliates, but no stalked
(E) Nemotodes, rotifers, ciliates flagellates, and amoeboids

917.4IN. This unit process consists of collecting uneven flows of wastewater in a large tank and then controlling the flow rate out of that tank and into the downstream wastewater treatment processes
(A) A wide spot in the line
(B) Flow equalization
(C) Complete mix
(D) Primary treatment
(E) Secondary Treatment

918.50MW. Cation exchangers used for chromium removal are regenerated with this chemical
(A) Sodium chloride
(B) Hydrochloric acid
(C) Sulfuric acid
(D) Sodium hydroxide

919.78A. The BOD loading rate divided by the quantity of microorganisms present in the biological reactors (aeration tanks) is known as
(A) Toxicity
(B) Food-to-microorganism ratio
(C) Organic loading
(D) Hydraulic loading

920.72MP. What type of in situ maintenance is recommended for most flexible membrane diffusers?
(A) Acid flushing
(B) Backwashing
(C) Exhaust heating
(D) Air bumping

921.148G. Which of the following chemicals is not used for odor control?
(A) Metal salts
(B) Chlorine compounds
(C) Sulfate salts
(D) Hydrogen peroxide
(E) Nitrate salts

922.45A. Because nitrifiers grow slower than other bacteria, sludge ages longer than ____ days are often needed.
(A) 0.5 days
(B) 5 days
(C) 15 days

923.101L. When reading the liquid level in a graduated cylinder, one should read from the bottom of the meniscus at eye level.
(A) False
(B) True

924.47R. The first step the maintenance staff should take in properly locking and tagging out a piece of equipment is to _____.
(A) Turn the equipment off at the motor control center (MCC)
(B) Alert the operator on duty
(C) Fill out the tags
(D) Pull the switch on the electrical panel to “off”

925.23S. Methane is odorless.
(A) False
(B) True

926.95S. The primary purpose of sludge thickening prior to processing is to reduce the volume of sludge that must be handled, processed, and disposed of.
(A) False
(B) True

927.25MP. Instrumentation friction disks or clutch surfaces should be:
(A) Frequently brushed with a solution of water and soda
(B) Oiled frequently
(C) Kept free of oil
(D) Roughened with emery cloth as necessary

928.15IN. This toxic metal compound is utilized in the tanning process.
(A) Chrome chloride
(B) Chromic sulfate
(C) Mercuric sulfate
(D) Mercuric chloride

929.162G. What is the primary operational concern for using a float-level indicator in an open channel?
(A) Solids, debris, or ice
(B) Turbulent flows
(C) Heavy flows
(D) The type of counterweight used

930.32MW. Strong reducing agents that may be used to convert Cr+6 to Cr+3 include all of the following:
(A) Potassium permanganate
(B) sodium hydroxide
(C) Sodium bisulfite
(D) Sodium metabilsulfite
(E) Sodium hydrosulfite
(F) Sulfur dioxide
(G) Ferrous sulfate

931.24MW. Wastewaters with a low pH can be neutralized by: There may be more than one correct answer. Check all that apply.
(A) Hydrochloric acid
(B) Caustic soda
(C) Sulfuric acid
(D) Calcium hydroxide
(E) Magnesium hydroxide

932.77G. 1 horsepower = .7457 _____.
(A) ft-lbs/sec.
(B) watts
(C) kilowatts
(D) ft-lbs/min

933.29FF. Before snails and filter flies can establish themselves in a trickling filter, this condition must exist.
(A) Organic overloading and excess biofilm growth
(B) Hydraulic overloading and ponding.
(C) Inadequate hydraulic loading and dry areas of media
(D) Inadequate organic loading and patchy biofilm development

934.110S. Besides gasification, this condition can result in rising solids in a gravity thickener.
(A) Sludge collection mechanism rotating too slowly
(B) Presence of phosphate accumulating organisms
(C) Sludge blanket too deep
(D) Excessive hydraulic loading rate

935.28D. In wastewater disinfection, hypochlorination refers to the use of _____ hypochlorite
(A) Magnesium
(B) Potassium
(C) Calcium
(D) Sodium

936.19MP. If a centrifugal pump loses its prime after starting, what is the most probable cause?
(A) Foreign matter in the impeller
(B) Speed to high
(C) Air leaks into the pump through stuffing boxes
(D) Air pocket in the discharge line

937.69D. Which pair of parameters is most typically used to adjust chlorine feed rates?
(A) Sulfur dioxide supply and chlorine supply
(B) Chlorine residual and wastewater flow
(C) Sulfur dioxide supply and flow rate
(D) Chlorine supply and temperature

938.141G. In what order will bacteria break down the following oxygen-containing compounds: sulfate, carbon dioxide, and nitrate. That is, what is the source of bound oxygen that requires the least amount of energy?
(A) Carbon dioxide > nitrate > sulfate
(B) Nitrate > carbon dioxide > sulfate
(C) Nitrate > sulfate > carbon dioxide
(D) Sulfate > nitrate > carbon dioxide

939.7IN. For a wastewater to be balanced and to not be nutrient limited, the BOD to N to P ratio should be what?
(A) 50 : 2.5 :1
(B) 100 : 5 : 1
(C) 100 : 2.5 : 1
(D) 100 : 5 : 2

940.25FF. Trickling filters may be used to remove all of the following from wastewater EXCEPT:
(A) Ammonia
(B) Nitrate
(C) Fecal coliforms
(D) Biochemical Oxygen Demand

941.22A. Considering the layout and flow diagram most oxidation ditch plants would be most similar to which of the following?
(A) Extended aeration
(B) Contact stabilization
(C) Completely mixed activated sludge
(D) Conventional activated sludge

942.42S. What is the most common cause of problems in the gas system or the equipment utilizing digester gas?
(A) Pilot light going out
(B) Leaks and explosions
(C) Excessive moisture
(D) Lack of moisture

943.13MP. Before repairing a pumps electrical circuit, which of the following actions should you take?
(A) Notify your supervisor
(B) Tell all of the operators not to activate the circuit.
(C) Disconnect the circuit breaker, place a red tag stating "do not activate", and lock out.
(D) Turn the pump off

944.106L. The amperometric titration method is used to measure residual chlorine.
(A) False
(B) True

945.19FF. Which of the following is the most probable cause of filter ponding?
(A) Poor filter ventilation
(B) Excessive organic loading
(C) Excessive hydraulic loading
(D) Hydraulic loading too low

946.41MW. After all of the Cr+6 has been converted to Cr+3, it can be precipitated at pH _____ with _____.
(A) pH 5-7, Sodium hydroxide
(B) pH > 12, Calcium hydroxide
(C) pH 5-7, Hydrochloric acid
(D) pH 8.0 - 8.5, Sodium hydroxide

947.21C. Silver cyanide complexes, when oxidized, can precipitate as either _____ or _____.
(A) Silver chloride or Silver oxide
(B) Silver hydroxide or Silver chloride
(C) Silver hydroxide or Silver oxide
(D) Silver cyanate or Silver chloride

948.36S. What is the typical organic loading rate for a well mixed and heated anaerobic digester in pounds of volatile solids per cubic foot per day?
(A) 0.05 - 0.10
(B) 0.4 - 0.8
(C) 0.8 - 1.2
(D) 0.1 - 0.4

949.74L. Calmagite turns blue in the absence of these ions.
(A) All carbonates
(B) Magnesium and Sodium
(C) Calcium and Magnesium
(D) Sodium and Calcium

950.23M. A cylindrical tank is 10 ft in diameter and 20 ft in height. What is the approximate capacity in liters?
(A) 4,445 liters
(B) 31,030 liters
(C) 5,942 liters
(D) 44,450 liters

951.19IN. Stockyard wastes are high in organic materials and high in nutrients.
(A) False
(B) True

952.159G. The temperature of wastewater that is being treated has the following effect on reaction rates of the microorganisms used in the treatment process:
(A) Reaction rates stay constant until they stop when temperatures exceed 20 deg. C (70 deg. F)
(B) Temperature has no effect on reaction rates when it is in the range of 5 deg. C (41 deg. F) to 30 deg. C (86 deg. F); outside of this range, all reaction rates go to zero.
(C) Reaction rates exponentially decrease for every 10 deg. C (18 deg. F) increase in temperature
(D) Reaction rates double with every 10 deg. C (18 deg. F) increase in temperature up to a level where high temperature inhibits biological activity

953.13D. Proper disinfection kills all organisms.
(A) False
(B) True

954.87G. A device used for quick, uniform dispersal of a chemical throughout a liquid is called a what?
(A) Chemical feeder
(B) Flash mixer
(C) Turbulence inducer
(D) Polymer thinner

955.98S. This factor does not contribute to gravity thickener performance
(A) Feed sludge temperature
(B) Solids and hydraulic loading rates
(C) Feed sludge age
(D) Blanket depth
(E) Feed sludge type
(F) Return sludge flow rate

956.27FF. Rotating biological contactors consists of multiple plates of support media that are attached to a central shaft. The rotation of this shaft moves the support media into and out of the wastewater.
(A) True
(B) False

957.80A. The predominance of which microorganisms is an indication of abnormal activated sludge process operation?
(A) Ciliates
(B) Bacteria
(C) Fungi
(D) Rotifers

958.25L. _____ is defined as the number of equivalents of solute dissolved in one liter of solution.
(A) Molarity
(B) Total dissolved solids
(C) Normality
(D) Solubility Limit

959.35M. A centrifugal pump is pumping 200 gpm against a 40 ft total pumping head. The output power of the pump is approximately _____ hp.
(A) 15
(B) 2
(C) 121
(D) 0.5

960.35R. Loudness, length of exposure, and distance from the noise source are factors in determining if a noise is hazardous enough to damage hearing.
(A) True
(B) False

961.43L. BOD values for the influent to a domestic wastewater plant are usually this fraction of the COD value.
(A) 0.50
(B) 0.67
(C) 0.35
(D) 0.80

962.14C. Sodium cyanate reacts with sodium hypochlorite to produce these two gasses in addition to sodium hydroxide, sodium chloride, and water.
(A) Carbon dioxide and nitrogen gas
(B) Carbon dioxide and methane
(C) Nitrogen gas and methane
(D) Nitrogen gas and oxygen

963.60D. As water temperatures decrease, the disinfecting action of chlorine
(A) Decreases
(B) Increases
(C) Remains the same

964.31MP. _____ is the relationship in time between two waveforms of the same frequency.
(A) Current
(B) Resistance
(C) Phase
(D) Voltage
(E) Amperage

965.25MW. The common metals usually treated in electroplating and metal finishing wastestreams are: There may be more than one correct answer. Check all that apply.
(A) Silver
(B) Lead
(C) Iron
(D) Zinc
(E) Cyanide

966.27C. When using an ORP meter to control the chlorine residual in a cyanide oxidation process, you should know that for every tenfold increase in chlorine concentration, the ORP potential increases by approximately _____ mV.
(A) 50 mV
(B) 75 mV
(C) 75 V
(D) 60 mV

967.17S. An ammonia concentration of 1500-3000 mg/L is _____ to a digester.
(A) No adverse effects
(B) Inhibitory at pH 7.4 to 7.6
(C) Beneficial
(D) Toxic

968.6A. An abundance of stalked ciliates in an activated sludge plant is preferred to an abundance of flagellated ciliates.
(A) False
(B) True

969.33S. Organic loading rates for a well-mixed and heated digester typically range between:
(A) 0.005 - 0.5 lbs VS/cu ft/day
(B) 0.1 - 0.4 lbs VS/cu ft/day
(C) 0.5 - 1.0 lbs VS/cu ft/day

970.105G. Anaerobic conditions have no effect on the pH of wastewater.
(A) True
(B) False

971.149G. Anaerobic and anoxic mean the same thing.
(A) True
(B) False

972.96A. What is the most effective way to solve a Nocardia foam problem in your activated sludge system?
(A) Spray the foam with a degreasing compound
(B) Decrease the MCRT (increase wasting), skim the foam off the surface and dispose of it
(C) Pump sodium chloride into your reactors (aeration tanks)
(D) Raise the pH of the wastewater to 10 or higher

973.59A. One of the greatest advantages of a complete-mix activated sludge system is
(A) The ability to design an aeration tank in any convenient shape or size to fit the available area
(B) The requirement for less air than in a conventional aeration system
(C) Its ability to absorb sudden shock loads without losing equilibrium

974.51IN. Groundwater contaminated with petroleum must meet many criteria to be accepted at a wastewater treatment plant, but at a minimum, it must have
(A) Concentration of less than 5 mg/l of petroleum products
(B) A closed cup flashpoint of less than 140 deg. F
(C) Oil and grease content of less than 15 mg/l

975.48IN. Breakthrough occurs when the
(A) Regulated contaminant can no longer be removed.
(B) Three-way valves cannot direct flows up or down.
(C) Carbon fines are found in the effluent.
(D) Fine mesh screens develop holes.

976.96S. Gravity thickeners consist of circular tanks with rotating pickets at the bottom. The pickets stick straight up through the sludge blanket from a rotating sludge rake. What is their primary purpose?
(A) To release trapped gas bubbles in the sludge.
(B) To help ensure a uniform concentration of sludge leaving the tank.
(C) To disperse added chemicals evenly.
(D) To prevent extra thick sludge from sticking to the bottom of the tank.

977.51MP. Pumps are often required to bring wastewater into a treatment plant. What types of pumps are typically used to lift influent wastewater?
(A) Positive displacement
(B) Centrifugal
(C) Progressing cavity
(D) Air-lift

978.29M. A single-piston reciprocating pump has a 6" diameter piston with a 6" length of stroke. It makes 16 discharge strokes/min, the pumping rate is _____gpm.
(A) 47
(B) 6
(C) 25
(D) 12

979.93G. Flow that enters the wastewater collection system through cracks and loose joints in the sewer line is called what?
(A) Infiltration
(B) Surging
(C) Outflow
(D) Inflow

980.106S. The overflow or effluent from a gravity thickener should contain less than _____ mg/L of total suspended solids.
(A) 500 mg/L
(B) 30 mg/L
(C) 100 mg/L
(D) 2000 mg/L

981.34C. Techniques used by electroplaters and metal finishers to remove oils from wastestreams include: Check all that apply.
(A) Centrifugation
(B) Emulsion breaking
(C) Flotation
(D) Reverse osmosis
(E) Skimming
(F) All of the above.

982.71A. Controlling the solids wasting rate by constant mixed liquor suspended solids concentration involves maintaining a certain concentration of
(A) Volatile suspended solids in the return sludge
(B) Volatile suspended solids in the aeration tank
(C) Volatile suspended solids in the waste sludge
(D) Suspended solids in the aeration tank

983.53D. A chlorine leak can be detected by
(A) Smell
(B) Green or reddish deposits on metal
(C) Waving an ammonia-soaked rag
(D) All of these answers are correct
(E) None of these answers are correct

984.30S. What is affected first when the anaerobic digestion process is starting to deteriorate?
(A) Temperature
(B) Volatile solids concentration
(C) Volatile acid:alkalinity ratio
(D) Supernatant quality

985.7L. The ___ test procedure provides a means of rapidly estimating the BOD sample. Its values are normally higher than the BOD values.

_____

986.56L. The BOD test is a bulk measurement of this.
(A) All biologically available organic matter in a sample.
(B) All of the organic matter in a sample.
(C) How much oxygen will be produced when the wastewater enters the receiving water.

987.22R. What document is intended to regulate discharges into waterways?
(A) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
(B) National Pollutant Discharge Elimination System (NPDES) Permit
(C) Material Safety Data Sheet (MSDS)
(D) Occupational Safety and Health Act.

988.5IN. Because dairy wastes contain a lot of floatable fats and greases, this unit process is often utilized as a pretreatment step.
(A) Ion exchange column
(B) Gravity thickening
(C) Chemical precipitation
(D) Scum skimmers
(E) Dissolved air floatation thickener

989.18C. When oxidizing cyanide compounds with chlorine, the ORP must be at _____ mV when the pH is at 9.5 SU.
(A) +700
(B) +650
(C) +550
(D) +400

990.8N. Biological phosphorus removal requires the presence of this type of chamber just ahead of the aeration basins.
(A) Stirred and not shaken
(B) Anaerobic
(C) Aerobic
(D) Anoxic

991.20L. What is the common name for commercial sodium carbonate?
(A) slaked lime
(B) baking soda
(C) soda ash
(D) lime

992.47MP. A centrifugal untreated wastewater pump starts pumping at 25 gal/min and has a maximum pumping capacity of 100 gal/min. A Venturi flowmeter can be used to measure flow from this pump.
(A) False
(B) True

993.69A. As the size of activated sludge floc particles increases, what relative levels of oxygen are needed to prevent filamentous organisms?
(A) Oxygen levels do not need adjusting
(B) Oxygen levels do not apply to floc particle increases
(C) Higher than current levels of dissolved oxygen

994.95A. A small area of dark gray/black sludge in an aeration tank can be due to aeration equipment failure or _____.
(A) Low BOD
(B) Absence of bacteria in that area
(C) The fact that mixing is too turbulent in that location
(D) The introduction of a septic sidestream

995.49MP. Wet well influent flow has increased because of rain and the level is rising. The lead and lag pumps are running. The lead pump check valve lifting arm is up; the lag pump check valve lifting arm is down. The force-main pressure remains at normal range for one pump. Low-level and high-level pressure switches are normal. Electrical controls are in automatic mode. What is the most likely cause of the problem?
(A) The lag pump is clogged
(B) The lead pump is clogged
(C) Both pumps are clogged
(D) The force-main pressure is too high

996.98A. What is typically the cause of a rolling, wave-like action in a mechanically aerated biological reactor (aeration tank)?
(A) Hydraulic surging
(B) Short-circuiting
(C) Increased MLSS temperature
(D) High flow

997.40IN. Explosions in sewers may be caused by the discharge of all of the following.
(A) Hexavalent chromium
(B) Methyl ethyl ketone
(C) Barium
(D) Acetic acid
(E) Hexane
(F) Gasoline

998.65G. Generally, as an individual progresses upward in management, reliance on personal technical skill:
(A) Remains the same
(B) Decreases
(C) Increases
(D) Becomes more complex

999.37L. Samples for TSS may be held for up to this many days prior to analysis if they are kept at 4oC.
(A) Seven
(B) Two
(C) Fourteen
(D) Twenty-one

1000153G. Large debris (sticks, rocks, etc.), large floating solids, and fibrous materials (rags, strings, cloth, etc.) are categorized as
(A) Screenings
(B) Grit
(C) Scum
(D) Floc

100133FF. A white or gray biomass on an RBC unit indicates ____?
(A) Filamentous bacteria dominance
(B) The unit is overloaded
(C) The biomass is freezing
(D) Unit start up

100210MW. Common metals can be removed from wastestreams by
(A) Precipitation with acid followed by filtration
(B) Sucking them out with a special straw
(C) Complexing the metals with cyanide
(D) Hydroxide precipitation or sulfide precipitation

10038R. The Threshold Limit Value (TLV) of a substance may be expressed as a
(A) Ceiling (C) exposure limit
(B) As either Ceiling or TWA
(C) Short-Term Exposure Limit (SEL)
(D) As TWA, SEL, or Ceiling
(E) Permissible Exposure Limit (PEL)
(F) Lower Exposure Limit (LEL)
(G) Time Weighted Average (TWA)

100476M. A potable water flowmeter reads 76 gal/min. What is the total flow, in gal/d?
(A) 14,085 gal/d
(B) 109,440 gal/d
(C) 633.8 gal/d
(D) 1824 gal/d

100543A. One pound of BOD was converted to 0.67 pounds of MLSS. The other 0.33 pounds became this.
(A) Exopolymer
(B) Energy for the growing cells
(C) Effluent suspended solids and BOD
(D) Carbon dioxide and water

100620C. When copper, nickel, and zinc cyanide complexes are oxidized, the metals precipitate out of solution in this form.
(A) Chlorides
(B) Oxides
(C) Hydroxides
(D) Cyanates

100741M. A rotating biological contactor treats a flow of 2.2 MGD with a BOD of 110 mg/L. The surface area of the media is 550,000 sq ft. What is the organic loading in lb BOD/day/1000 sq ft
(A) 2.7
(B) 3.7
(C) 3.0
(D) 3.5

100867A. Under which of the following conditions should you consider increasing the wasting rate?
(A) White, billowing foam on the aeration tank
(B) A sludge volume index of 175 and no filaments
(C) The sludge is dark brown with settled volume of 650 ml
(D) None of these answers are correct

100964MP. What is surging in a centrifugal blower?
(A) When the blower suddenly doubles its volume of flow for an extensive period
(B) When an excessive electrical charge develops from amperage draw
(C) When a clog in the system is expelled
(D) When the blower's discharge pressure is less than the aeration system's backpressure

10109MW. The following chemicals may be used to neutralize a highly alkaline wastewater
(A) Calcium hydroxide, sodium hydroxide, and sulfur dioxide
(B) Carbon dioxide, sulfuric acid, and calcium hydroxide
(C) Sulfuric acid, hydrochloric acid, and carbon dioxide

101133MP. During plant rounds, an operator notices a pump is spraying water from a packing gland. The operator should
(A) Turn off the seal water and continue running the pump
(B) Loosen the packing gland
(C) Tighten the packing gland until the spray is reduced to a small drip
(D) Do nothing

101280MP. How often should the packing on a gate valve be replaced?
(A) Annually
(B) Weekly
(C) As required
(D) Monthly

101335S. The washing of digested sludge with freshwater or plant effluent to reduce the fine particles or alkalinity in the sludge is called_____.
(A) Leaching
(B) Elutriation
(C) Extraction
(D) Tackification

10145N. In addition to oxygen, nitrifiers consume bicarbonate alkalinity and produce carbonic acid.
(A) True
(B) False

101522FF. A “rotten egg” odor near a trickling filter generally indicates
(A) Anaerobic conditions within the filter
(B) The clogging of distributor arm orifices
(C) The presence of the Psychoda fly
(D) A too-high DO level in wastewater being applied to the filter
(E) Too much recirculation

101641C. In ion exchange, a cation exchanger contains a resin with this type of charge
(A) Negative
(B) Positive
(C) Neutral

101718IN. Meat packing wastes include stockyard wastes, slaughterhouse wastes, and _____ wastes.

_____

101870MP. What does a gradual increase in the bearing temperature of a centrifugal blower indicate?
(A) There is a problem with the bearing lubrication or connection
(B) The packing is loose
(C) The motor is simply adjusting to new inlet conditions
(D) The air is becoming less dense

101911MP. The elevation of any pump above the source of supply should not exceed _____ ft.
(A) 2.2
(B) 22
(C) 224
(D) 200

10203FF. The periodic loss of portions of the slime layer on a trickling filter is called what?
(A) De-sliming
(B) Sloughing
(C) Turnover
(D) Grazing

102183L. Don't forget to adjust your dissolved oxygen meter for this important correction.
(A) Barometric pressure
(B) Measured concentration range
(C) Air temperature
(D) Sample temperature

102231G. Aerobic organisms give end products of:
(A) CO2 && H2S
(B) CO2 && methane
(C) Methane && H2O
(D) CO2 && H2O

102357L. For a sample result to be considered valid, it should use up at least this much dissolved oxygen over the five day BOD test.
(A) 1.0 mg/L
(B) 5.0 mg/L
(C) 2.0 mg/L
(D) 0.5 mg/L

102435MW. When sulfur dioxide is used to reduce hexavalent chromium, the sulfur dioxide forms _____ which reacts with _____ to form the final products _____ and _____.
(A) sulfuric acid, chromic sulfate, chromic acid and water
(B) sulfurous acid, hexavalent chromium, trivalent chromium and water
(C) sulfurous acid, chromic acid, chromic sulfate and water

102554G. All suspended solids are volatile.
(A) True
(B) False

10261S. Belt filter presses are operated as a _____ process.
(A) Batch
(B) Continuous
(C) Either one, depending on circumstances

102738MW. When sodium bisulfite is used to reduce hexavalent chromium, this chemical must also be added.
(A) Sulfuric acid
(B) Cyanide
(C) Sodium hydroxide
(D) Hydrochloric acid

10286C. These metal-cyanide complexes are difficult to oxidize and are considered refractory.
(A) Iron
(B) Gold
(C) Silver
(D) Potassium
(E) Sodium

102924MP. Information on preventive maintenance procedures, materials, and frequencies for plant structures should be taken from:
(A) Manufacturers operation and maintenance manuals
(B) Who needs books? we don't need no stinkin' books!
(C) As-built blueprints
(D) Experience at the plant
(E) Lab records

103062G. Public relations are important because we:
(A) Must deal with the public
(B) Want to keep our jobs
(C) Want to finish our work in a hurry
(D) Don't want to be late for lunch
(E) Hate listening to whiners

103196L. An amperometric titrator is used to measure:
(A) Chlorine residual
(B) Conductivity
(C) COD
(D) Alkalinity

103227IN. Brewery wastes are nearly always lacking these essential elements.

_____

103398L. The fecal coliform membrane filter test is incubated at ___ degrees C and produces blue or blue-green colonies.
(A) 35.0 oC
(B) 44.5 oC
(C) 44.5 oF
(D) 35.0 oF

103444D. Ultraviolet disinfection is becoming more popular because UV systems
(A) Conserve energy
(B) Reduce capital costs
(C) Eliminate safety concerns about handling chlorine
(D) Require no maintenance

103597G. Raw influent settleable solids are measured in units of mL/L.
(A) False
(B) True

103634MP. A pump's seal water pressure should be set at
(A) 2 to 3 psi below the pump operating discharge pressure
(B) 5 to 10 psi more than the pump operating discharge pressure
(C) At the same level as the pump operating discharge pressure
(D) 15 to 20 psi more than the pump operating discharge pressure
(E) 1 to 2 psi more than the pump operating discharge pressure

103767D. Which of the following is an appropriate location to collect a final effluent sample for a chlorine residual test?
(A) At the point where influent enters the plant
(B) At the downstream end of the aeration tanks
(C) At the chlorine injection point
(D) At the downstream end of the chlorine contact tank

103886G. A laboratory procedure for evaluating coagulation, flocculation, and sedimentation is called what?
(A) Jar test
(B) Flash mix analysis
(C) Polymer analysis
(D) Optimization check

103994A. Large clumps of rising sludge on the surface of a secondary clarifier are typically caused by _____.
(A) Ashing
(B) Nocardia
(C) Denitrification
(D) Nitrification

104030C. Cyanide complexes that are considered amenable to chlorination include all of the following.
(A) Sodium, Potassium, Cadmium, and Zinc cyanide
(B) Copper cyanide complexes
(C) Sodium ferrocyanide salts
(D) Iron complexes
(E) Silver and Gold complexes

1041112L. The range of a pH analyzer is
(A) 1 to 14 pH units
(B) 2 to 14 pH units
(C) 0 to 14 pH units
(D) 4 to 14 pH units

1042163G. The company to contact for updates and corrections to the PEST wastewater question database is
(A) Indigo Water Group
(B) 450 Decatur Street, Denver Colorado 80110
(C) Main Line is (303)825-1802
(D) Contact: Sidney Biesterfeld at ext. 48

104353M. Given the following information, calculate the %VSS reduction in the digester. Influent %VSS = 80% Effluent %VSS = 67%
(A) 67%
(B) 81%
(C) 13%
(D) 49%

104442MW. When reducing Cr+6 to Cr+3, an oxidation-reduction potential (ORP) of _____ or less should be achieved.

(A) +250 mV
(B) -400 mV
(C) +400 mV
(D) -250 mV

Wastewater Cert 10-19-07

Indigo Water Group

Answer Key

1. C
2. B
3. A
4. C
5. C
6. D
7. D
8. B
9. A
10. B
11. C
12. A
13. C
14. A
15. B
16. C
17. B
18. B
19. C
20. D, E
21. A
22. D
23. E
24. B
25. A
26. B
27. D
28. D
29. B
30. B

31. A
32. A
33. B
34. A
35. B
36. 4.33, 4.5
37. A
38. D
39. D
40. C
41. C
42. A
43. D
44. Nutrient, Nitrogen
45. C
46. A
47. A
48. D
49. B
50. A
51. C, D
52. Calcium Carbonate - mg/L, Calcium carbonate, Calcium carbonate, mg/L, mg/L Calcium carbonate
53. C
54. A
55. C
56. C
57. B
58. B
59. D
60. A
61. B
62. A
63. D
64. cubic feet per second, cubic feet/second, cubic ft/sec, ft3/sec, cuft/sec
65. B
66. A
67. B

68. D

69. C

70. B

71. A, C, F

72. A

73. A

74. A

75. B

76. A

77. C

78. C

79. A

80. A

81. C

82. C

83. C

84. C

85. A

86. A

87. D

88. A

89. A

90. B

91. A

92. A

93. A

94. D

95. B

96. A

97. A

98. A

99. C

100. D

101. B

102. D

103. B

104. E

105. B
106. B
107. B
108. C
109. B
110. C
111. A
112. A
113. D
114. C
115. C, E, F
116. A
117. Mean
118. D
119. A
120. A
121. A
122. B
123. D
124. C
125. C
126. A
127. Dose = Intensity * Time, Dose = Intensity x Time, D = It, D=It
128. B
129. B
130. C
131. B
132. A
133. C
134. B
135. D
136. A
137. B
138. B, D, E
139. A
140. B
141. C

142. C

143. B

144. A

145. D

146. Floating Sludge, Blanket Pops, Rising Sludge

147. D

148. D

149. B

150. D

151. B

152. D

153. G

154. E

155. E

156. A

157. B

158. B

159. A

160. A

161. B

162. B

163. A

164. A

165. C

166. C

167. B

168. B

169. A

170. A

171. B

172. A

173. C

174. C

175. B

176. A

177. B

178. D

179. B

180. A, C, D

181. C

182. A

183. B

184. D

185. A

186. A

187. D

188. C

189. D

190. C

191. C

192. A, B, C, F

193. D

194. B

195. B

196. A

197. D

198. A

199. B

200. C

201. D

202. D

203. Buffering, Acid Neutralizing

204. B

205. A

206. D

207. B

208. A

209. C

210. D

211. D

212. D, E, F

213. B

214. B

215. A

216. A

217. A

218. B

219. A

220. C

221. A

222. B

223. B

224. E

225. D

226. Sequence = B, D, C, A

227. A

228. Parshall Flume

229. B

230. B

231. A

232. D

233. B

234. A

235. C

236. A

237. B

238. C

239. A

240. D

241. D

242. A

243. C

244. B

245. D

246. A

247. A

248. C

249. A

250. A

251. D

252. D

253. C

254. C

255. A

256. A

257. A

258. D

259. D

260. C

261. A

262. A

263. E

264. C

265. C

266. B

267. B

268. A, B, C, D

269. B

270. A

271. D

272. C

273. C

274. D

275. C, D, E

276. A

277. A

278. D

279. D

280. D

281. C

282. B

283. A

284. A

285. C

286. A

287. A

288. B

289. B

290. A
291. C
292. B
293. B
294. A
295. B
296. D
297. A
298. A
299. D
300. D
301. B
302. A
303. A
304. D
305. A
306. B
307. A
308. C
309. A
310. C
311. A
312. A
313. A
314. B
315. C
316. D
317. C
318. D
319. A
320. D
321. B
322. B
323. D
324. A
325. A
326. C

327. C

328. A

329. A

330. B

331. C

332. A

333. C

334. A

335. C

336. A

337. B

338. D

339. C

340. B

341. D

342. D

343. A

344. A

345. A

346. B

347. B

348. B

349. A

350. B

351. B

352. C

353. B

354. Dessicator, Desiccator, Dessicators, Desiccators

355. C

356. B

357. A

358. A

359. C

360. B

361. C

362. B

363. C

364. A

365. A

366. A

367. B

368. A

369. rotten egg, rotten eggs

370. B

371. A

372. A

373. B

374. D

375. B

376. D

377. D

378. D

379. D

380. C

381. C

382. C

383. A

384. A

385. B

386. A

387. D

388. B

389. A

390. A

391. B

392. A

393. B

394. A

395. B

396. B

397. E

398. C

399. A

400. A

401. B

402. B

403. A

404. B

405. D

406. A

407. A

408. B

409. B

410. D

411. B

412. C

413. A

414. B

415. D

416. A

417. D

418. B

419. C

420. D

421. A

422. Geometric

423. Clean in Place, Clean-in-Place

424. C

425. B

426. A

427. A

428. A

429. A

430. B

431. D

432. E

433. A

434. C

435. C

436. A, B, C

437. A

438. E

439. C

440. volatile fatty acids, volatile acids, VFA, VFAs

441. E

442. D

443. A

444. B

445. B

446. C

447. A

448. A, B, D, E

449. D

450. A

451. A

452. A

453. D, E

454. Nitrobacter and Nitrosomonas, Nitrosomonas and Nitrobacter, Nitrobacter, Nitrosomonas, Nitrosomonas, Nitrobacter

455. B

456. A

457. A

458. C

459. B

460. C

461. A

462. B

463. D

464. C

465. D

466. A

467. C

468. Shock

469. A, D, E

470. C

471. C

472. C

473. D

474. B

475. feed rate, pounds per day, lb/day, dose, ppd

476. D

477. D

478. C

479. A

480. C

481. B

482. A

483. A

484. A

485. F

486. A, B, C, D

487. C

488. D

489. B

490. D

491. B

492. B

493. A

494. A

495. D

496. D

497. A

498. B

499. B

500. C

501. A

502. B

503. A

504. C

505. A

506. C

507. C

508. C

509. A

510. A

511. A

512. C

513. C

514. D

515. B

516. A

517. D

518. D

519. Calcium hypochlorite, Sodium hypochlorite, Calcium hypochlorite and Sodium hypochlorite, Calcium and Sodium, Calcium, Sodium, Ca, Na

520. A

521. A, D

522. B

523. C

524. A

525. A

526. D

527. D

528. C

529. A

530. D

531. A

532. A

533. C

534. C

535. A

536. B

537. A

538. B

539. 7.14

540. E

541. A

542. B

543. C

544. C

545. A

546. A

547. C

548. C

549. C

550. B

551. A

552. A

553. C

554. A

555. most probable number, MPN

556. D

557. A

558. A, C, D, E

559. D

560. B

561. B

562. B, D, E

563. C

564. C

565. C

566. B

567. B

568. total dissolved solids

569. A

570. D

571. C

572. D

573. C

574. D

575. A

576. C

577. B

578. A

579. A

580. C

581. D

582. C

583. B

584. D

585. Head

586. D

587. E

588. D

589. B

590. E

591. B, C, D

592. D

593. A

594. C

595. A

596. C

597. D

598. B

599. C

600. B

601. B

602. B

603. D

604. B

605. F

606. C

607. B

608. B

609. A

610. A

611. B

612. main, side, side, main, main and side, side and main

613. B

614. C

615. D

616. B

617. B

618. A, B, D

619. B

620. A

621. chain custody, chain of custody, chain, custody

622. B

623. C

624. D

625. B

626. B

627. A

628. D

629. Trends

630. A

631. D

632. A

633. A

634. B

635. C

636. C

637. D

638. C

639. A

640. D

641. D

642. C

643. E

644. C

645. A

646. C

647. A

648. C

649. E

650. D, E, F

651. C

652. A

653. F

654. A

655. A

656. B

657. B

658. Grab and Composite, Composite and Grab, Grab, Composite, Composite, Grab

659. C

660. A

661. A

662. D

663. D

664. A

665. C

666. A

667. A

668. B

669. D

670. A

671. A

672. B

673. D

674. B

675. B

676. C

677. C

678. Color

679. C

680. D

681. D

682. D

683. B

684. A

685. A

686. C, D

687. C

688. A, B, C, E, F

689. C

690. C

691. C

692. C

693. A

694. B

695. B

696. A

697. B

698. B

699. A

700. D

701. B, D, E

702. C

703. B

704. B

705. A

706. B

707. D

708. C

709. A

710. C

711. B

712. A

713. B

714. B

715. A

716. A

717. B

718. A

719. B

720. A

721. A

722. B

723. A

724. A

725. C

726. A

727. B

728. D

729. B

730. A

731. A, E, F

732. C

733. A

734. D

735. E

736. A

737. A

738. A

739. A

740. B

741. A

742. D

743. D

744. A

745. C

746. B

747. B

748. Negatives and Positives, Positives and Negatives, Negatives, Positives, Positives, Negatives

749. A

750. B

751. D

752. D

753. C

754. B

755. B

756. B

757. C

758. C

759. D

760. Fixed film, Attached growth

761. C

762. A

763. E

764. E

765. C

766. A

767. B

768. C

769. B

770. A

771. D

772. E

773. A

774. D

775. A

776. Pretreatment, Preliminary treatment, Preliminary

777. A

778. A

779. A

780. B

781. A

782. A

783. A

784. A

785. D

786. C

787. C

788. A

789. B

790. B

791. Strategic, Contingency, Single use, Program, Capital facility, Financial

792. C

793. C

794. D

795. A

796. D

797. A

798. A

799. A

800. C

801. A

802. C

803. B

804. C

805. D

806. A

807. A

808. A

809. B

810. A

811. D

812. C

813. B

814. B

815. D

816. D

817. A

818. B

819. B

820. A

821. A

822. B

823. D

824. C

825. A

826. A

827. A

828. B

829. C

830. A

831. B

832. B, D, E

833. B

834. B

835. A

836. A

837. B

838. D

839. A

840. C

841. D

842. A

843. C

844. C

845. B

846. E

847. B

848. Combined

849. D

850. B

851. C

852. A

853. A

854. D

855. B

856. D

857. D

858. C

859. D

860. C

861. B

862. C

863. D

864. D

865. C

866. B

867. B

868. A

869. D

870. D

871. E

872. B

873. B

874. A

875. D

876. B

877. bioassay, whole effluent toxicity test, whole effluent toxicity, WET, WET test

878. A

879. A

880. D

881. C

882. B

883. A

884. level sensing, level

885. D

886. B

887. A, B, D

888. A

889. B

890. D

891. B

892. B

893. A

894. D, E

895. A

896. A

897. disinfection

898. B

899. A

900. D

901. C

902. A

903. A

904. A

905. B

906. C

907. D

908. B, E

909. B

910. B

911. C

912. C

913. A

914. B

915. A

916. B

917. B

918. C

919. B

920. D

921. C

922. B

923. B

924. B

925. B

926. B

927. C

928. B

929. A

930. C, D, E, F, G

931. B, D, E

932. C

933. C

934. D

935. D

936. C

937. B

938. A

939. B

940. C

941. A

942. C

943. C

944. B

945. B

946. D

947. A

948. D

949. C

950. D

951. B

952. D

953. A

954. B

955. F

956. A

957. C

958. C

959. B

960. A

961. B

962. A

963. A

964. C

965. A, B, D

966. D

967. B

968. B

969. B

970. B

971. B

972. B

973. C

974. A

975. A

976. A

977. B

978. D

979. A

980. A

981. F

982. B

983. D

984. C

985. Chemical Oxygen Demand, COD

986. A

987. B

988. E

989. B

990. B

991. C

992. B

993. C

994. D

995. A

996. A

997. B, E, F

998. B

999. A

1000. A

1001. A

1002. D

1003. D

1004. B

1005. D

1006. C

1007. B

1008. C

1009. D

1010. C

1011. C

1012. C

1013. B

1014. A

1015. A

1016. B

1017. Packing, Packinghouse, Packing house

1018. A

1019. B

1020. B

1021. A

1022. D

1023. C

1024. C

1025. B

1026. B

1027. A

1028. A

1029. A

1030. A

1031. A

1032. Nitrogen and Phosphorus, Phosphorus and Nitrogen, Nitrogen, Phosphorus, Phosphorus, Nitrogen, N P, N, P

1033. B

1034. C

1035. B

1036. B

1037. D

1038. A

1039. C

1040. A, B, E

1041. C

1042. A

1043. D

1044. A