15 Examination Questions

1. What is the area of a rectangle 11.8 x 3.3 ft? *Basic*

a. 19.5 sq ft.
b. 30.2 sq ft.
c. 38.9 sq ft.
d. 79.8 sq ft.

2. A triangle has its base 8 1/3 ft, and its height is 3 3/5 ft. Compute its area. *Basic*

a. 15 sq ft.
b. 18 sq ft.
c. 25 sq ft.
d. 30 sq ft.

3. A circle has a radius of 8 ft. Compute its area to the closest square foot. *Basic*

a. 128 sq ft.
b. 185 sq ft.
c. 201 sq ft.
d. 250 sq ft.

4. The effluent weir is located along the rim of a 60-ft diam clarifier. What is the approximate length of the weir? *Basic*

a. 188 ft.
b. 248 ft.
c. 562 ft.
d. 1,130 ft.
e. 2,032 ft.

5. What is the surface area of a trickling filter 40 ft in diam? *Basic*

a. 126 sq ft.
b. 422 sq ft.
c. 630 sq ft.
d. 1,120 sq ft.
e. 1,256 sq ft.

6. The volume of sludge in a sludge storage tank 14 ft in diam and 20 ft deep is about *Basic*

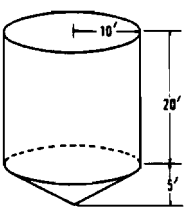
a. 900 cu ft.
b. 2,000 cu ft.
c. 3,100 cu ft.
d. 4,200 cu ft.

7. A circular digester has the dimensions and bottom shape shown in the sketch. *Basic*

Area of a circle $= \frac{22}{7} R^2 \quad R = 10$

Volume of a cylinder $= \frac{22}{7} R^2 h$ 20′

Volume of a cone $= 1/3 \left(\frac{22}{7} R^2 h\right)$ 5′



1. Find the surface area of the roof, assuming that it is flat. (Answer will be in square feet.)

a. 31.4.
b. 62.8.
c. 314.
d. 512.

2. Find the volume of the cone at the bottom of the tank.
   a. 1,570.
   b. 1,140.
   c. 927.
   d. 523.

8. Find the volume of a 100-ft diam tank, 12 ft deep. *Basic*
   a. 94,200 cu ft.
   b. 98,600 cu ft.
   c. 103,300 cu ft.
   d. 285,200 cu ft.
   e. 572,000 cu ft.

9. A plant effluent flowing at a rate of 2 mgd contains 15 mg/l solids. How many pounds of solids will be discharged per day? *Advanced*
   a. 100 lb/day.
   b. 150 lb/day.
   c. 180 lb/day.
   d. 220 lb/day.
   e. 250 lb/day.

10. Calculate which of the two sewer lines below would be most likely to contribute the most infiltration. *Basic*
   a. 2,000 ft long, 8 in. diam with 4-ft lengths.
   b. 1,800 ft long, 12 in. diam with 5-ft lengths.

11. Eight boxes of packing (for pumps) were delivered, and the invoice showed $15.93 each. What is the total cost of packing? *Basic*
   a. $100.24.
   b. $106.34.
   c. $109.31.
   d. $111.51.
   e. $127.44.

12. What is the approximate volume of a settling tank that is 30 ft long, 10 ft wide, and 8 ft deep? *Basic*
   a. 17,950 gal.
   b. 22,300 gal.
   c. 15,000 gal.
   d. 24,000 gal.

13. If the sludge level in a digester 30 ft in diam is lowered 1 ft, how many square feet of sludge bed area would be necessary to cover the bed to a depth of 12 in.? *Basic*
   a. 132.
   b. 157.
   c. 314.
   d. 706.
   e. 831.

14. If the sludge bed is 15 ft square, how many inches will the above digester be drawn down to fill the bed to a depth of 12 in.? *Basic*
   a. 4.
   b. 8.
   c. 12.
   d. 17.

15. 4 mg/l of chlorine are added continuously to a wastewater flow that averages 5 mgd. How much clorine will be used in 30 days? *Advanced*

a. 5.000 lb.
b. 3,000 lb.
c. 1,500 lb.
d. 15,000 lb.

16. The cross sectional area of an 8-in. pipe is how many times as great as the cross sectional area of a 4-in. pipe? *Advanced*

a. 2.
b. 4.
c. 6.
d. 8.

17. An average chlorine dosage applied to plant effluent is 8.0 mg/l, and the average plant flow is 2.0 mgd. How many pounds of chlorine are used every day? *Advanced*

a. 16 lb.
b. 32 lb.
c. 133 lb.
d. 232 lb.
e. 332 lb.

18. The number of pounds of BOD from a sewer discharging 20 mgd of waste at 150 mg/l BOD is about *Advanced*

a. 25,000 lb.
b. 125,000 lb.
c. 150,000 lb.
d. 40,000 lb.

19. A stream has a DO of 8 mg/l and flow of 60 cfs. How many pounds of oxygen are available for waste assimilation if a 4-mg/l residual is required? *Advanced*

a. 5,010 lb.
b. 1,290 lb.
c. 3,880 lb.
d. 3,200 lb.

20. The volume of wastewater from a community was measured to be 600,000 gpd and the 5-day BOD to be 250 mg/l. The pounds of 5-day BOD contained in the wastewater per day were *Advanced*

a. 5,000 lb.
b. 2,500 lb.
c. 1,250 lb.
d. 1,500 lb.

21. Raw wastewater enterin ga primary settling tank contains 300 mg/l of SS. The effluent contains 200 mg/l of SS. The flow was 120,000 gal during the day the solids tests were made. How many pounds of solids, dry weight, were removed by settling? *Advanced*

a. 300 lb.
b. 215 lb.
c. 100 lb.
d. 83 lb.

22. A lagoon with a surface area of 450,000 sq ft is to be placed into operation. To prevent odor problems, the consulting engineer recommends that the pond be filled to a depth of 6 in. with water from a nearby stream. Assuming the lagoon to have straight sides, how many million gallons of water will be required? *Advanced*

a. 1.26 mil gal.
b. 1.68 mil gal.
c. 2.02 mil gal.
d. 3.14 mil gal.
e. 4.50 mil gal.

23. A community has wastewater stabilization ponds with a total area of 15 acres (650,000 sq ft). What rate of liquid loss by evaporation and percolation into the soil would equal the rate of inflow of 120,000 gpd? *Advanced*

a. 0.205 in./day.
b. 0.462 in./day.
c. 1.60 in./day.
d. 0.295 in/day.

24. The raw wastewater entering a primary settling tank contained 250 mg/l of SS. The effluent from the same tank contained only 100 mg/l SS. The flow was 500,000 gal during the day. (One gal=8.34 lb.) *Advanced*
Calculate the number of pounds of solids (dry weight) that were removed by settling.

a. 62.5.
b. 75.0.
c. 150.0.
d. 625.0.
e. None of the above.

25. What is the volume of a settling tank 100 ft long, 25 ft wide, and 8 ft deep? *Basic*

a. 16,000 cu ft.
b. 20,000 cu ft.
c. 25,000 cu ft.
d. 36,200 cu ft.
e. 56,400 cu ft.

26. Find, to the closest tenth of a cubic foot, the volume of a cylinder with a radius of 5 ft and height of 8 ft. *Advanced*

a. 251.3 cu ft.
b. 328.3 cu ft.
c. 451.3 cu ft.
d. 628.3 cu ft.

27. Find, to the closest cubic foot, the volume of a cone with a radius of 8 ft and and altitude of 12 ft. *Advanced*

a. 84 cu ft.
b. 256 cu ft.
c. 502 cu ft.
d. 804 cu ft.

28. Find, to the closest tenth of a cubic foot, the volume of a sphere with a radius of 2 ft. *Advanced*

a. 25.1 cu ft.
b. 33.5 cu ft.
c. 250.1 cu ft.
d. 303.5 cu ft.

29. The volume of sludge, above the hopper bottom, in a separate sludge digester 50 ft in diam with a sludge depth of 15 ft above the hopper, is *Advanced*

a. 4,700 gal.
b. 10,600 gal.
c. 35,000 gal.
d. 79,300 gal.
e. 31,800 gal.

30. A cylinder tank with a radius of 5 ft is filled to a depth of 10 ft with water. Approximately how many gallons of water does it contain? *Advanced*

a. 578 gal.
b. 785 gal.
c. 870 gal.
d. 5,870 gal.

31. Sludge is drawn onto a 20- x 40-ft bed to a depth of 6 in. The number of gallons of sludge withdrawn would be *Advanced*

a. 4,400 gal.
b. 3,000 gal.
c. 2,200 gal.

32. The following measurements were made around the property line of a water treatment plant in order to determine the length of fence required. What total length of fence will be required if the measurements were 211, 608, 35, 37, and 704 ft? *Basic*

a. 4,142 ft.
b. 2,243 ft.
c. 1,595 ft.
d. 425 ft.

33. The effluent of a wastewater treatment plant is 35,000 gpd. How would you show the 35,000 gal as a decimal fraction of 1 mil gal? *Basic*

a. 0.35 mil gal.
b. 0.035 mil gal.
c. 3.50 mil gal.
d. 0.0035 mil gal.
e. 0.00035 mil gal.

34. Divide 8×10^8 by 1.6×10^{10}. *Advanced*

a. 2×10^{-2}.
b. 5×10^{-4}.
c. 0.5.
d. 5×10^{-2}.
e. 50.

35. Multiply 0.000015 by 0.000003 and express the product in scientific notation. *Advanced*

a. 4.5×10^{-13}.
b. 5×10^{-10}.
c. 4.5×10^{-7}.
d. 4.5×10^{-11}.
e. 4.5×10^{-9}.

36. The difference between the desired value and the measured value is called *Advanced*

a. Closed loop.
b. Deviation.
c. Correcting chains of elements.

37. An operator of a small plant performs four BOD tests during a certain month, obtaining the following results: 29.0, 22.5, 27.0, and 26.3. What is the average BOD for the month? *Basic*

a. 25.5.
b. 27.8.
c. 30.5.
d. 21.9.
e. 26.2.

38. An operator of a small treatment works takes two BOD tests every week. At the end of the month he finds he has the following results: 19.3, 21.4, 17.0, 29.9, 24.0, and 21.0. What is the average BOD for the month? *Basic*

a. 17.0.
b. 19.8.
c. 22.1.
d. 23.9.
e. 24.2.

39. A water treatment plant used 647 chlorine cylinders during one year's operation. The average withdrawal from each cylinder was 138 lb. What was the total number of pounds of chlorine used? *Basic*

a. 89,876 lb.
b. 89,286 lb.
c. 70,872 lb.
d. 69,876 lb.

40. A total of 3,060 hr was worked by 15 employees of a water treatment plant. What was the average number of hours worked by each employee? *Basic*

a. 420 hr.
b. 402 hr.
c. 240 hr.
d. 204 hr.

41. A trickling filter plant receiving 0.5 mgd raw wastewater produces an effluent with 20 mg/l BOD. The receiving stream flows at 20 mgd and has a BOD of 4 mg/l just upstream from the plant. After thorough mixing of the plant effluent with the stream, the BOD of the stream may be expected to be about *Advanced*

a. 1.0 mg/l.
b. 2.4 mg/l.
c. 3.2 mg/l.
d. 4.4 mg/l.
e. 7.2 mg/l.

42. Fifty thousand gal of wastewater having an SS content of 40 mg/l is intimately mixed with 100,000 gal of wastewater having an SS content of 130 mg/l. The SS content of the mixture would be *Advanced*

a. 50 mg/l.
b. 100 mg/l.
c. 150 mg/l.
d. 170 mg/l.

43. A new industry proposes to locate in a community. The wastewater treatment plant is now treating 20 mgd. The industry proposes to discharge 2 mgd with a phenol content of 10 mg/1,000 l. The resulting phenol concentration by admixture if no removals were obtained would be *Advanced*

a. 0.0005 mg/l.
b. 0.017 mg/l.
c. 0.009 mg/l.
d. 0.0183 mg/l.
e. 0.001 mg/l.

44. Given: Plant flow = 15 mgd, upstream flow = 140 mgd, BOD upstream = 3 mg/l, BOD downstream = 5 mg/l. The BOD of the plant effluent is approximately *Advanced*

a. 236.
b. 24.
c. 100.
d. 10.

45. The bottom of a rectangular tank measures 8 ft 4 in. x 5 ft 10 in. If the tank contains 210,000 lb of water, what is the approximate pressure in pounds per square inch exerted on its bottom? *Advanced*

a. 91 psi.
b. 30 psi.
c. 21 psi.
d. 15 psi.

46. A partially treated wastewater having a 5-day BOD of 150 mg/l is discharged at the rate of 1 mil gal/day to a stream, the BOD of which is 5 mg/l above the point of discharge. If the stream flow is 15.5 cu ft/sec, what would be the hypothetical BOD of the stream after the wastewater was well mixed? (One mil gal/day = 1.55 cu ft/sec.) *Advanced*

a. 18.2.
b. 14.2.
c. 12.8.
d. 10.4.

47. Calculate the SVI from the following laboratory data: Sludge level in 1-l graduated cylinder after 30 min settling is 195 ml; SS in mixed liquor is 2,300 mg/l; and *Basic*

$$\text{SVI} = \frac{\text{ml settled sludge} \times 1{,}000}{\text{mg/l SS}}$$

a. 117.
b. 100.
c. 147.
d. 85.
e. 170.

48. A sample is taken from the aeration tank at an activated sludge plant. In 30 min. the sludge floc in a 1,000-cu cm graduated cylinder had settled to the 280 cu cum mark. The SS were determined to be 2,200 mg/l. The sludge index was then *Advanced*

a. 50.
b. 80.
c. 127.
d. 180.

49. Lab results and flow rate for an activated sludge plant are listed below. The aeration tank volume is 0.50 mil gal. *Advanced*

MLSS = 1,800 mg/l
Mixed liquor volatile content = 76 percent
Thirty-min settleable solids test = 170 ml or 17 percent
Primary effluent BOD = 140 mg/l
Primary effluent SS = 110 mg/l
Flow rate = 2.0 mgd

Find the SVI.

a. 52.
b. 65.
c. 81.
d. 94.
e. 142.

50. In an activated sludge plant, it was determined that an SVI of less than 60 was good, between 60 and 80 was fair, and above 80 indicated bulking would soon follow. A test was made, and the 30-min settling volume was 15 percent and SS were 3,000 mg/l. The results were *Advanced*

a. Fair.
b. Good.
c. Indicative of bulking.
d. Not enough information given.

51. Determine the BOD of a raw wastewater represented by the information below: *Advanced*

DO in blank = 7.8 mg/l; DO in incubated test = 4.0 mg/l;
Number of milliliters of wastewater added to bottle = 5;
Capacity of bottle in milliliters = 300.

a. 228.
b. 168.
c. 79.
d. 57.

52. If the desired DO depletion is 4.0 mg/l in the BOD test and the expected BOD strength of the wastewater sample is 200 mg/l, how much sample should be added to a 300-ml BOD bottle? *Advanced*

a. 2.0 ml.
b. 4.0 ml.
c. 6.0 ml.
d. 8.0 ml.
e. 10.0 ml.

53. Find the theoretical horsepower required to operate a 1.5-mgd pump against a head of 48.5 ft. [Theoretical horsepower = $\frac{\text{gpm} \times 8.34 \times \text{head (ft)}}{33{,}000}$] *Basic*

a. 7.5.
b. 12.8.
c. 15.0.
d. 25.5.
e. 36.8.

54. The overload heaters on a 10-hp motor stopped it after running a short while. A power check was made while the motor was running and showed the following results: 430 v and 22 amp. Assuming all other conditions were normal, what was the horsepower overload? *Advanced*

a. 2.68.
b. 5.3.
c. 1.2.
d. Not enough information given.

55. Calculate the power bill for one month (30 days) if an electrical load of 500 hp is used and the cost is $0.01/kwh. *Advanced*

a. $8,952.
b. $373.
c. $2,685.
d. $3,600.
e. $746.

56. A pump has a capacity of 7,000 gpm and lifts wastewater 22 ft (total head). If the motor efficiency is 90 percent and pump efficiency is 85 percent, what size horsepower motor is required? *Advanced*

a. 50 hp.
b. 40 hp.
c. 45 hp.
d. 55 hp.

57. Efficiency is an important consideration in pumping operations. Which of the following relations should be used to determine it? *Advanced*

a. Gpm x 1,440/kw x 746.
b. Output/input (x 100).
c. Gpm x 1,440 x 7.5/kwh x 0.746 (x 100).
d. Gpm x 8.3 x 1,440/kwh x 33,000 (x 100).

58. If a sewer service charge is based on $0.15/1,000 gal, how much does a user have to pay for 30,000 gal of wastewater discharge? *Basic*

a. $0.15.
b. $1.50.
c. $3.00.
d. $4.50.
e. $6.00.

59. A tank holding 2,340 gal fills in 12 min. What is the rate of flow in gallons per minute? *Basic*

a. 195 gpm.
b. 234 gpm.
c. 284 gpm.
d. 362 gpm.
e. 412 gpm.

60. A settling tank in a community of 5,000 population receives a flow of 500,000 gpd. The tank is 10 ft deep, 10 ft wide, and 50 ft long. The theoretical detention period in hours is *Basic*

a. 1.33 hr.
b. 1.8 hr.
c. 2.0 hr.
d. 3.0 hr.

61. In order to provide for 2 hr detention time in a primary tank at a 7-mgd rate, the tank would have to be designed to have a capacity of *Basic*

a. 789,000 gal.
b. 722,000 gal.
c. 621,000 gal.
d. 583,000 gal.

62. A plant with a flow of 24 mgd has a clarifier size of 4 mil gal. What is the settling time? *Basic*

a. 6 hr.
b. 4 hr.
c. 1.66 hr.
d. 6 days.

63. Approximately how far down should the level in a wet well be lowered in 1 min by a pump with a rated capacity of 200 gpm? The wet well is 5 ft wide and 5 ft long. *Basic*

a. 0.1 ft.
b. 0.5 ft.
c. 1.0 ft.
d. 1.1 ft.
e. 2.0 ft.

64. A community has wastewater stabilization ponds with a total area of 13.8 acres (600,000 sq ft). The average winter wastewater flow to the ponds is 100,000 gpd. The maximum liquid storage depth in the ponds is 5 ft. In order to provide 180 days storage of winter wastewater flow, the liquid level of the ponds must be lowered in the fall about how many feet below the normal 3-ft depth? (Assume no loss of liquid by percolation or evaporation and that the ponds will fill to the maximum storage level of 5 ft.) *Advanced*

a. 1.0.
b. 1.0.
c. 2.0.
d. 2.5.
e. 3.0.

65. The weir overflow rate per day for a settling tank is *Advanced*

a. The product of the weir length and the volume of flow.
b. The volume of flow divided by the length of the weir.
c. The volume of flow divided by the volume of the tank.
d. The sum of the volume of flow and the weir length.

66. The surface settling rate per day for a settling tank is *Advanced*

a. The product of the tank surface area and the volume of flow.
b. The volume of flow divided by the surface area of the tank.
c. The volume of flow divided by the volume of the tank.
d. The sum of the volume of flow and the surface area of the tank.

67. A one cylinder reciprocating sludge pump with an 8-in. bore and a 4.5-in. stroke pumps 50 cycles/min. The pump must be operated how many minutes to pump 1,500 gal of sludge? *Advanced*

a. 15.
b. 30.
c. 60.
d. 90.

68. The average flow at a small wastewater plant is 120,000 gpd. Assume that a wet well of such size will require 35 min to fill at the average flow. What would be the wet well capacity in gallons? *Advanced*

a. 34,321 gal.
b. 12,000 gal.
c. 2,916 gal.
d. 8,256 gal.
e. 1,667 gal.

69. A flow of 6 mgd entered six aeration tanks 150 x 15 x 15 ft. What is the detention period in hours? *Advanced*

a. 1.5.
b. 4.0.
c. 6.1.
d. 10.0.
e. 5.3.
f. 7.6.

70. If 543 lb of BOD/day are applied to a trickling filter with a surface area of 3,215 sq ft and a depth of 7 ft, what is the loading in pounds per day per 1,000 cu ft? *Advanced*

a. 41.4.
b. 30.0.
c. 24.1.
d. 22.5.
e. 19.0.

71. A filter 100 ft in diam and 6 ft deep receives a flow of 0.5 mgd with a BOD of 150 mg/l. What is the BOD loading in pounds per day per 1,000 cubic feet of filter media?

Advanced

a. 13.3.
b. 26.8.
c. 53.2.
d. 108.
e. 625.

72. At an average flow of 6 mgd, 192 mg/l of BOD were removed; what was the cost per 1,000 lb of BOD if the operating cost was $54,000/yr?

Advanced

a. $15.40.
b. $9.70.
c. $7.65.
d. $35.30.
e. $22.00.

73. If a wastewater treatment plant wet well has horizontal dimensions of 10 x 5 ft above the sloping bottom and, with the raw wastewater pumps off, the time required for the liquid level to raise 1 ft is 5 min, what is the rate of raw wastewater flow into the wet well in gallons per minute?

Advanced

a. 50 gpm.
b. 75 gpm.
c. 83.3 gpm.
d. 150 gpm.

74. A dosing tank 6 x 8 ft and a working depth of 18 in. fills in 6 min. What is the rate of flow of wastewater into the dosing tank in gallons per minute?

Advanced

a. 6.0 gpm.
b. 12.0 gpm.
c. 36 gpm.
d. 90 gpm.
e. 180 gpm.

75. The volume of tank, expressed in cubic feet to provide a detention time of 2 hr for a flow of 1.0 mgd, is most nearly

Advanced

a. 5,560.
b. 10,000.
c. 11,120.
d. 83,300.

76. Find the detention time in hours of a sedimentation tank having a capacity of 250,000 gal with a daily flow of 2,400,000 gal.

Advanced

a. 5 hr.
b. 2.5 hr.
c. 1.2 hr.
d. 2 hr.
e. 6 hr.

77. An SS test was run with the following results: *Basic*

Volume of sample = 50 ml
Crucible weight = 21.6329 g
Crucible plus dry solids = 21.6531 g
Crucible plus ash = 21.6360 g
What is the total SS concentration of the sample?

a. 20.2 mg/l.
b. 180 mg/l.
c. 202 mg/l.
d. 318 mg/l.
e. 404 mg/l.

78. What is the chlorine demand if the residual is 0.6 mg/l and 6.6 mg/l have been applied? *Basic*

a. 1.1 mg/l.
b. 4.0 mg/l.
c. 6.0 mg/l.
d. 6.6 mg/l.
e. 7.2 mg/l.

79. Find the SS in milligrams per liter when the laboratory bench sheet shows the following data for a settled sample:

Volume of sample = 100 ml *Basic*
Weight of crucible and solids = 18.7104 g
Weight of crucible = 18.6984 g

a. 240.
b. 24.
c. 40.
d. 120.
e. 12.

80. It is desired to have a chlorine residual of 0.5 mg/l on wastewater having chlorine demand of 5.4 mg/l. What is the required chlorine dose? *Basic*

a. 0.5 mg/l.
b. 1.0 mg/l.
c. 5.0 mg/l.
d. 5.4 mg/l.
e. 5.9 mg/l.

81. A digester with a volume of 25,000 cu ft receives 2,000 dry pounds of raw sludge/day with a volatile content of 70 percent. What is the digester loading? *Advanced*

a. 23 lb volatile matter/day/1,000 cu ft.
b. 36 lb volatile matter/day/1,000 cu ft.
c. 42 lb volatile matter/day/1,000 cu ft.
d. 56 lb volatile matter/day/1,000 cu ft.
e. 71 lb volatile matter/day/1,000 cu ft.

82. HTH is fed to the head of a chlorine contact tank at the rate of 55 lb/day on a wastewater flow of 0.55 mgd. The effective portion of chlorine in 1 lb of HTH is 67 percent. Calculate the chlorine dose. *Advanced*

a. 6.2 mg/l.
b. 8.0 mg/l.
c. 10.0 mg/l.
d. 12.0 mg/l.
e. 15.0 mg/l.

83. 250,000 gal of water contain 300 lb of solids. Find the concentration of solids in pounds per 10^6 gal. *Advanced*

a. 830 lb/10^6 gal.
b. 1,200 lb/10^6 gal.
c. 3,750 lb/10^6 gal.
d. 7,500 lb/10^6 gal.

84. How many pounds of a chemical must be added to 50,000 gal of water in order to produce a dosage of 75 mg/l? *Advanced*

a. 15.
b. 31.
c. 60.
d. 150.

85. Chlorine feed rate in pounds per day may be calculated from *Advanced*

a. Chlorine residual and chlorine demand.
b. Chlorine dose and clorine demand.
c. Chlorine dose and average flow rate.
d. Chlorine residual and average flow rate.
e. Chlorine demand and average flow rate.

86. We wish to dose the final effluent with 5 mg/l of chlorine, and we will pace the chlorinator based on flow. It is anticipated that the peak flow will be 1.5 times the daily flow of 7 mgd. Under no circumstances should we purchase a chlorine machine that would feed at a rate less than *Advanced*

a. 200 lb/day.
b. 300 lb/day.
c. 400 lb/day.
d. 500 lb/day.

87. A rectangular reservoir 110 x 60 x 12 ft is filled with water. How many pounds of a chemical must be added in order to produce a dosage of 80 mg/l? *Advanced*

a. 125 lb.
b. 250 lb.
c. 110 lb.
d. 395 lb.

88. Five lb of liquid chlorine are dissolved in 10 gal of water. If 7 gal of the resulting solution are fed over a 24-hr period, the rate of available chlorine applied is *Advanced*

a. 0.7 lb/24 hr.
b. 1.5 lb/24 hr.
c. 2.8 lb/24 hr.
d. 3.5 lb/24 hr.

89. One thousand mg/l is equal to *Basic*

a. 0.01 percent.
b. 0.10 percent.
c. 1.00 percent.
d. 10.00 percent.

90. Sludge concentration of 25,000 mg/l is the same as what percentage of sludge? *Basic*

a. 0.15 percent.
b. 0.50 percent.
c. 2.5 percent.
d. 5.0 percent.
e. 25.0 percent.

91. Reduction of the moisture content of a digested wastewater sludge from 95 to 90 percent will reduce its volume by about *Advanced*

a. 5 percent.
b. 15 percent.
c. 25 percent.
d. 35 percent.
e. 50 percent.

92. The average result of the Imhoff cone settleable solids test on raw wastewater is 6.0 ml/l. If the total flow entering the plant is 0.5 mgd, how many gallons of sludge should be pumped from the primary clarifier each day? *Basic*

a. 3,000 gal/day.
b. 3,300 gal/day.
c. 15,000 gal/day.
d. 22,500 gal/day.
e. 25,000 gal/day.

93. If the primary unit in a plant may be expected to remove 25 percent of the BOD load applied and the trickling filter unit can remove 70 percent of the BOD load applied, the expected overall removal will be *Basic*

a. 95 percent.
b. 75 percent.
c. 77 percent.
d. Cannot be determined.

94. Of the $90 allotted to maintenance at a plant, 15 percent was spent on pump repair. How many dollars were spent? *Basic*

a. $60.
b. $45.
c. $15.50.
d. $13.50.

95. What is the efficiency of a primary tank if the influent BOD is 200 mg/l and the effluent BOD of the tank is 140 mg/l? *Basic*

a. 15 percent.
b. 30 percent.
c. 40 percent.
d. 60 percent.
e. 85 percent.

96. The results of 5-day BOD determinations for composite samples of wastewater in a trickling filter plant are *Basic*

Raw wastewater = 300 mg/l
Final effluent = 45 mg/l
What is the percentage reduction in 5-day BOD accomplished by the plant?

a. 35 percent.
b. 65 percent.
c. 15 percent.
d. 95 percent.
e. 85 percent.

97. The results of 5-day BOD determinations for composite samples of wastewater in a trickling filter plant are as follows: *Basic*

Raw wastewater = 300 mg/l
Primary tank effluent = 200 mg/l
Final tank effluent = 60 mg/l
What is the percentage reduction in 5-day BOD accomplished by the trickling filter and final tank only?

a. 47 percent.
b. 65 percent.
c. 70 percent.
d. 80 percent.
e. 90 percent.

98. With a raw wastewater BOD of 300 mg/l and an effluent BOD of 75 mg/l, percentage reduction is *Basic*

a. 25 percent.
b. 49 percent.
c. 75 percent.

99. When 10,000 gal of sludge containing 1 percent solids are thickened to 5 percent solids, the new volume will be *Advanced*

a. 1,000 gal.
b. 2,000 gal.
c. 4,000 gal.
d. 5,000 gal.

100. A secondary treatment plant has a single digester. Raw sludge addition is 1,000 gal/day, total solids (TS) are 6 percent, volatile solids (VS) are 80 percent. The supernatant is 1 percent TS, 60 percent VS. Digested sludge is withdrawn at a rate of 15,000 gal/month (assume 30 days/month). The TS of digested sludge is 8 percent, VS 40 percent. The number of gallons of supernatant withdrawn per month is about 15,000. *Advanced*

1. Find the percentage reduction of VS based on raw sludge input and digested sludge output.
   a. 32 percent.
   b. 48 percent.
   c. 50 percent.
   d. 67 percent.
   e. 83 percent.

104. An analysis of wastewater from a given plant is as follows: *Advanced*

	BOD (mg/l)	SS (mg/l)	Settleable Solids (mg/l)
Raw wastewater	136	142	3.5
Primary effluent	40	82	0.5
Trickling filter effluent	17		
Final effluent	9	30	0.2

1. Overall BOD removal expressed as a percentage is
   a. 15.0.
   b. 66.1.
   c. 77.5.
   d. 93.5.
   e. 95.0.

2. Overall SS removal expressed as a percentage is
   a. 21.2.
   b. 47.0.
   c. 79.0.
   d. 82.4.
   e. None of these.

3. Overall settleable solids removal expressed as a percentage is
   a. 57.2.
   b. 78.5.
   c. 80.1.
   d. 85.7.
   e. 94.3.

4. Efficiency of BOD removal by the primary clarifier expressed as a percentage is
   a. 28.0.
   b. 30.2.
   c. 34.0.
   d. 57.6.
   e. 70.6.

5. Efficiency of BOD removal by the trickling filter and final clarifier expressed as a percentage is
   a. 5.75.
   b. 77.5.
   c. 71.0.
   d. 85.7.
   e. 93.1.

105. The SS test was run with the following results *Advanced*

Volume of sample = 50 ml
Crucible weight = 21.6329 g
Crucible plus dry solids = 21.6531 g
Crucible plus ash = 21.6360 g
Compute the percentage VS.

a. 34.2 percent.
b. 40.4 percent.
c. 62.0 percent.
d. 84.7 percent.
e. 98.1 percent.

2. The number of pounds of VS withdrawn from the bottom of the digester per day averages about
   a. 133.
   b. 103.
   c. 53.
   d. 33.
   e. 13.

3. Based on the information given, this digester would be considered
   a. Normal.
   b. "Stuck."
   c. High rate.
   d. Overmixed.
   e. Overloaded.

101. Assume 0.2 lb of SS/day/capita in the raw wastewater entering a primary treatment plant serving 1,000 people. 75 percent of the material is discharged to the digester.

Advanced

1. How many pounds per day of SS go to the digester?
   a. 150.
   b. 200.
   c. 500.
   d. None of these.

2. The above raw sludge discharged to the digester is 5 percent solids. How many pounds of sludge were pumped?
   a. 1,040.
   b. 3,000.
   c. 7,885.
   d. 9,500.

3. How many gallons of liquid sludge were pumped?
   a. 120.
   b. 360.
   c. 1,000.
   d. None of these.

102. Pump efficiency is 85 percent; motor efficiency is 94 percent. The combined efficiency of the two is *Advanced*

a. 90 percent.
b. 80 percent.
c. 70 percent.
d. 75 percent.
e. No way to know.

103. If 1-l Imhoff cones of raw and settled wastewater contain 3.0 and 0.3 m of sediment, the reduction of settleable solids is *Advanced*

a. 34 percent.
b. 90 percent.
c. 27 percent.
d. 82 percent.
e. 64.6 percent.

106. A sludge conditioning tank contained 54,000 gal of 4.5 percent dry solids and 26 percent ash. The number of pounds of dry solids was *Advanced*

a. 20,200.
b. 5,250.
c. 45,000.
d. 11,070.

107. Six hundred twenty five lb of dry solids are removed from a primary tank daily. If the moisture content is 95.5 percent, what is the total volume of the sludge in gallons? *Advanced*

a. 495,000.
b. 22,500.
c. 12,000.
d. 1,670.
e. 1,542.

108. Chlorinated lime containing 15 percent available chlorine is used to chlorinate 250,000 gal of wastewater. How many pounds are needed for a 2.5 mg/l dosage? *Advanced*

a. 12.5 lb.
b. 83.2 lb.
c. 34.7 lb.
d. 49 lb.
e. 66.7 lb.

109. An anaerobic digester is being fed with sludge that is 70 percent VS. The digested sludge being withdrawn is 42 percent VS. What is the precentage reduction in VS during digestion? *Advanced*

a. 20.
b. 30.
c. 40.
d. 42.
e. 70.

110. A plant ran blowers for 24 hr at 5,000 cu ft/min. A BOD removal of 90 percent was obtained with a 5-mgd flow containing 12,000 lb BOD. How many cubic feet of air were required to remove a pound of BOD if the activated sludge system removed 6,000 lb BOD? *Advanced*

a. 660.
b. 1,200.
c. 595.
d. 1,000.

111. When considering a lateral sewer serving a number of residences, the minimum size allowed is usually 8 in. diam. An 8-in. sewer must be placed on a slope of at least 0.4 percent. Which of the following is most nearly equal to that? *Advanced*

a. 1/16 in./ft.
b. 1/8 in./ft.
c. 1/4 in./ft.
d. 1/2 in./ft.

112. A sludge drying bed 60 x 90 ft is filled to a depth of 12 in. When the sludge is ready for removal, it is found that its volume has been reduced by 70 percent. How many cubic feet of dried sludge are there on the bed? *Advanced*

a. 540 cu ft.
b. 1,010 cu ft.
c. 1,620 cu ft.
d. 2,420 cu ft.
e. 3,780 cu ft.

113. Parts per million is essentially the same as milligrams per liter. It is the same as *Basic*

a. 7.48 gal/mil gal.
b. 8.34 lb/mil gal.
c. 1 gal/mil lb.

114. A stream has a flow of 1 mgd. Its oxygen content is 8 mg/l. The number of pounds of oxygen in the stream per day is nearest to which value? *Basic*

a. 8.
b. 60.
c. 67.
d. 1,200.
e. 8,000.

115. One cubic foot contains *Basic*

a. 5.7 gal.
b. 7.5 gal.
c. 10 gal.
d. 15 gal.

116. What is the approximate volume in gallons occupied by 15,000 cu ft of water? *Basic*

a. 22,100 gal.
b. 112,000 gal.
c. 120,000 gal.
d. 210,000 gal.

117. One gal of water weighs *Basic*

a. 7.5 lb.
b. 8.3 lb.
c. 3.8 lb.
d. 5.7 lb.

118. What is the approximate weight in pounds of 50,000 gal of water? *Basic*

a. 41,000 lb.
b. 71,000 lb.
c. 170,000 lb.
d. 417,000 lb.

119. Five gal of water weigh how many pounds? *Basic*

a. 7.5.
b. 8.34.
c. 37.5.
d. 50.
e. 41.7.

120. Change 95 mg/l to pounds per 10^6 gal. *Basic*

a. 792 lb/10^6 gal.
b. 1,139 lb/10^6 gal.
c. 1,390 lb/10^6 gal.
d. 5,620 lb/10^6 gal.

121. To which of the following temperatures on the centigrade scale does a reading of 95°F most nearly correspond? *Basic*

a. 35°C.
b. 37°C.
c. 127°C.
d. 63°C.
e. 18°C.

122. How many gallons per minute is a flow of 1.0 mgd? *Basic*

a. 521 gpm.
b. 681 gpm.
c. 693 gpm.
d. 813 gpm.
e. 826 gpm.

123. A wastewater treatment plant receives an average flow of 261 gpm with a strength of 225 mg/l BOD. What is the daily total flow to the plant? *Basic*

a. 0.15 mgd.
b. 0.30 mgd.
c. 0.32 mgd.
d. 0.38 mgd.
e. 4.8 mgd.

124. If a plant receives 510 lb of BOD/day and the population equivalent (PE) is 0.17 lb BOD, what is the PE tributary to the plant? *Advanced*

a. 170.
b. 340.
c. 510.
d. 2,000.
e. 3,000.

125. The PE of an industrial waste with 560 lb of BOD/day is *Advanced*

a. 330.
b. 560.
c. 1,750.
d. 3,300.
e. 5,600.

126. The number of pounds of BOD that a population of 8,400 people served by a sewer system would contribute to a wastewater treatment plant per day would be approximately *Advanced*

a. 4,100.
b. 850.
c. 500.
d. 250.
e. 1,400.

127. A treatment plant serves a town of 5,700. It also receives an industrial waste with 969 lb of BOD daily. What is the PE load of the plant? (PE is 0.17 lb BOD/day/person.) *Advanced*

a. 969.
b. 5,700.
c. 6,669.
d. 8,218.
e. 11,400.

128. A temperature of 20°C corresponds to a temperature of *Advanced*

a. 32°F.
b. 48°F.
c. 68°F.
d. 85°F.

129. The factor 2.3 is often used in related pounds per square inch pressure and discharge head in feet. A pump is equipped with a pressure gauge in the discharge pipe that reads 100 psi. The total discharge head in feet would be approximately *Advanced*

a. 43 ft.
b. 230 ft.
c. 178 ft.

130. Five ft of water are equal to *Advanced*

a. 1.10 psi.
b. 1.80 psi.
c. 1.65 psi.
d. 2.00 psi.
e. 2.17 psi.

131. The water level in an elevated tank is 100 ft above the ground surface. The resultant pressure at a tap on a line on the ground below the tank is about *Advanced*

a. 43.5 psi.
b. 15.0 psi.
c. 75 psi.
d. 32.5 psi.
e. None of these.

132. What would be the correct reading in pounds per square inch on the pressure gauge on the discharge line of a blower supplying air to an aeration unit having a water depth of 12 ft and overall friction loss of 1.6 psi? *Advanced*

a. 4 to 5 psi.
b. 6 to 7 psi.
c. 8 to 9 psi.
d. 12 to 13 psi.

133. The pressure in pounds per square inch on a 1-ft square plate on the bottom of a sludge tank containing sludge 50 ft deep is *Advanced*

a. 115.5.
b. 3,124.8.
c. 21.7.
d. 2.31.
e. 62.4.

134. A flow of wastewater of 0.7 mgd is most nearly equal to *Advanced*

a. 30,000 gph.
b. 0.45 cfs.
c. 1.08 cfs.
d. 550 gpm.

135. A flow of wastewater of 1 cfs is most nearly equal to *Advanced*

a. 0.547 mil gal/day.
b. 449 gph.
c. 8.33 gpm.
d. 0.646 mil/day.

136. Change 600 lb/10^6 gal to milligrams per liter. *Advanced*

a. 10.3 mg/l.
b. 24.0 mg/l.
c. 42.0 mg/l.
d. 71.9 mg/l.

137. The average amount of gas per day to be expected from a primary plant digester serving 1,000 persons is *Advanced*

a. 100 cu ft.
b. 200 cu ft.
c. 400 cu ft.
d. 800 cu ft.

138. How many milliliters of 0.1 *N* sodium thiosulfate will be required to make 2 l of 0.025 *N* solution? *Basic*

a. 50.
b. 500.
c. 40.
d. 200.

139. You are to design a treatment plant using the following processes or pieces of equipment: bar screens, grit chamber, Parshall flume, lift pumps, primary settling tanks, trickling filter (roughing), aeration tanks, final settling tanks, chlorine contact chamber, digester, vacuum filter, and incinerator. The town for which you are to design this plant supplies you with the following information: population, 45,000; flow, 7.0 mgd; BOD, 350 mg/l; SS, 300 mg/l; settleable solids, 5.0 ml/l flow in the creek in which to discharge the effluent is 6 cfs and has a BOD of 3 mg/l and a DO of 7.2 mg/l during critical or low flow conditions. *Advanced*

1. If five large industries contribute 35 percent of the flow and 50 percent of the BOD, the per capita discharge of wastewater is
   a. 115 gpd/capita.
   b. 128 gpd/capita.
   c. 156 gpd/capita.
   d. 175 gpd/capita.
2. The total number of pounds of BOD and SS contributed to the plant each day, respectively, is
   a. 20,500 and 17,500.
   b. 18,250 and 14,750.
   c. 20,500 and 14,750.
   d. 18,250 and 17,500.

3. We expect the following efficiencies of BOD removal from the various units: primary tanks, 25 percent; trickling filters, 40 percent; aeration tank (activated sludge), 85 percent. Based on the expected efficiencies, the overall efficiency of the plant will be
   a. 97 percent.
   b. 93 percent.
   c. 87 percent.
   d. 83 percent.

4. In order to provide for 2 hr detention time in the two primary tanks at a 7-mgd rate, these tanks would have to be designed to have a capacity of
   a. 789,000 gal.
   b. 722,000 gal.
   c. 621,000 gal.
   d. 583,000 gal.

5. If a pump capacity is designed to handle eventually 60,000 gpd of sludge on the basis of continuous pumping, the pump would have to be capable of delivering
   a. 37 gpm.
   b. 42 gpm.
   c. 47 gpm.
   d. 52 gpm.

6. If 30 days digestion time are provided for the ultimate 60,000 gpd, how much digester capacity will be needed?
   a. 240,000 cu ft.
   b. 300,000 cu ft.
   c. 360,000 cu ft.
   d. 400,000 cu ft.

140. One wishes to use two vacuum filters that will dewater 60,000 gal of sludge daily and feed the filter cake to an incinerator continuously. Each filter must be capable of feeding continuously to the incinerator alone. The solids in the sludge will average 6.0 percent, and the cake will have 75 percent moisture. A polymer having a weight of 10 lb/gal will be used to dewater the sludge. Answer the following questions by using the above information: *Advanced*

1. How many pounds of dry solids will be filtered each day?
   a. 15,000 lb.
   b. 20,000 lb.
   c. 25,000 lb.
   c. 30,000 lb.

2. How many pounds of wet cake will be produced each day?
   a. 60,000 lb.
   b. 80,000 lb.
   c. 100,000 lb.
   d. 120,000 lb.

3. If the polymer dosage is 1.0 percent by dry weight, how many gallons of polymer would be used each day?
   a. 20 gal.
   b. 30 gal.
   c. 40 gal.
   d. 50 gal.
4. If the polymer cost is $0.25/lb, what is the cost per ton of dry cake?
   a. $2.50.
   b. $5.00.
   c. $7.50.
   d. $10.00.

141. A stream with a cross section of 322 sq ft has a flow of 805 cfs. Given Q = AV where *Advanced*

Q = quantity of flow
A = area of cross section
V = velocity
Find the velocity of the stream.

a. 0.40 ft/sec.
b. 2.50 ft/sec.
c. 4.0 ft/sec.
d. 25.0 ft/sec.
e. 25.9 ft/sec.

142. By the time a trickling filter plant reaches design hydraulic loading, it is anticipated that the BOD loading to the filters will be 20,000 lb/day. If we are to have two filters each 4 ft deep, what will the diameter have to be in order not to load the filters with more than 100 lb of BOD/ 1,000 cu ft of filter media? *Advanced*

a. 145 ft.
b. 160 ft.
c. 178 ft.
d. 198 ft.

143. We wish to dose the final effluent with 5 mg/l of chlorine and will pace the chlorinator based on flow. It is anticipated that the peak flow will be 1.5 times the daily flow of 7 mgd. Under no circumstances should we purchase a chlorine machine that could feed at a rate less than *Advanced*

a. 200 lb/day.
b. 300 lb/day.
c. 400 lb/day.
d. 500 lb/day.

144. Which is the stronger solution of sodium thiosulfate? *Basic*

a. N/40.
b. N/25.
c. N/10.
d. N/5.

145. Atomic weights are based on all atoms being lighter or heavier than which element as a standard? *Basic*

a. Hydrogen.
b. Iron.
c. Oxygen.

146. The word "Normal" associated with a reagent refers to *Basic*

a. The exact concentration of the reagent.
b. The purity of the chemicals.
c. The reagent usually used.
d. The molecular weight of the reagent.

147. Substances that cannot be broken down into simpler substances by chemical changes are called *Basic*

a. Atoms.
b. Elements.
c. Compounds.
d. Ions.

148. Those materials that dissolve in water are called dissolved solids, while other solids are called SS. Which of the following is a dissolved solid? *Basic*

a. Salt in water.
b. Baking soda in water.
c. Sugar in coffee.
c. All of these.

149. The term pH is used to express the *Basic*

a. Rapidity of ascent of a logarithmic growth curve.
b. Ratio between the diameter and total surface area of a coccus.
c. Factor 3.1415.
d. Mean average density of a bacterial population.
e. Concentration of hydrogen ions in a solution.

150. Organic chemistry is concerned with compounds containing the element *Advanced*

a. Iron.
b. Methane.
c. Carbon.
d. Chlorine.

151. Odor problems at wastewater treatment plants are generally associated with hydrogen sulfide. The hydrogen sulfide may be present in wastewater as _____ depending on the pH levels. *Advanced*

a. H_2SO_4, HS^-, or SO_2.
b. H_2S, H_2SO_4, or S^{2-}.
c. H_2S, or HS^-.
d. S^{2-}, or H_2SO_4.
e. H_2S, HS^-, or S^{2-}.

152. Carbon dioxide in water will do which of the following? *Advanced*

a. Increase turbidity.
b. Decrease turbidity.
c. Raise pH.
d. Lower pH.
e. Act as a catalyst for soda ash.

153. To control the pH of water, when using aluminum sulfate as the coagulant, what would you use? *Advanced*

a. $CaSO_4$.
b. $Ca(OH)_2$.
c. Either of the above.
d. Neither of the above.

154. pH is a measure of what in water? *Advanced*

a. Hydroxide ions.
b. Sodium ions.
c. Calcium ions.
d. Hydrogen ions.
e. Chloride ions.

155. The symbols OH and SO_4 are called Advanced

a. Molecules.
b. Radicals.
c. Atoms.

156. The precipitate in coagulation with alum is aluminum *Advanced*

a. Sulfate.
b. Chloride.
c. Carbonate.
d. Bica nate.
e. Hyd ide.

157. Which of the following ions is not responsible for the existence of alkalinity in water? *Advanced*

a. SO_4^{2-}.
b. OH^-.
c. CO_3^{2-}.
d. HCO_3^-.

158. Which of the following pairs of chemical determinations would be most valuable in determining the value of activated sludge as a fertilizer? *Advanced*

a. Phosphoric acid anhydride and nitrogen.
b. Chlorine and potassium thiosulfate.
c. Sodium thiosulfate and hydrogen.
d. DO and potassium iodide.
e. Hydrogen sulfide and manganous sulfate.

159. The molecular weight of sodium hydroxide is 40. The percentage concentration of sodium hydroxide in an 0.5 *N* solution is *Advanced*

a. 4.0.
b. 2.0.
c. 8.0.
d. None of the above.

160. A 1 *N* stock solution of NaOH is prepared by dissolving *Advanced*

a. 4 g of NaOH/l.
b. 40 g of NaOH/l.
c. 0.4 g of NaOH/l.
d. None of the above.

161. Which of the following is the approximate correct percentage of oxygen and nitrogen in the air? *Basic*

a. 21 percent O_2; 79 percent N_2.
b. 50 percent O_2; 50 percent N_2.
c. 5 percent O_2; 95 percent N_2.

162. The standard unit of electrical power is the *Basic*

a. Current.
b. Resistance.
c. Watt.
d. All of the above.
d. None of the above.

163. The amount of oxygen that may become dissolved in a given amount of water is most related to *Basic*

a. Temperature.
b. Turbidity.
c. Depth.
d. Pressure.

164. The temperature of a stream is 10°C. What is the equivalent Fahrenheit temperature? *Basic*

a. 122°F.
b. 82°F.
c. 50°F.
d. 42°F.

165. Cathodic protection means *Advanced*

a. Protection against contamination.
b. Protection against infiltration.
c. Protection against corrosion.
d. Protection against hardness.
e. None of these.

166. If a sewer line 1,000 ft long and 24 in. in diam is filled with wastewater, approximately how many pounds will it hold, if the wastewater has a specific gravity of 1.20? *Advanced*

a. 250,000 lb.
b. 3,000,000 lb.
c. 2,500,000 lb.
d. 28,000 lb.
e. 38,500 lb.

167. Which of the following has the highest heat value? *Advanced*

a. 1 lb of oil.
b. 1 cu ft of natural gas.
c. 1 cu ft of digester gas.

168. The saturation level for DO in distilled water at 20°C is about *Advanced*

a. 5.0 to 6.0 mg/l.
b. 6.0 to 7.0 mg/l.
c. 8.0 to 9.0 mg/l.
d. 12.0 to 15.0 mg/l.

169. The temperature versus DO relations for water (or wastewater) are such that *Advanced*

a. The higher the temperature the higher the DO saturation level.
b. The lower the temperature the lower the DO saturation level.
c. The higher the temperature the lower the DO saturation level.
d. All of the above.
e. None of the above.

170. The velocity in a circular sewer flowing one-half full is what percentage of the velocity when flowing full? *Advanced*

a. 100.
b. 66.
c. 50.
d. 25.

171. The hydraulic capacity of an 8-in. sewer flowing full is what part of that of a 24-in. sewer also flowing full and at the same velocity? *Advanced*

a. 1/6.
b. 1/3.
c. 1/9.
d. 1/12.

172. The head on a weir is measured *Advanced*

a. From the floor of the weir stilling basin to the water surface in the weir stilling basin.
b. From the crest of the weir to the horizontal water surface in the weir stilling basin.
c. From the weir crest to the water surface at the weir plate.
d. From the floor of the weir stilling basin to the water surface at the weir plate.

173. Which of the following wastewater treatment plants has the lowest loss of head? *Advanced*

a. Oxidation ponds.
b. Contact beds.
c. Intermittent sand filters.
d. Trickling filters.
e. Activated sludge.

174. An 8-in. sewer line with a grade of 0.40 ft/100 ft flowed at capacity for 24 hr could flow 0.46 mgd. What would be the flow in million gallons per day for a 12-in. line with a fall of 0.22/100 ft? *Advanced*

a. 0.66.
b. 0.75.
c. 0.85.
d. 0.90.
e. 1.00.

ANSWERS TO SECTION 15
BASIC SCIENCE & MATHEMATICS.

1- AREA OF RECTANGLE = LENGTH x WIDTH

$= 11.8 \times 3.3 = 38.9$ sq ft

ANSWER C

2- AREA OF TRIANGLE $= \dfrac{\text{BASE} \times \text{HEIGHT}}{2}$

$= \dfrac{8\frac{1}{3} \times 3\frac{3}{4}}{2} = 15$ sq ft

ANSWER a

3- AREA OF CIRCLE $= \pi r^2$

$= 3.14 \times 8^2 = 201$ sq ft

ANSWER C

4- LENGTH OF CIRCULAR WEIR = LENGTH OF CIRCUMFERENCE OF CIRCLE $= \pi D$

$= 3.14 \times 60 = 188$ ft

ANSWER a

5- SURFACE AREA OF TRICKLING FILTER $= \pi r^2$

$= 3.14 \times \left(\frac{40}{2}\right)^2 = 1256$ sq ft

ANSWER e

6 - VOLUME OF SLUDGE $= \pi r^2 . d$

$= 3.14 \times 7^2 \times 20 = 3100$ cu ft

ANSWER C

7- 1. SURFACE AREA OF ROOF $= \pi r^2$

$= 3.14 \times 10^2 = 314$ sq ft

ANSWER C

7. 2. VOLUME OF CONE $= \frac{1}{3} \pi r^2 h$

$= \frac{1}{3} \times 3.14 \times 10^2 \times 5 = 523$ cu ft

ANSWER d

8. VOLUME OF TANK $= \pi r^2 d$

$= 3.14 \times \left(\frac{100}{2}\right)^2 \times 12 = 94,200$ cu ft

ANSWER a

9. POUNDS OF SOLIDS DISCHARGED/DAY = FLOW, mgd X concentration, mg/l

x 8.34

$= 2 \times 15 \times 8.34$

$= 250$ lbs / Day

ANSWER e

10. CASE 1 : No OF PIPES $= \frac{2000}{4} = 500$ PIPES

No OF INCHES OF PIPE JOINTS $= 500 \times \pi \times 8 = 12566$ inche

CASE 2 : No OF PIPES $= \frac{1800}{5} = 360$ PIPES

No OF INCHES OF PIPE JOINTS $= 360 \times \pi \times 12 = 13572$ inc

ANSWER b

11. TOTAL COST OF PACKING = 8 X 15.93 = $127.44

ANSWER e

12. VOLUME OF TANK = LENGTH X WIDTH X DEPTH

= 30 X 10 X 8 = 2400 cu ft

VOLUME IN GALLONS = 2400 X 7.48 = 17,950 gal.

ANSWER a

13. AREA OF DIGESTER = πr^2

= $3.14 \times \left(\frac{30}{2}\right)^2$ = 706 sq ft

VOLUME OF SLUDGE = 707 X 1.0 = 706 cu ft

AREA OF BED = $\frac{706}{12/12}$ = 706 sq ft

ANSWER d

14. VOLUME OF SLUDGE = 15 X 15 X 1 = 225 cu ft

No OF INCHES OF DRAWDOWN = $\frac{225}{706}$ X 12 = 4 inches

ANSWER a

15. lbs OF CHLORINE USED IN 30 DAYS = FLOW, mgd X CONCENTRATION, mg/l X 8.34 X 30

= 5 X 4 X 8.34 X 30 = 5,000 lbs

ANSWER a

16. AREA OF 8 INCH PIPE = πr^2 = $3.14 \times \left(\frac{18}{2}\right)^2$ = 50 sq ft

AREA OF 4 INCH PIPE = πr^2 = $3.14 \times \left(\frac{4}{2}\right)^2$ = 12.5 sq ft

RATIO OF 8" : 4" AREA = $\frac{50}{12.5}$ = 4

ANSWER b

17. LBS OF CHLORINE USED /DAY = FLOW, mgd x DOSE, mg/l x 8.34

= 2.0 x 8.0 x 8.34

= 133 lbs / day

ANSWER C

18. LBS OF BOD / DAY = FLOW, mgd x CONCENTRATION, mg/l x 8.34

= 20 x 150 x 8.34

= 25,000 lbs / DAY

ANSWER a

19. AMT OF OXYGEN AVAILABLE = 8 - 4 = 4 mg/l

STREM FLOW = 60 cfs = $\frac{60}{1.55}$ = 38.7 mgd

lbs of oxygen available = 38.7 x 4 x 8.34 = 1290 lbs

ANSWER b

20. LBS OF BOD IN WASTEWATER = 0.6 mgd X 250 mg/l X 8.34

= 1250 lbs

ANSWER C

21. SOLIDS REMOVED BY SETTLING = 300 - 200 = 100 mg/l.

lbs OF SOLIDS REMOVED = 100 mg/l x .12 mgd x 8.34

= 100 lbs

ANSWER C

22. VOLUME OF WATER $= 450{,}000 \times \frac{6}{12} = 225{,}000$ cu ft

No OF GALLONS $= 225{,}000 \times 7.48 = 1680{,}000$ gal

$= 1.68$ million gallons

ANSWER b

23. RATE OF EVAPORATION & PERCOLATION

$$= \frac{120{,}000 \times 12}{7.48 \times 650{,}000} = 0.295 \text{ in/day}$$

ANSWER d.

24. lbs REMOVED BY SETTLING $= (250-100) \times .5 \times 8.34$

$= 625$ lbs

ANSWER d

25. VOLUME OF SETTLING TANK = LENGTH X WIDTH X DEPTH

$= 100 \times 25 \times 8$

$= 20{,}000$ cu ft

ANSWER b

26. VOLUME OF CYLINDER $= \pi r^2 h$

$= 3.14 \times 5^2 \times 8 = 628.3$ cu ft

ANSWER d

27. VOLUME OF CONE $= \frac{1}{3} \pi r^2 h$

$= \frac{1}{3} \times 3.14 \times 8^2 \times 12 = 804$ cu ft

ANSWER d

28. VOLUME OF A SPHERE $= \pi r^3$

$= 3.14 \times 2^3 = 25.1$ cuft

ANSWER a

29. VOLUME OF SLUGE IN GALLONS $= \pi r^2 h \times 7.48$

$= 3.14 \times \left(\frac{30}{2}\right)^2 \times 15 \times 7.48 = 79{,}300$ gal

ANSWER d.

30. VOLUME OF CYLINDER TANK $= \pi r^2 h \times 7.48$

$= 3.14 \times 5^2 \times 10 \times 7.48 = 5870$ gal

ANSWER d.

31. No. OF GALLONS OF SLUDGE $= 20 \times 40 \times \frac{6}{12} \times 7.48 = 3000$ gal

ANSWER b.

32. LENGTH OF FENCE $= 211 + 608 + 35 + 37 + 704$

$= 1595$ ft

ANSWER C

33. EFFLUENT IN MILLION GALLONS $= \frac{35{,}000}{1{,}000{,}000} = .035$ mgd.

ANSWER b.

34. $\frac{8 \times 10^8}{1.6 \times 10^{10}} = 5 \times 10^{-2}$

ANSWER d.

35. $.000015 \times .000003$

$= 15 \times 10^{-6} \times 3 \times 10^{-6}$

$= 45 \times 10^{-12} = 4.5 \times 10^{-11}$

ANSWER d.

36. DIFFERENCE BETWEEN DESIRED VALUE & MEASURED VALUE IS DEVIATION

ANSWER b.

37. AVERAGE BOD FOR THE MONTH $= \frac{29.0 + 22.5 + 27.0 + 26.3}{4} = 26.2$

ANSWER e

38. AVERAGE BOD FOR THE MONTH =

$\frac{19.3 + 21.4 + 17.0 + 29.9 + 24.0 + 21.0}{6} = 22.1$

ANSWER C

39. TOTAL LBS OF CHLORINE USED $= 647 \times 138 = 89{,}286$ lbs

ANSWER b.

40. AVERAGE No OF HOURS WORKED PER EMPLOYEE $= \frac{3060}{15} = 204$ HRS

ANSWER d.

41. BOD OF STREAM $= \frac{20 \times 4 + 0.5 \times 20}{20.5} = 4.4$ mg/l

ANSWER e

42. SS CONTENT OF MIXTURE $= \frac{50{,}000 \times 40 + 100{,}000 \times 130}{150{,}000} = 100$ mg/l

ANSWER b.

43. Phenol Concentration $= \dfrac{2 \times 10/1000 + 20 \times 0}{20+2} = .001$ mg/l

Answer e

44. BOD of Plant Effluent $= \dfrac{(140+15)\,5}{140 \times 3 + 15 \times x}$

$\therefore 775 = 420 + 15x$

$\therefore x = \dfrac{775-420}{15} = 24$ mg/l

Answer b

45. Approx. Pressure Exerted $= \dfrac{210{,}000 \text{ lbs}}{8'\text{-}4'' \times 5'\text{-}10''}$

$= \dfrac{210{,}000}{100 \text{ in} \times 70 \text{ in}} = \dfrac{210{,}000 \text{ lb}}{7000 \text{ sq in}}$

$= 30$ psi

Answer b.

46. 1 MGD Wastewater Flow = 1.55 cfs

BOD of Stream after Mixing $= \dfrac{1.55 \times 150 + 15.5 \times 5}{1.5 + 15.5}$

$= \dfrac{232.5 + 77.5}{17}$

$= 18.2$ mg/l

Answer a

47. SVI $= \dfrac{195 \times 1{,}000}{2300} = 85$

Answer d.

48. Sludge Index $= \frac{280 \times 1{,}000}{2200}$

$= 127$

ANSWER c

49. SVI $= \frac{170 \times 1{,}000}{1800} = 94$

ANSWER d.

50. SVI $= \frac{15}{100} \times 1000 \times \frac{1{,}000}{3000} = 50$

RESULTS ARE GOOD

ANSWER b.

51. OXYGEN USED $= 7.8 - 4.0 = 3.8$ mg/l

BOD $= 3.8 \times \frac{300}{5} = 228$ mg/l

ANSWER a

52. BOD = DEPLETION $\times \frac{300}{\text{ml of waste}}$

$200 = 4.0 \times \frac{300}{x}$

$x = \frac{4.0 \times 300}{200} = 6$ ml

ANSWER c

53. HP REQ'D $= \frac{1.5\text{mgd} \times 694\text{gpm} \times 8.34 \times 48.5}{33{,}000}$

$= 12.8$ HP

ANSWER b.

54. TO FIND HP REQ'D, NEED gpm + head which were not given

ANSWER d.

55. POWER BILL = 500 HP x 30 DAYS x 24 HRS/DAY x .746 KW/HP x .01 $/KWH

= $ 2,685.00

ANSWER c

56. HP REQ'D = 7,000 gpm x 8.34 x 22 ft / .90 x .85 x 33000

= 50 HP

ANSWER a

57. Efficiency = $\frac{\text{OUTPUT}}{\text{INPUT}}$ x 100

ANSWER b.

58. USER CHARGE = 30,000 x $.15/1000 = $4.50

ANSWER d.

59. RATE OF FLOW, gpm = $\frac{2340}{12}$ = 195 gpm

ANSWER a

60. DETENTION TIME = $\frac{10 \times 10 \times 50 \times 7.5 \times 24}{500,000}$ = 1.8 HRS

ANSWER b.

61. TANK CAPACITY = $7 \times 10^6 \times \frac{2}{24}$ = 583,000 gal

ANSWER d.

62. SETTLING TIME = $24 \times \frac{4}{24}$ = 4 HRS

ANSWER b.

63. AMOUNT PUMPED IN ONE MINUTE = 200 gal
= 200/7.5 = 26.7 cu ft
AREA OF WET WELL : 5 X 5 = 25 sq ft
DEPTH OF FLOW = 26.7/25 = 1.1 ft
ANSWER d.

64. WINTER FLOW = 100,000 gpd X 180 days = 18,000,000 gal
WINTER FLOW IN cu ft = 18 000 000 /7.5 = 2,400,000 cu ft
DEPTH OF LAGOON = 2,400,000 /600,000 = 4 FT
WATER DEPTH IN LAGOON = 5 - 4 = 1.0 FT
DEPTH LOWERED BELOW 3 FT = 3 - 1 = 2 Ft
ANSWER c

65. WEIR O/F RATE = $\frac{\text{VOL. OF FLOW}}{\text{LENGTH OF WIER}}$

ANSWER b

66. SURFACE SETTLING RATE = $\frac{\text{VOL. OF FLOW}}{\text{SURFACE AREA OF TANK}}$

ANSWER b.

67. VOL OF ONE STROKE = $\pi \times 8^2 \times 4.5 / 144$ = .13 cu ft
= .13 X 7.5 = 0.98 gallons
No. OF GALLONS PUMPED IN ONE MIN = 0.98 X 50 = 50 gallons
MINUTES OF OPERATION = $\frac{1500}{50}$ = 30 MIN.

ANSWER b.

68. FLOW IN GPM $= \frac{120,000}{24 \times 60} = 83.3$ gpm

CAPACITY OF WET WELL $= 83.3 \times 35 = 2,915$ gallons

ANSWER C

69. FLOW / TANK $= 6/6 = 1.0$ MGD

VOL. OF TANK IN GALLONS $= 150 \times 15 \times 15 \times 7.5 = 253,125$ gal.

DET. PERIOD $= \frac{253,125 \times 24}{1,000,000} = 6.1$ HRS

ANSWER C

70 VOL. OF FILTER $= 3,215 \times 7 = 22,505$ cu ft

Loading lb/d / 1000 cu ft $= \frac{543}{22,505/1000} = 24.1$

ANSWER C

71 VOL. OF FILTER $= \pi r^2 d = \pi \times 50^2 \times 6 = 47,124$ cu ft

LBS OF BOD / DAY $= 0.5 \times 150 \times 8.34 = 625.5$

LOADING $= \frac{625.5}{47,124/1000} = 13.3$

ANSWER a

72. LBS OF BOD/DAY $= 6 \times 192 \times 8.34 = 9607.7$

1000 LBS OF BOD/YR $= 9607.7 \times 365/1000 = 3506.8$

COST / 1000 LBS of BOD $= \frac{54,000}{3,506.8} = \$15.40$

ANSWER a

73. RATE OF FLOW $= \frac{10 \times 5 \times 1 \times 7.5}{5} = 75$ gpm

ANSWER b.

74. RATE OF FLOW = $\frac{6 \times 8 \times 1.5 \times 7.5}{6}$ = 90 gpm

ANSWER d

75. FLOW RATE = $\frac{1,000,000}{24 \times 60}$ = 694 gpm

VOL IN GALLONS = 694 X 2 X 60 = 83,280 gal

VOL IN CUFT = 83,280 / 7.5 = 11,104 cuft

ANSWER c

76. DET. TIME = $\frac{250,000 \times 24}{2400,000}$ = 2.5 HRS

ANSWER b.

77. WEIGHT OF SOLIDS = 21.6521 − 21.6319 = .0202 gm

TOTAL SOLIDS CONC. = $.0202 \times \frac{1000}{50} \times 1000$ = 404 mg/l

ANSWER e

78. DEMAND = APPLICATION − RESIDUAL

= 6.6 − .6 = 6.0 mg/l

ANSWER c

79. WEIGHT OF SOLIDS IN 100ml sample

= 18.7104 − 18.6984 = .0120 gm

= .0120 X 1000 = 12 mg

SS in mg/l = $12 \times \frac{1000}{100}$ = 120 mg/l

ANSWER d

80 CHLORINE DOSE = DEMAND + RESIDUAL

= 5.4 + 0.5 = 5.9 mg/l.

ANSWER e

81. LBS OF VOL. SOLIDS = 0.70 X 2,000 = 1400

DIGESTOR LOADING = $\frac{1400}{25{,}000/1000}$ = 56 lbs

ANSWER d

82. AMT OF CHLORINE = 55 X 0.67 = 36.85 lbs

DOSE = $\frac{36.85}{.55 \times 8.34}$ = 8.0 mg/l

ANSWER b

83. SOLIDS CONCN = $\frac{300}{250{,}000}$ x 1,000,000 = 1200

ANSWER b

84. LBS OF CHEMICAL = $\frac{50{,}000}{1{,}000{,}000}$ x 8.34 x 75

= 31

ANSWER b.

85. CHLORINE FEED RATE MAY BE CALCULATED FROM CHLORINE DOSE & AVERAGE FLOW RATE

ANSWER c

86. CHLORINE CAPACITY = 7 x 1.5 x 5 x 8.34 = 438

MACHINE CAPACITY 500 lbs

ANSWER d.

87 VOL OF RES. IN GAL = 110 X 60 X 12 X 7.5 = 594,000 gal

lbs OF CHEM. = .594 x 8.34 X 80 = 396 lbs

ANSWER d.

88. CHLORINE CONC. $= \frac{5 \text{ lbs}}{10 \text{ gal}} = 0.5$ lb/gal

RATE OF AVAIL. CHLORINE $= 7 \times 0.5 = 3.5$ lb/24 hr

ANSWER d

89. 1000 mg/l = 1 gm/l

$= \frac{1 \times 100}{1000} = 0.1\ \%$

ANSWER b

90. 25000 mg/l $= \frac{25{,}000}{1{,}000{,}000} \times 100 = 2.5\ \%$

ANSWER c

91 Amt of sludge 5% Amt of water 95%

Amt of sludge 10% Amt of water 90%

% Reduction in volume $= \frac{5}{10} \times 100 = 50\ \%$

ANSWER e

92. SLUDGE CONCN $= \frac{6 \times 100}{1000} = 0.6\ \%$

GALLONS PUMPED $= 0.5 \times 10^6 \times 0.6 = 3{,}000$ gal/day

ANSWER a

93. EXPECTED REMOVAL $= 25\% \times 1.0 + 70\% \times .75$

$= 25\% + 52.5\% = 77.5\ \%$

ANSWER c

94. Dollars Spent $= 15\% \times 90 = \$13.50$

ANSWER d

95. TANK EFFICIENCY $= \frac{200-140}{200} = 30\%$

ANSWER b.

96. % BOD REDUCTION $= \frac{300-45}{300} = 85\%$

ANSWER e

97. % REDUCTION BY FILTER & FINAL TANK

$= \frac{200-60}{200} = 70\%$

ANSWER c

98. % REDUCTION $= \frac{300-75}{300} = 75\%$

ANSWER c

99. 1% Solids $= 10{,}000 \times .01 = 100$ gal

100 gal $= 5\%$

NEW Volume $= 100 \times \frac{100}{5} = 2000$ gal

ANSWER b.

100. 1. % Volatile in Raw Sludge $= .80 \times 6\% = 4.8\%$

% Volatile in Digested sludge $= .40 \times 8\% = 3.2\%$

RAW SLUDGE PUMPED TO Digestn $= 1000 \times 30 \times 4.8\% = 1440$

Digested SLUDGE WITHDRAWN $= 15000 \times 3.2\% = 480$

% Reduction of VS $= \frac{1440-480}{1440} = 67\%$

ANSWER d

2. No of lbs withdrawn $= 500 \times 8.34 \times .032 = 133$

ANSWER a

3. Digester is operating Normally

ANSWER a

101. 1. lbs going to digestor

$= 0.2 \times 1{,}000 \times .75 = 150$ lbs

ANSWER a

2. LBS OF SLUDGE PUMPED

$150 \times \frac{100}{5} = 3{,}000$ lbs

ANSWER b

3. GAL. OF SLUDGE PUMPED $= 3{,}000 / 8.34 = 360$ gal

ANSWER b

102. COMBINED EFFICIENCY $= .85 \times .94 = 80\%$

ANSWER b.

103 SOLIDS REDUCTION $= \frac{3 - .3}{3} = 90\%$

ANSWER b

104. 1. OVERALL BOD REMOVAL $= \frac{136 - 9}{136} \times 100 = 93.5\%$

ANSWER d

2. OVERALL SS REMOVAL $= \frac{142 - 30}{142} \times 100 = 79\%$

ANSWER c

3. OVERALL Settlable solids Removal $= \frac{3.5 - .2}{3.5} \times 100 = 94.3\%$

ANSWER e

4. BOD REMOVAL BY PRIMARY CLARIFIER $= \frac{136 - 40}{136} \times 100$

$= 70.6\%$

ANSWER e

5. BOD REMOVAL BY FILTERS & CLARIFIERS IS

$\frac{40 - 9}{40} \times 100 = 77.5\%$

ANSWER b

105. SS = 21.6531 − 21.6329 = .0202

WT OF ASH = 21.6360 − 21.6329 = .0031

$\% \text{ VS} = \frac{.0202 - .0031}{.0202} \times 100 = 84.7\%$.

ANSWER d

106. No OF LBS OF DRY SOLIDS

= 54,000 gal × .045% × 8.34 LB/GAL

= 20,200 lbs

ANSWER a

107. SLUDGE VOL. IN. GAL. $= 625 \times \frac{100}{.045} \times \frac{1}{8.34}$

= 1670 gal

ANSWER d.

108. LBS OF CHLORINE NEEDED

$= 2.5 \times \frac{250000}{1,000,000} \times 8.34 \times \frac{100}{15} = 34.7$ lbs

ANSWER c

109. % VS REDUCTION $= \frac{.70 - .42}{.70} \times 100 = 40\%$.

ANSWER c

110. TOTAL AIR SUPPLIED, cu ft = 5,000 cu ft/min × 60 × 24 = 7,200,000

AIR / LB OF BOD = 7,200,000 / 6,000 = 1200

ANSWER b.

111. SLOPE OF SEWER = .4% = .004 ft/ft

= .004 × 12 = .048 in/ft

1/16 in/ft = .063 in/ft

ANSWER a

112. cu ft of Sludge = 60 X 90 X 1 X 0.3 = 1620 cu ft

ANSWER c.

113 PPM is same as mg/l, same as 8.34 lb/MG

ANSWER b.

114 No of LBS of OXYGEN IN STREAM =

1.0 MGD X 8 mg/l X 8.34 lb/MG = 67 lbs

ANSWER c.

115. 1 cu ft contains 7.5 gal

ANSWER b.

116. APPROX. VOL. IN GAL. = 15,000 X 7.5 = 112,500 gal

ANSWER b.

117. ONE GAL OF WATER WEIGHS 8.3 lbs

ANSWER b.

118. APPROX. WEIGHT IN LBS = 50,000 X 8.34

= 417,000 lbs

ANSWER d.

119. WEIGHT OF 5 GAL OF WATER = 5 X 8.34 = 41.7 lbs

ANSWER e

120. 95 mg/l = 95 X 8.34 = 7.92 lb/MG.

ANSWER a

121. $95°F = (95 - 32) \times \frac{5}{9} = 63 \times \frac{5}{9} = 35°C$

ANSWER a

122. $1 MGD = \frac{1,000,000}{24 \times 60} = 693$ gpm

ANSWER c

123. FLOW = 261 gpm X 24 hrs X 60 min /1,000,000 = 0.36 mgd

ANSWER d.

124. PE Tributary to plant = $\frac{510}{0.17}$ = 3,000 persons

ANSWER e.

125. PE of Industrial Waste = $\frac{560}{0.17}$ = 3,300 persons

ANSWER d

126. LBS OF BOD = 8,400 X .17 = 1400 lbs

ANSWER e

127. PE LOAD OF PLANT = $\frac{969}{.17}$ + 5700 = 11,400

ANSWER e

128. $20°C = 20 \times \frac{9}{5} + 32 = 68°F$

ANSWER c

129. Discharge Head = 100 psi X 2.3 = 230 ft

ANSWER b

130. 5 ft of water $= \frac{5}{2.3} = 2.17$ psi

ANSWER e

131. PRESSURE AT TAB $= \frac{100}{2.3} = 43.5$ psi

ANSWER a

132. CORRECT READING $= \frac{12}{2.3} + 1.6 = 6.8$ psi

ANSWER b.

133. PRESSURE $= \frac{50}{2.3} = 21.7$

ANSWER c

134. 0.7 mgd in gph $= \frac{0.7 \times 1000,000}{24} = 29,166$ gph

0.7 mgd in cfs $= 0.7 \times 1.55 = 1.085$ cfs

0.7 mgd in gpm $= 0.7 \times 694 = 486$ gpm

ANSWER a & c

135. 1 cfs in mgd $= \frac{1}{1.55} = 0.645$ mgd

1 cfs in gph $= 1 \times 7.5 \times 60 \times 60 = 26,928$ gph

1 cfs in gpm $=$ $= 449$ gpm

ANSWER d

136. 600 lbs / 8.34 $= 71.9$ mg/l

ANSWER d

137. Amt of gas / capita = 0.8 cu ft /day

Ave Amt /1000 people = 1,000 X 0.8 = 800 cu ft

ANSWER d.

138. $\frac{0.1N}{.025N}$ = 4

2 liters /4 = 500 ml

ANSWER b

139. INDUSTRIAL FLOW = 7.0 X .35 = 2.45 mgd

DOMESTIC FLOW = 7.0 - 2.45 = 4.55 mgd

PER CAPITA FLOW = $\frac{4.55 \times 10^6}{45000}$ = 101 gpc

1. PER CAPITA FLOW, INCL. IND = $\frac{7 \times 10^6}{45,000}$ = 156 gpc

ANSWER c

2. TOTAL LBS OF BOD = 7.0 X 8.34 X 350 = 20,433

TOTAL LBS OF SS = 7.0 X 8.34 X 300 = 17,514

ANSWER a

3. OVERALL PLANT EFFICIENCY = 1 X .25 + (.75) X .40 + .45 X .85

= .25 + .30 + .38 = 93 %

ANSWER b

4. PRIMARY TANK CAPACITY = 7,000,000 X $\frac{2}{24}$ = 583,330 gal

ANSWER d

5. PUMP CAPACITY = 60,000 /1440 = 42 gpm

ANSWER b

6. DIGESTER CAPACITY IN CU FT = 60,000 X 30 /7.5 = 240,000 cu ft

ANSWER a

140. 1. LBS OF DRY SOLIDS = $60{,}000 \times \frac{6}{100} \times 8.34 = 30{,}000$ LBS

ANSWER d

2. lbs of wet cake = $30{,}000 \times \frac{100}{25} = 120{,}000$ lbs

ANSWER d

3. gal of Polymer = 1 % of 30,000 lbs

$= .01 \times 30{,}000 = 300$ lbs

Polymer wt is 10 lbs / gal

No. of gal of Polymer = $\frac{300}{10} = 30$ gal

ANSWER b

4. COST OF 30 gal of Polymer = $30 \times 10 \times .25 = \$75$

TONS OF WET CAKE = $120{,}000/2000 = 60$ Tons

TONS OF DRY CAKE = $\frac{60}{4} = 15$ TONS

COST / TON = $\frac{75}{15} = \$5.00$

ANSWER b

141. Stream Velocity = $\frac{Q}{A} = \frac{805}{322} = 2.5$ fps

ANSWER b.

142. VOL OF FILTERS = $\frac{20{,}000}{100/1{,}000} = 200{,}000$ cu ft

VOL OF EACH FILTER = $200{,}000/2 = 100{,}000$

AREA OF EACH FILTER = $100{,}000/4 = 25{,}000$ sq ft

DIAM. OF EACH FILTER = $\frac{25{,}000 \times 4}{\pi \times D^2} = 178$ ft

ANSWER c

143. CHLORINE FEED RATE = $7 \times 1.5 \times 5 \times 8.34 = 438$ lbs

ANSWER d

144. Stronger Solution N/5

ANSWER d

145. ATOMIC WEIGHTS ARE BASED ON OXYGEN

ANSWER C

146. NORMAL INDICATE AN EXACT CONCENTRATION OF A REAGENT

ANSWER a

147. SUBSTANCES NOT BROKEN DOWN FURTHER ARE ATOMS

ANSWER a

148. ALL OF THE ABOVE

ANSWER C

149. pH means concentration of hydrogen ion in solution

ANSWER e

150. Organic Chemistry is concerned with compounds containing the element Carbon

ANSWER C

151. Odor is caused by H_2S or HS^-

ANSWER C

152. Carbon Dioxide in Water will Lower pH

ANSWER d

153. To control pH of water add lime $Ca(OH)_2$

ANSWER b

154. pH is a measure of hydrogen ion in water

ANSWER d

155. OH & SO4 are called molecules

ANSWER a

156. The precipitate in coagulation is Aluminum Hydroxide

ANSWER e

157. SO_4^- is not responsible for alkalinity in water

ANSWER a

158. Sludge value as fertilizer is determined by the values of phosphorus and nitrogen

ANSWER a

159 $0.5\,N = 0.5 \times 40 = 20$ gm/litre

CONC IN % $= \frac{20}{1000} = 2\%$

ANSWER b

160. 1 N of NaOH contains 40 g/l

ANSWER b

161. CORRECT % of O_2 & N_2 is 21% & 79% RESPECTIVELY

ANSWER a

162. The standard unit of electrical power is watt

ANSWER c

163. Oxygen dissolved in water is most related to temperature.

ANSWER a

164. 10°c in Fahrenheit $= 10 \times \frac{9}{5} + 32 = 50°F$

ANSWER c

165. Cathodic protection means protection against corrosion

ANSWER c

166. VOL OF WATER IN CUFT $= \frac{\pi \times 2^2}{4} \times 1000 = 3,141.6$ cuft

Weight of Water $= 3,141.6 \times 62.4 \times 1.2 = 235,240$

ANSWER a

167. Oil has higher heating value

ANSWER a

168. DO Saturation at 20°c is 8.0 – 9.0 mg/l

ANSWER c

169. DO & Temp have inverse relationship

ANSWER c

170. VEL. FLOWING ½ FULL is 100% OF VEL. FLOWING FULL

ANSWER a

171. 8 in : 24 in is the ratio of areas

i.e. $\frac{8^2}{24^2} = \frac{1}{9}$

ANSWER C

172. HEAD ON A WEIR is From crest to the Horiz. surface of water

ANSWER b

173. Oxidation Ponds has lowest Head Loss

ANSWER a

174. $V = \frac{Q}{A} = \frac{.46 \times 1.55}{\frac{\pi \times .67^2}{4}} = \frac{0.713}{.352} = 2 \text{ fps}$

$Q = V.A = 2.0 \times \frac{\pi D^2}{4} = 1.57 \text{ cfs}$

$= 1.0 \text{ MGD}$

ANSWER e