13. Examination Questions

1. An analytical balance is sensitive to the nearest *Basic*

a. Milligram.
b. 1/1,000 mg.
c. 1/100 mg.
d. 1/10 mg.

2. An Imhoff cone is *Basic*

a. Used to determine pH.
b. Used to determine chlorine residual.
c. Used to determine settleable solids.
d. Used to determine SS.

3. A buret is used to *Basic*

a. Heat a sample.
b. Titrate a sample.
c. Filter a sample.
d. Weigh a sample.

4. To pipette wastewater or strong chemicals, you should use a *Basic*

a. Beaker.
b. Flask.
c. Stopper.
d. Rubber bulb.

5. Which of these equations is correct? *Basic*

a. Dissolved solids + Total solids = SS.
b. SS + Dissolved solids = Total solids.
c. SS + Total solids = Dissolved solids.
d. None of the above.

6. Samples for making laboratory tests on wastewater should be *Basic*

a. Collected when possible during the day.
b. Representative of the wastewater to be tested.
c. Collected at a convenient location in the plant.
d. Collected only after the final treatment unit.

7. Proper sample collection techniques are specified in *Basic*

a. "Standard Methods."
b. Manual of Practice No. 11.
c. The O & M manual for the plant.
d. All of the above.

8. When unit processes are being investigated, grab samples are preferable to composite samples to demonstrate the

a. Efficiency of treatment. *Basic*
b. Effect of individual industrial waste "slugs."
c. Load that may be effectively treated.
d. Accomplishment of each process unit.

9. A composite sample will give *Basic*

a. An even color.
b. A high pH.
c. A representative sample.
d. Low solids.

10. Samples collected over several hours during the day and combined are known as *Basic*

a. Composite samples.
b. Grab samples.
c. Deep samples.
d. Periodic samples.

11. Characteristics that should be measured immediately after the sample is collected are *Basic*

a. Velocity and dissolved solids.
b. Temperature, pH, and DO.
c. Sulfur, iron, and copper.
d. Hardness and alkalinity.

12. The best method for collecting residual chlorine samples is *Basic*

a. Grab samples during the day.
b. Composite samples made up of 24-hr portions, each taken in equal volumes for 24 hr.
c. Composite samples made up of 24-hr portions, each taken proportional to the flow at the time taken, for 24 hr.
d. A composite sample of the contact chamber influent and effluent.

13. Composite samples are collected because *Basic*

a. The waste characteristics are continually changing.
b. The flow is continually changing.
c. The flow and characteristics of the waste are continually changing.
d. This requires less time than grab samples.

14. Composite samples for BOD tests should be preserved by *Basic*

a. 10-ml chloroform.
b. Refrigeration.
c. 10-ml nitric acid.
d. 10-ml formaldehyde.

15. In sampling wastewater for a BOD test, the best results are obtained from *Basic*

a. A 24-hr composite sample.
b. A grab sample.
c. A sample made of 2 to 4 portions taken at time of high flow.
d. A sample taken at time of low flow.

16. To have significant meaning for laboratory tests of the evaluation of a wastewater treatment plant's performance, the best method of sampling is *Advanced*

a. Grab sampling.
b. Hourly sampling.
c. Sampling during peak flow.
d. Proportional composite sampling.
e. Automatic sampling.

17. BOD samples should be collected before chlorination because *Advanced*

a. Chlorine reacts with the buffer solution.
b. Chlorine interferes with the activity of organisms.
c. Chlorine reacts with the calcium ions.
d. Chlorine affects the alkalinity.

18. A water sample is "fixed" in the field by *Advanced*

a. Keeping the sample in a Cipolletti device.
b. Anchoring the container to the stream bed.
c. Adding chemicals to prevent the changing of water quality.
d. Maintaining a constant sample temperature of 95° F.

19. The best procedure for determining the SS of a plant effluent is to analyze *Advanced*

a. A 24-hr composite sample of the effluent.
b. A grab sample of the effluent at high flow.
c. A grab sample of the effluent at low flow.
d. A series of grab samples taken at different times during the day.

20. A sample obtained by taking portions of wastewater at a collection point in proportion to the flow is called *Advanced*

a. A most probable number (MPN).
b. A weighted composite.
c. A routine sample.
d. A bacterial-solids sample.

21. Settleable solids by volume are determined through the use of *Basic*

a. A Nessler tube.
b. A Kjeldahl flask.
c. A Gooch crucible.
d. An Imhoff cone.

22. An Imhoff cone is used to determine the amount of *Basic*

a. SS.
b. Total solids.
c. Settleable solids.
d. Organic solids.

23. The settleable solids test is primarily used to *Basic*

a. Measure the volume of solids that may be removed by settling tanks.
b. Determine the BOD required for treatment.
c. Measure the rate of decomposition of organic volatile solids.
d. Determine the amount of chlorine required.

24. An operator allowed 1,000 ml of raw wastewater to stand in an Imhoff cone for 1 hr. He then observed that the solids had accumulated in the bottom of the cone up to the 5 mark. From this, he knew that the raw wastewater contained *Basic*

a. 5 ml/l of settleable solids.
b. 5 mg/l of SS.
c. 5 percent solids.
d. 5 percent grit.

25. A piece of laboratory equipment used in the determination of total solids is *Basic*

a. An Imhoff cone.
b. A Gooch crucible.
c. An evaporating dish.
d. A distillation flask.

26. The three measurements that are essential in calculating the solids and organics on a wastewater treatment plant are *Basic*

a. Flow, BOD, DO.
b. Flow, SS, pH.
c. BOD, SS, DO.
d. Flow, SS, BOD.

27. SS in wastewater are determined by *Basic*

a. Filtration of a known quantity through a prepared Gooch crucible.
b. Evaporating a known quantity in a prepared evaporating dish.
c. Removal of the settleable solids in a prepared Imhoff cone.
d. Distillation for 30 min in a prepared Kjeldahl flask.

28. The standard total SS test requires the Gooch crucible, fiber glass mat, and solids to be dried in the oven at *Basic*

a. 95° C.
b. 103° C.
c. 110° C.
d. 115.5° C.

29. The SS content of wastewater is most accurately measured by *Advanced*

a. Filtering the sample through a specially prepared filter; drying the filter and material retained on it in an oven at 103° C; weighing the filter; and determining its added weight caused by the solids retained.
b. Evaporating the sample and weighing the residue.
c. Centrifuging the sample and measuring the volume of solids separated from the liquid.
d. Distilling the sample after acidification with sulfuric acid and titrating the distillate with 0.1 *N* sodium hydroxide.

30. The amount of sample to be used in determining SS depends on the *Advanced*

a. Amount of grease in the sample.
b. Amount of SS in the sample.
c. Degree of turbidity of the sample.
d. Type of vacuum apparatus available.

31. The advantage of the centrifuge test for SS determination in comparison with the other method is *Advanced*

a. Accuracy of results.
b. Large volume of sample it can handle.
c. Low cost.
d. Speed of answer.

32. The following data are given for an SS determination: Filtered 100 ml of sample; Tare weight, 14.9913 g; SS, 1,312 mg/l. The final weight after drying was *Advanced*

a. 14.8601 g.
b. 14.7289 g.
c. 15.1225 g.
d. 15.2537 g.

33. The following indicator is most useful in determining pH values near neutrality: *Advanced*

a. Bromthymol blue.
b. Bromcresol green.
c. Methyl orange.
d. Thymol blue.

34. If a sample of sludge is taken from a digester and allowed to stand for an hour before a pH determination is made, the result will be *Basic*

a. An increase in oxygen content.
b. A decrease in pH.
c. An increase in pH.
d. None of the above.

35. Buffer capacity in water is a measure of *Advanced*

a. Ability to resist change in pH.
b. Ability to hold settleable solids.
c. Saturation DO.
d. Ability to treat fluctuating BOD load.

36. The pH's of 6 grab samples were: 6.0, 7.5, 6.9, 5.2, 8.9, and 8.5. From this, we may determine that the pH of the composite sample was *Advanced*

a. 4.2
b. 8.9
c. 7.0
d. Cannot be determined from the above data.

37. One way to determine chlorine residual is the *Basic*

a. pH test.
b. Phenolphthalein test.
c. Orthotolidine test.
d. Chloride test.

38. The amperometric titration method is used to measure *Advanced*

a. BOD.
b. pH.
c. Residual chlorine.
d. Total coliform.

39. A chlorine demand test for various time periods on plant effluent samples will show *Advanced*

a. The safe amount of chlorine that may be fed without killing fish.
b. The number of pounds of chlorine required to kill 100 percent of the coliform.
c. The amount of chlorine required to give a desired residual after a given time.
d. The amount of chlorine required to reduce the BOD to 10 mg/l in the effluent.

40. In determining the residual chlorine in wastewater, when either nitrite nitrogen (in amounts greater than 2 mg/l) or manganic manganese is present, the most accurate results will be obtained by *Advanced*

a. Titration by the neutral starch-iodide method.
b. Nitrate thiocyanate titration at less than 20° C.
c. Colorimetric methods.
d. Orthotolidine method.

41. The best procedure for determination of the DO content of a plant effluent is to analyze *Basic*

a. A 24-hr composite sample.
b. A grab sample at high flow.
c. A grab sample at low flow.
d. Several grab samples at various flows.

42. Standard sodium thiosulfate used in the DO test has a normality of *Basic*

a. 0.04
b. 0.025
c. 0.004
d. 0.0025

43. The standard DO test for water is *Basic*

a. Winkler.
b. Kjeldahl.
c. Wesserman.
d. Krump.

44. Agitating a sample before performing the DO test *Basic*

a. Decreases the DO.
b. Increases the DO.
c. Decreases the SS.
d. Increases the SS.

45. The most reliable sample for BOD seed correction will have a DO depletion of between *Basic*

a. 30 and 90 percent.
b. 40 and 70 percent.
c. 20 and 40 percent.
d. 70 and 90 percent.

46. The DO depletion on unseeded dilution water should be no more than *Basic*

a. 1.00 mg/l.
b. 0.02 mg/l.
c. 0.20 mg/l.
d. 0.50 mg/l.

47. When washing BOD bottles, it is important to use *Basic*

a. Distilled water.
b. Chromic acid cleaning solution and distilled water.
c. Nitric acid and distilled water.
d. Sulfuric acid and distilled water.

48. The BOD of wastewater determines the milligrams per liter of oxygen required *Basic*

a. During stabilization of decomposable organic matter by aerobic bacterial action.
b. To produce an equilibrium between the oxygen of the wastewater and atmospheric oxygen.
c. To unit chemically with the inorganic matter present in the sample.
d. For the oxidation of sulfites and thiosulfates to sulfates.

49. BOD incubation is at *Basic*

a. 37° C.
b. 98° F.
c. 20° F.
d. 20° C.

50. The DO probe is recommended over the modified Winkler method when the following conditions are present in the sample: *Advanced*

a. Sulfite.
b. Free chlorine.
c. Intense color.
d. All of the above.

51. Sodium thiosulfate is used to determine *Advanced*

a. pH.
b. DO.
c. Volatile acids.
d. Alkalinity.

52. The most generally used modification of the Winkler test for determining DO is *Advanced*

a. Bicarbonate.
b. Alkali-hypochlorite.
c. Permanganate.
d. Azide.

53. If a BOD sample is incubated at 18° C for 5 days, the result will be *Basic*

a. Higher than 20°C reading.
b. Lower than 20° C reading.
c. Equal to 20° C reading.
d. None of the above.

54. If the BOD of a sample is determined after the recommended 5 days, the result will be *Basic*

a. Higher than 5-day reading.
b. Lower than 5-day reading.
c. Equal to 5-day reading.
d. None of the above.

55. BOD dilution water must be aerated *Basic*

a. Sufficiently long to saturate it with DO.
b. At least 2 days.
c. 3.5 hr.
d. 15 min.

56. BOD dilution water should be *Basic*

a. Tap water with nutrients and buffer added.
b. Boiled to kill all bacteria.
c. Aerated distilled water with nutrients and buffer added.
d. Treated with sodium thiosulfate.

57. A sample collected for BOD determination *Basic*

a. Should be analyzed as soon as possible.
b. Should be aged several days before beginning the determination.
c. Should be chlorinated to preserve the sample.
d. None of the above.

58. When compared with the total BOD, the 5-day BOD of normal wastewater is approximately *Basic*

a. 75 percent.
b. 65 percent.
c. 55 percent.
d. 45 percent.

59. In putting up BOD's of strong industrial wastes of about 8,000 mg/l BOD. the dilution should be about *Advanced*

a. 0.01 percent.
b. 1.0 percent.
c. 2.0 percent.
d. 0.05 percent.

60. The most reliable BOD samples use at least the following amount of DO: *Basic*

a. 1.0 mg/l.
b. 2.0 mg/l.
c. 0.5 mg/l.
d. 7.0 mg/l.

61. The following data are given for a BOD test: 1, 0.5, and 0.1 percent samples were set up. Initial DO for all samples was 7.6 mg/l. Final DO was 0 mg/l for all samples. The seed correction was 0.6 mg/l. From the results of this test we conclude *Advanced*

a. The BOD is greater than 700.
b. The BOD is less than 700.
c. The BOD is greater than 7,000.
d. The BOD is less than 7,000.

62. Assume that the BOD of a sample to be tested is about 200 mg/l and the DO is zero. The DO of dilution water to be used is known to be 8 mg/l. Which of the following ratios of dilution water: wastewater sample would most logically be used in setting up a BOD bottle for incubation? *Advanced*

a. 20:1
b. 50:1
c. 100:1
d. 500:1

63. The BOD test is a measure of *Advanced*

a. The amount of oxygen required for decomposition under aerobic conditions.
b. The number of organisms present in wastewater.
c. The amount of oxygen required to maintain at least 1 mg/l of DO in the wastewater at all times.
d. The amount of oxygen given up by potassium permanganate when boiled in a mixture with organic matter.

64. The standard glucose-glutamic acid solution will have a BOD of about *Advanced*

a. 120 mg/l.
b. 500 mg/l.
c. 250 mg/l.
d. 220 mg/l.

65. What would be the effect on a BOD determination if the dilution water used contained either copper or chlorine?

a. The DO level would be increased. *Advanced*
b. The BOD would be higher.
c. The BOD would be lower.
d. There would be no effect.

66. "Standard Methods" prescribes that ferric chloride, calcium chloride, magnesium sulfate, phosphate buffer solution, and ammonium sulfate be added to distilled water to be used for dilution water in making BOD determinations. These chemicals serve the following purpose, namely, *Advanced*

a. To assure the presence of DO to the saturation level and increase the thermal conductivity.
b. To assure the presence of a slight oxygen demand.
c. To adjust the pH to within a desirable range and to provide essential elements for the growth of the biological life exerting the BOD.
d. To assure the presence of coliform organisms and to satisfy any natural oxygen demand that may exist.

67. In order to run a BOD determination on a chlorinated wastewater, it is necessary, after dechlorinating the specimen, to *Advanced*

a. Add an excess of potassium permanganate to the wastewater and then remove the excess permanganate with potassium oxalate.
b. Add a solution of mineral salts to the wastewater.
c. Implant the wastewater with normal wastewater organisms.
d. Pass air through the wastewater for a time.

68. One of the following compounds is not needed in the BOD test: *Advanced*

a. Alkaline iodide-sodium azide solution.
b. Sulfuric acid.
c. Starch solution.
d. Orthotolidine.

69. When BOD water is needed, the best material for seed is *Advanced*

a. Tap water.
b. River water.
c. Digested sludge.
d. Fresh settled wastewater.

70. Before running a BOD test, samples that are highly acidic should be neutralized to a pH of *Advanced*

a. 8.4.
b. 8.9.
c. 7.0.
d. 4.3.

71. Toxic metals in high concentration in a sample for BOD will result in *Advanced*

a. High BOD result.
b. Low BOD result.
c. Normal BOD result.
d. None of the above.

72. The percentage of the ultimate BOD of normal domestic wastewater satisfied in 5 days at 20° C is *Advanced*

a. 35 percent.
b. 45 percent.
c. 52 percent.
d. 68 percent.

73. The standard BOD test requires *Advanced*

a. Pure tap water for dilution purposes.
b. A buffer solution and trace elements composed of iron, magnesium, calcium chloride, and copper to be added to the dilution water.
c. The pH of the dilution water be 5.2 to 5.6.
d. A water seal be continuously provided.

74. The COD test is considered a better operational control test than the BOD test because *Basic*

a. It takes less time to run the test.
b. The result are more accurate.
c. Everyone uses it.
d. The results are independent of alkalinity.

75. The relative stability test *Basic*

a. Requires 5 days to complete.
b. Involves incubation of a sample with methylene blue solution.
c. Is used to determine whether a sample is acidic or alkaline.
d. Is usually only performed on raw wastewater.

76. The relative stability test is often used in connection with wastewater treatment plants to *Basic*

a. Check for toxic materials that would interfere with the operation of the trickling filter.
b. Measure the oxygen demand of the plant effluent.
c. Test the raw wastewater.
d. None of the above.

77. Because the actual compounds causing alkalinity are seldom known in water and wastewater, alkalinity is expressed in terms of equivalent *Basic*

a. mg/l CO.
b. mg/l $NaCO_3$.
c. mg/l CO_3.
d. mg/l $CaCO_3$.

78. COD is a good estimate of *Advanced*

a. Nitrogenous oxygen demand.
b. Carbonaceous oxygen demand.
c. 1st-stage oxygen demand.
d. 2nd-stage oxygen demand.
e. 20-day BOD.

79. The "Standard Method" specified chemical for the oxidation of organic matter in the COD test is *Advanced*

a. $Na_2S_2O_3$.
b. $KMnO_4$.
c. $K_2Cr_2O_7$.
d. CCl_4.
e. $KH(IO_3)_2$.

80. The COD test is a measure of *Advanced*

a. Concentrated oxygen demand.
b. Chemical odor demand.
c. Clinical oxygen dosage.
d. Chemical oxygen demand.

81. Compared with the BOD, the COD of a wastewater sample is generally *Advanced*

a. Greater.
b. Equal.
c. Less.
d. None of the above.

82. A relative stability test on a wastewater sample loses its color within 12 hr. This indicates *Advanced*

a. The wastewater is not adequately treated for discharge to a dry stream.
b. The wastewater is adequately treated for discharge to a dry stream.
c. Nothing if the test was taken on the plant effluent.
d. None of the above.

83. The methylene blue test is generally used in wastewater treatment to determine the *Advanced*

a. Strength of digester supernatant.
b. Amount of industrial waste in influent.
c. Stability of plant effluent.
d. Stability of plant influent.

84. A certain determination made on a sample of mixed liquor from aeration tanks shows "the volume in milliliters of one gram of sludge after settling 30 minutes." This determination is known as the *Advanced*

a. SS test.
b. Sludge volume index.
c. Settleable solids test.
d. Sludge stability test.

85. The end point for the titration of the distillation method of the volatile acids test is *Advanced*

a. The change to a yellow or light tan color.
b. The change from brown to a straw yellow color.
c. The change from blue to colorless after the addition of starch.
d. The change from colorless to pink.

86. If it takes 15 ml of 0.10 *N* H_2SO_4 to run a total alkalinity test using 100-ml sample, the total alkalinity, as $CaCO_3$, is *Advanced*

a. 7.5 mg/l.
b. 75 mg/l.
c. 750 mg/l.
d. 7,500 mg/l.

87. The indicator methyl orange is used in the test for *Advanced*

a. Hardness.
b. Chlorine residual.
c. Alkalinity.
d. Turbidity.

88. A spectrophotometer is used to measure *Advanced*

a. DO.
b. Dissolved solids.
c. Settleability.
d. Color intensity.

89. Nitrogen is present in wastewater in many forms. Total Kjeldahl nitrogen means *Advanced*

a. Ammonia nitrogen.
b. Nitrite nitrogen.
c. Nitrate nitrogen.
d. Organic nitrogen.

90. The probable number of coliform organisms found in wastewater is indicated by *Basic*

a. COD.
b. DO.
c. MPN.
d. pH.

91. A clarity test on plant effluent *Basic*

a. Indicates if the effluent is safe to drink.
b. Is measured by an amperometer.
c. Is measured with a Gooch crucible.
d. Is measured by a Secchi disk.

92. The bacterial reduction affected by a wastewater treatment plant is based on results of tests for *Basic*

a. Rotifers.
b. Coliforms.
c. Nematodes.
d. Zooglea.

93. In the membrane filter methods, the number of coliforms is estimated by *Basic*

a. The number of positive tubes.
b. The number of negative tubes.
c. The number of colonies grown.
d. The sum of positive and negative tubes.

94. According to the current edition of "Standard Methods," the maximum time allowed for the storage or transportation of a relatively pure water sample for bacteriological examination is *Advanced*

a. 6 hr.
b. 12 hr.
c. 30 hr.
d. 36 hr.

95. The significance of running a fecal coliform test is

a. To indicate pathogenic organisms. *Advanced*
b. To indicate recent wastewater pollution.
c. To indicate a measure of waste strength.
d. To indicate the presence of rotifers.

ANSWER KEY

SECTION 13 - Sampling and Laboratory

1. d
2. c
3. b
4. d
5. b
6. b
7. d
8. b
9. c
10. a
11. b
12. a
13. c
14. b
15. a
16. d
17. b
18. c
19. a
20. b
21. d
22. c
23. a
24. a
25. c
26. d
27. a
28. b
29. a
30. b
31. d
32. c
33. a
34. b
35. a
36. d
37. c
38. c
39. c
40. a
41. d
42. b
43. a
44. b
45. b
46. c
47. a
48. a
49. d
50. b & c
51. b
52. d
53. b
54. a
55. a
56. c
57. a
58. b
59. d
60. b
61. c
62. b
63. a
64. d
65. c
66. c
67. c
68. d
69. b & d
70. c
71. b
72. d
73. d
74. a
75. b

76. d
77. d
78. e
79. c
80. d
81. a
82. a
83. c
84. b
85. d
86. c
87. c
88. d
89. d
90. c
91. d
92. b
93. c
94. a
95. b