State of Mississippi

Pollution Control Operator Certification Examination Study Guide

MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY

Prepared by
Office of Pollution Control, Field Services Division
Environmental Training and Certification

2011

STATE OF MISSISSIPPI

POLLUTION CONTROL OPERATOR (I - IV)

CERTIFICATION EXAMINATION

STUDY GUIDE

Prepared by

MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF POLLUTION CONTROL
ENVIRONMENTAL TRAINING and CERTIFICATION
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CONTENTS

Each chapter quiz has twenty (20) questions except Chapter 1, Mathematics, and Chapter 5, Biological Treatment. These chapters have fifty (50) questions each.

INTRODUCTION AND USER GUIDE

PURPOSE

This study guide was developed to enable persons to prepare for the State of Mississippi, Pollution Control Operator (I-IV) certification examinations.

SCOPE

The study guide should be used in conjunction with the "Mississippi Wastewater Facilities, Operations/Training Manual". It consists of quizzes for each chapter in the manual as well as a mathematics section.

INSTRUCTIONS

1. Read a chapter in the Operations/Training Manual

2. Complete the corresponding chapter quiz.
   (Each question has the classes and Need-to-Know categories noted in parentheses next to the question number)

   Example: 1. (II-IV) (02) This question should be answered by those preparing for a Class II, Class III or Class IV exam.

3. Find the answer key in the back of the guide and grade the quiz.

4. If your score is less than 70%, reread the chapter and retake the quiz.

SUMMARY

After all of the chapter quizzes and math problems have been successfully completed, the person preparing for the certification examination may wish to attend a preparatory short course to review prior to taking the exam.

For information regarding the next short course and certification examination, contact the Environmental Trainer in your region.

North: 662-234-3733

Central: 601-961-5634

South: 228-432-1056

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Mississippi
Department of Environmental Quality
Wastewater Certification
*Need to Know Criteria **

CODE	CATEGORY	CLASS I	CLASS II	CLASS III	CLASS IV
CH 1	**MATHEMATICS**				
01	GENERAL	A	P	P	P
02	CONVERSIONS	A	P	P	P
03	AREA/VOLUME/FLOW	A	P	P	P
04	DETENTION TIME	A	P	P	P
05	POUNDS	A	P	P	P
06	HEAD (TDH)	A	P	P	P
07	PUMP CAPACITY (GPM)	A	P	P	P
08	PERCENT REMOVAL	A	A	A	A
09	POPULATION EQUIVALENTS	A	P	P	P
	HYDRAULIC	A	P	P	P
	ORGANIC	A	A	P	P
10	CHLORINE DEMAND	A	A	P	P
11	ORGANIC LOADING (LAGOONS)	A	A	P	P
12	HYDRAULIC LOADING (SAND FILTERS)	A	A	P	P
13	BOD		A	P	P
14	SOLIDS (TSS,VSS)		A	P	P
15	FECAL COLIFORM		A	P	P
16	BACK-IN POUNDS		A	P	P
17	AIR SUPPLY (AERATED LAGOON)		A	P	P
18	SLUDGE VOLUME INDEX (SVI)		A	P	P
19	F/M RATIO		A	P	P
20	SLUDGE AGE (S.A.)			P	P
21	SURFACE LOADING RATE (SLR)			P	P
22	WEIR OVERFLOW RATE (WOR)			P	P
23	SOLIDS LOADING RATE			P	P
24	ORGANIC LOADING (AS,TF)			P	P
25	HYDRAULIC LOADING (TF)			A	A
26	RECIRCULATION (RATIO, RATE)			A	A
27	MIXING			A	A
28	SLUDGE PUMPING			A	P
29	DRYING BEDS			A	P
30	RETURN SLUDGE (MLSS METHOD)			A	P
31	WASTE SLUDGE (MLSS METHOD)			A	P
32	AIR SUPPLY (ACTIVATED SLUDGE)			A	A
33	MCRT				A
34	GAS PRODUCTION				A
35	MLSS CONCENTRATION (S.A., F/M)				A

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CODE	CATEGORY	CLASS I	CLASS II	CLASS III	CLASS IV
	MATHEMATICS CONT'D				
36	WASTE SLUDGE (MCRT METHOD)				P
37	MIXING (ALGEBRAIC)				P
CH 2	**WASTEWATER CHARACTERISTICS**				
01	TERMINOLOGY	K	K	C	C
02	PHYSICAL	K	K	C	C
03	CHEMICAL	K	K	C	C
04	BIOLOGICAL	K	K	C	C
05	SEWAGE QUANTITIES	K	K	C	C
CH 3	**PRE-TREATMENT**				
01	GENERAL	K	K	C	C
02	SCREENING	K	K	C	C
03	COMMUNITION	K	K	C	C
04	GRIT REMOVAL		K	C	C
05	OIL & GREASE REMOVAL	K	K	C	C
06	PRE-AERATION		K	C	C
07	FLOCCULATION			C	C
08	NEUTRALIZATION	K	K	C	C
09	CHLORINATION			C	C
10	FLOW EQUALIZATION			C	C
11	SEWER USE ORDINANCE	K	K	C	C
12	INDUSTRIAL WASTEWATER	K	K	C	C
CH 4	**PRIMARY TREATMENT**				
01	GENERAL		K	C	C
02	SEDIMENTATION		K	C	C
03	SKIMMING			C	C
04	CLARIFIERS		K	C	C
05	COMMON OPERATIONAL PROBLEMS			C	C
06	LABORATORY CONTROLS			C	C
CH 5	**BIOLOGICAL TREATMENT**				
01	BASIC CONCEPTS	C	C	C	C
02	MICROORGANISMS	K	K	C	C
03	CONVENTIONAL LAGOONS	C	C	C	C
04	AERATED LAGOONS	C	C	C	C
05	ANAEROBIC LAGOONS	K	C	C	C
06	TRICKLING FILTERS		K	C	C

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CODE	CATEGORY	CLASS I	CLASS II	CLASS III	CLASS IV
	BIOLOGICAL TREATMENT CONT'D				
07	ROTATING BIOLOGICAL CONTACTORS			C	C
08	ACTIVATED SLUDGE		C	C	C
09	SEQUENCING BATCH REACTORS			C	C
10	GENERAL FACILITY O & M	C	C	C	C
CH 6	**ADVANCED TREATMENT**				
01	DEFINITIONS/ GENERAL			K	K
02	BASIC NITROGEN REMOVAL			C	A
03	ADVANCED NITROGEN REMOVAL			C	A
04	BASIC PHOSPHORUS REMOVAL			K	C
05	ADVANCED PHOSPHORUS REMOVAL			K	C
06	PHYSICAL/ CHEMICAL TREATMENT			K	C
CH 7	**DISINFECTION**				
01	GENERAL	C	K	K	K
02	ALTERNATIVE DISINFECTANTS	K	K	C	C
03	CHLORINATION/ DECHLORINATION	C	C	C	C
04	ULTRAVIOLET IRRADIATION	K	K	C	C
05	OZONATION	K	K	C	C
CH 8	**SLUDGE TREATMENT AND DISPOSAL**				
01	GENERAL		C	C	C
02	SOURCES/ CHARACTERISTICS			C	C
03	SLUDGE THICKENING		C	C	C
04	SLUDGE STABILIZATION **			C	C
05	SLUDGE CONDITIONING		C	C	C
06	SLUDGE DEWATERING **		C	C	C
07	FINAL DISPOSAL **		K	C	C
CH 9	**FLOW MEASUREMENT**				
01	HISTORICAL BACKGROUND	C	C	C	C
02	GENERAL	C	C	C	C
03	WEIRS	C	C	C	C
04	FLUMES	K	C	C	C
05	METERS & RECORDERS	K	C	C	C

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CODE	CATEGORY	CLASS I	CLASS II	CLASS III	CLASS IV
CH 10	**COLLECTION SYSTEMS**				
01	HISTORICAL BACKGROUND	K	K	C	C
02	GENERAL/ DEFINITIONS	K	K	C	C
03	CONSTRUCTION	K	K	C	C
04	DESIGN FACTORS	K	K	C	C
05	INFILTRATION/ INFLOW	K	K	C	C
06	O & M	K	K	C	C
07	PUMPING STATIONS	K	K	C	C
CH 11	**PUMPING**				
01	GENERAL	K	K	C	C
02	TYPES OF PUMPS	K	K	C	C
03	PUMP STATIONS	K	K	C	C
04	ANALYSIS **	K	K	C	C
05	O & M	K	K	C	C
CH 12	**RECORDS & REPORTS**				
01	GENERAL	C	C	C	C
02	PHYSICAL	C	C	C	C
03	OPERATIONAL	C	C	C	C
04	MAINTENANCE	C	C	C	C
05	PERSONNEL	C	C	C	C
06	BUDGET & COSTS	C	C	C	C
CH 13	**SAFETY**				
01	GENERAL	C	C	C	C
02	PRACTICES	C	C	C	C
03	EQUIPMENT & SUPPLIES	C	C	C	C
04	RESCUE PRACTICES	C	C	C	C
CH 14	**LABORATORY**				
01	PURPOSE	K	K	C	P
02	PROCEDURES	K	K	C	P
03	GLASSWARE	K	K	C	P
04	WEIGHTS	K	K	C	C
05	SAMPLING	K	K	C	C
06	GENERAL	K	K	C	C
07	SAFETY	K	K	C	C

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CODE	CATEGORY	CLASS I	CLASS II	CLASS III	CLASS IV
	LABORATORY CONT'D				
08	ANALYSES	K	K	C	C
09	SUMMARY	K	K	C	C
CH 15	**FACILITIES MANAGEMENT ****				
01	BASIC PRINCIPLES	K	K	C	C
02	PERSONNEL	K	K	C	C
03	PLANNING	K	K	C	C
04	REGULATIONS	K	K	C	C
05	FINANCES	K	C	C	C
06	OPERATION AND MAINTENANCE	C	C	C	C
07	SAFETY AND HEALTH	C	C	C	C
08	EMERGENCY PREPAREDNESS/ RESPONSE	K	C	C	C
09	PUBLIC RELATIONS	K	C	C	C

***** SOURCE: MISSISSIPPI WASTEWATER FACILITIES OPERATIONS/TRAINING MANUAL 5th Edition

****** DEPTH OF KNOWLEDGE IN THESE CATEGORIES INCREASES WITH HIGHER CLASSES

K = KNOWLEDGE (List, Identify)
C = COMPREHENSION (Explain, Define)
A = APPLICATION (Routine Situations)
P = PROBLEM SOLVING (Non-Routine Situations)

Revised April 13, 2009

MDEQ CONVERSION FACTORS

MULTIPLY	BY	TO OBTAIN
Cubic Feet	7.5	Gallons
Cubic Feet/Second	0.646	Million Gallons/Day
M.G.D.	1.55	C.F.S.
Cubic Feet Water	62.4	Pounds
Gallons	8.34	Pounds
Gallons	0.133	Cubic Feet
Feet of Water	0.44	Lbs/Sq. Inch
Lbs/Sq. Inch	2.3	Feet of Water
Pounds of Water	0.016	Cubic Feet
Degrees Centigrade	9/5 C + 32	Degrees Fahrenheit
Degrees Fahrenheit	5/9 (F-32)	Degrees Centigrade
Acres	43,560	Square Feet
Cubic Yards	27	Cubic Feet
Horsepower	33,000	Ft.Lbs/Min
Horsepower	550	Ft.Lbs/Second
Horsepower	746	Watts
Horsepower	0.746	Kilowatts
Gallons	231	Cubic Inches
Pounds of Water	0.1198	Gallons
Population	0.17	Pounds/Day BOD
Population	100	Gallons/Day

TO OBTAIN	BY	DIVIDE

Revised April 13, 2009

WASTEWATER FORMULAS

1. Circumference of a Circle = 2 (R or (DUse Pi (( ) = 3.14

2. See Conversion Sheet

3. Area: Rectangle or Square:

$$A = L \times W$$

Circle:

$$A = (R^2 \text{ or } \frac{(D^2}{4}$$

Volume = Area x Depth

Flow (Q) = V x A (where V = velocity in ft/sec)

4. Detention Time = $\frac{\text{Volume}}{\text{Flow}}$

5. Lbs = MG x 8.34 x mg/l

Lbs/Day = MGD x 8.34 x mg/l

6. Total Dynamic Head (TDH) = Static Head + Friction Head + Station Head

Static Head = Final Elevation - Wet Well Elevation
Friction Head = Friction Loss x Length of Pipe
Station Head = Head Loss through fittings, valves, etc. (Given)

7. Pump Capacity or Drawdown(GPM)

Small Station Drawdown (stop inflow) = $\frac{\text{Volume Wet Well (Gals.)}}{\text{Pump Run Time (Mins.)}}$

Large Station Drawdown (continuous inflow) = Pump Rate + Fill Rate

8. Percent Removal = $\frac{\text{Influent - Effluent}}{\text{Influent}} \times 100$

9. Hydraulic P. E. = $\frac{\text{Gallons/Day}}{100}$

Organic P. E. = $\frac{\text{Lbs BOD/Day}}{0.17}$

10. Chlorine Demand = Chlorine Dosage - Chlorine Residual

11. Organic Loading (Lagoon) = $\frac{\text{BOD applied (lbs/Day)}}{\text{Water Surface Area (acres)}}$

12. Hydraulic Loading (Sand Filters) = $\frac{\text{Total Flow to Filter (GPD)}}{\text{Surface Area of Filter (SF)}}$

13. BOD_5 = [Initial D. O. - Final D. O.] x $\frac{300 \text{ ml}}{\text{ml sample}}$

14. TSS = [W_2 - W_1] x $\frac{1{,}000{,}000}{\text{ml sample}}$ Where: W_1 = weight of filter in grams (Tare Weight)
W_2 = weight of filter and residue in grams (Gross Weight)
W_3 = weight of filter and ash in grams (Ash Weight)

VSS = [W_2 - W_3] x $\frac{1{,}000{,}000}{\text{ml sample}}$

15. Fecal Coliform Count = Number of Colonies x $\frac{100}{\text{ml sample}}$

16. Back-In Pounds = See Lbs Formula, #5

17. Aerated Lagoon O_2 Required (Lbs/Day) = BOD Loading (Lbs/Day) x % Removal x 1.5

Aerator Run Time (Hrs/Day) = $\frac{O_2 \text{ Required (Lbs/Day)}}{\text{Aerator HP x Aeration capacity (Lbs/HP/Hr)}}$

18. Sludge Volume Index (SVI) = $\frac{\text{Volume (ml/l) settled sludge @ 30 min.}}{\text{MLSS (mg/l)}}$ x 1000

19. Sludge Age = $\frac{\text{MLSS in aeration tank (Lbs)}}{\text{TSS entering aeration tank (Lbs/Day)}}$

20. F/M Ratio = $\frac{\text{BOD entering aeration tank (Lbs/Day)}}{\text{MLVSS in aeration tank (Lbs)}}$

21. Surface Loading Rate = $\frac{\text{Flow applied (gpd)}}{\text{Surface Area (SF)}}$

22. Weir Overflow Rate = $\frac{\text{Flow applied (gpd)}}{\text{Length of weir (Ft)}}$

23. Solids Loading Rate = $\frac{\text{MLSS applied (Lbs/Day)}}{\text{Surface Area (SF)}}$

24. Organic Loading (AS) = $\frac{\text{BOD applied (Lbs/Day)}}{\text{Volume of A.T. (1000 CF)}}$

Organic Loading (TF) = $\frac{\text{BOD applied (Lbs/Day)}}{\text{Volume of Filter Media (1000 CF)}}$

25. Hydraulic Loading (TF) = $\frac{\text{Total Flow to Filter (GPD)}}{\text{Surface Area of Media (SF)}}$

26. Recirculation Ratio (TF) = $\frac{\text{Recirculated Flow}}{\text{Raw Wastewater Flow}}$

Recirculation Rate (TF) = Recirculation Ratio x Raw Wastewater Flow

27. Mixing: $C_T = \frac{(C_1 \times Q_1) + (C_2 \times Q_2)}{Q_T}$

28. Sludge Pumping: Lbs/Day Wasted = MGD x 8.34 x mg/l wasted

29. Drying Bed Volume (CF) = Area of Bed (SF) x Depth (Ft)

30. Return Sludge

MLSS method: $\%RS = \frac{\text{MLSS (mg/l)}}{\text{RS (mg/l) - MLSS (mg/l)}} \times 100$

Return Sludge Rate = % Return Sludge x Raw Wastewater Flow

31. Waste Sludge:

MLSS Method: $MG = \frac{[\text{Actual MLSS - Desired MLSS}]\text{ (mg/l) x A.T. Volume (MG)}}{\text{SS in Waste Sludge (mg/l)}}$

32. Air Supply (CF/Lb BOD destroyed) = $\frac{\text{Total CF air supplied}}{\text{Lbs/Day BOD destroyed}}$

33. Mean Cell Residence Time (MCRT) = $\frac{\text{MLSS (Lbs) in A.T. + MLSS (lbs) in Clarifier}}{\text{SS Wasted (Lbs/Day) + Effluent SS (Lbs/Day)}}$

34. Daily Gas Production (CF/Day) = Volatile solids destroyed (Lbs/Day) x Gas Production Rate (CF/Lb VS destroyed)

35. MLSS Concentration: Calculate MLSS concentration from given F/M or SA (#19, #20)

36. Waste Sludge:

MCRT Method

$\text{Lbs/Day} = \frac{\text{MLSS in A.T. \& Clarifier (Lbs) - Effluent SS (Lbs/Day)}}{\text{Desired MCRT (Days)}}$

$\text{MGD} = \frac{\text{Waste Sludge (Lbs/Day)}}{\text{SS in Waste Sludge (mg/l) x 8.34}}$

$\text{MGD} = \frac{\text{Waste Sludge (MG) x 24 Hrs/Day}}{\text{Wasting Period (Hrs)}}$

37. Solve for unknown using Mixing Formula (# 27)

CHAPTER 1
MATHEMATICS

CHAPTER 1: MATHEMATICS

1. (I - IV) (01) A wastewater facility accepted a bid of $1.10 per pound for chlorine gas. If the average feed rate to treat 0.5 MGD is 40 pounds per day, what is the estimated annual expenditure for chlorine?

   A. $14,600
   B. $16,600
   C. $16,060
   D. $16,400

2 (I - IV) (01) The manager of Bassville wastewater plant plans to paint the plant structures. He estimates that each of the four employees will have to work 12 hours overtime at time and one half to finish in one week. Three employees earn $10.50/hour and the shift operator earns $13.50/hour. How much money should be budgeted for overtime for this project?

   A. $567
   B. $810
   C. $243
   D. $1053

3. (I - IV) (02) Convert the following:

   A. 560 GPM to MGD:
   B. 3.7 CFS to MGD:
   C. 123,000 CF to gallons:
   D. .04 MG to pounds:

4. (I - IV) (03) What is the total surface area in acres of a two cell lagoon where the first cell measures 400 ft. by 600 ft. and the second cell measures 200 ft by 300 ft. ?

   A. 5.5 ac.
   B. 6.9 ac.
   C. 4.8 ac.
   D. 9.6 ac.

5. (I - IV) (03) Calculate the volume (gallons) of a circular tank that is 50 ft. in diameter and has a water depth of 12 ft.

   A. 176,125 gals.
   B. 176,625 gals.
   C. 23,550 gals.
   D. 14,719 gals.

6. (I - IV) (04) Calculate the detention time of the lagoon in problem No. 4 if the water depth is 6 ft. and the flow averages 0.32 MGD.

   A. 51 days
   B. 42 days
   C. 38 days
   D. 60 days

7. (I - IV) (05) Results of an effluent sample taken on the 3rd of the month were 28 mg/l. The total flow for the 3rd was 0.56 MGD. What should the operator enter on the DMR for pounds discharged?

   A. 131 lbs.
   B. 210 lbs.
   C. 89 lbs.
   D. 110 lbs.

8. (I - IV) (05) The influent BOD to the Gatian WWTP averages 166 mg/l and the average flow is 1.2 MGD. What is the average BOD loading on the facility?

A. 836 lbs./day
B. 1402 lbs./day
C. 690 lbs./day
D. 1661 lbs./day

9. (I - IV) (06) An operator must plan a pumping system for a new subdivision. The elevation of the low water level in the wet well is estimated to be 214 ft.. The discharge elevation is expected to be 301 ft. . The length of the 8 inch force main will be approx. 3620 ft. with a friction factor of 0. 23 ft./100 ft.. Station losses are expected to be negligible. What is the estimated TDH of the system?

A. 87 ft.
B. 95 ft.
C. 101 ft
D. 919 ft.

10. (I - IV) (08) Lab reports indicate the average influent TSS at a WWTP to be 145 mg/l and the average effluent TSS to be 43 mg/l. What is the % removal for TSS at this facility?

A. 70 %
B. 67 %
C. 84%
D. 77%

11. (I - IV) (09) The current population of Lyon, MS. is 6210 persons. The POTW was designed for an average flow of 0.7 MGD. An industry wants to locate in town that has a proposed discharge of wastewater of 40,000 gpd with 280 lbs./day of organics. Calculate the impact of the industrial waste on the POTW.

A. Ind. will hyd. and org. overload POTW
B. Ind. will org. overload POTW
C. Ind. will not hyd. or org. overload POTW
D. Ind. will hyd. overload POTW

12. (I - IV) (09) Assuming that a three (3) cell lagoon is designed to treat 30 pounds/day/acre of BOD, how many total acres of surface area are needed to treat a population of 3600 persons?

A. 20.4 ac.
B. 12 ac.
C. 15 ac.
D. 22 ac.

13. (I - IV) (10) An operator is feeding chlorine at a rate of 23 pounds/day to disinfect 0.28 MGD of effluent. If the residual after 30 minutes contact time is 0.6 mg/l, what is the chlorine demand of the effluent in terms of mg/l?

A. 9.3 mg/l
B. 22.4 mg/l
C. 9.9 mg/l
D. 10.1 mg/l

14. (I - IV) (10) An operator knows from past experience that the demand on chlorine used to disinfect the lagoon effluent is typically 0.8 lbs per pound of BOD in the effluent. An industry has increased the BOD in the effluent from 120 lbs./day to 140 lbs./day. How much chlorine should the operator feed in order to maintain a 0.5 mg/l residual in the 1.7 MGD discharge?

A. 112 lbs./day
B. 119 lbs./day
C. 7.1 lbs/day
D. 71 lbs./day

15. (I - IV) (11) What is the organic loading on a lagoon (lbs./day/acre) if the influent BOD averages 164 mg/l and the flow averages 0.67 MGD. The lagoon has two (2) cells that are each 800 ft square.

A. 29 lbs./ac.
B. 31 lbs./ac.
C. 23 lbs./ac.
D. 52 lbs./ac.

16. (I - IV) (11) A lagoon WWTF is designed to serve 4200 persons. Assuming a 30 lbs./day/acre loading, how many acres of surface area are needed?

A. 140 ac.
B. 24 ac.
C. 31 ac.
D. 28 ac.

17. (I - IV) (12) An intermittent sand filter that is 110 ft square receives an average flow of 0.14 MGD. What is the hydraulic loading (gpd/sf) on the filter?

A. 16 gpd/sf
B. 12 gpd/sf
C. 11 gpd/sf
D. 13 gpd/sf

18. (II - IV) (13) An operator got an initial D.O of 6.7 mg/l on a BOD sample and five days later got a final D.O of 4.2 mg/l. The operator had used 50 ml of effluent sample. What was BOD of the sample?

A. 20 mg/l
B. 6 mg/l
C. 15 mg/l
D. 18 mg/l

19. (II - IV) (14) An operator filtered 50 ml of influent sample through a prepared filter that weighed 0.0935 grams. After drying, the filter plus the residue weighed 0.1005 grams. Calculate the total suspended solids (TSS).

A. 140 mg/l
B. 210 mg/l
C. 156 mg/l
D. 132mg/l

20. (II - IV) (15) After 24 hours incubation, an operator counted 27 blue colonies on the membrane filter. The operator had used 0.1ml of effluent sample for the analysis. What is the fecal coliform count (cols./100ml) for the sample?

A. 2700
B. 270
C. 27000
D. 270000

21. (II - IV) (16) The chlorinator at an activated sludge plant is set to feed 30 pounds per day to disinfect 0.55 MGD. What is the dosage expressed as mg/l?

A. 6.5 mg/l
B. 5.6 mg/l
C. 10.2 mg/l
D. 8.1mg/l

22. (II - IV) (16) Design flow at a POTW is 1.2 MGD and the design organic load is 2042 pounds per day. What concentration of BOD is the plant designed to treat?

A. 190 mg/l
B. 200 mg/l
C. 204 mg/l
D. 250 mg/l

23. (II - IV) (17) An aerated lagoon recieves an average flow of 0.84 MGD and the average BOD concentration is 163 mg/l. The lagoon is equipped with four (4) fifteen (15) hp aerators that produce 2.5 lbs. 0_2/hp/hour. It is recommended to supply 1.5 lbs. 0_2 per lb. of BOD load. Calculate the minimum run time (hrs./day) for the aerators.

A. 11.4
B. 7.6
C. 24
D. 12

24. (II - IV) (18) An operator ran a 30 minute settling test on a mixed liquor sample using a 1000 ml graduated cylinder. The mixed liquor settled to 44% of the cylinder volume. The lab determined that the MLSS concentration was 3380 mg/l. What was the Sludge Volume Index for the mixed liquor?

A. 0.13
B. 130
C. 13000
D. 116

25. (II - IV) (19) Calculate F/M ratio based on the following data:

Influent BOD - 156 mg/l
Effluent BOD - 21 mg/l
Influent TSS - 210 mg/l
Four (4) aeration basins - 30 ft x 70 ft x 10 ft. deep
Flow - 0.65 MGD
MLSS - 3600 mg/l
MLSS average % volatile - 72%

A. 0.6
B. 0.04
C. 0.06
D. 0.02

26. (III - IV) (20) An activated sludge WWTP has eight (8) aeration tanks that are each 40 ft.x 20 ft. x 12 ft. The MLSS concentration averages 2900 mg/l and the influent TSS averages 168 mg/l. The average daily flow is 0.62 MGD. Calculate the Sludge Age.

A. 8 days
B. 16 days
C. 21 days
D. 26 days

27. (III - IV) (20) Calculate S.A. based on the following data:

Avg. flow - 0.6 MGD
Volume of aeration - 0.75 MGD
Avg. inf. TSS - 147 mg/l
Avg. MLSS - 2600 mg/l

A. 16 days
B. 8 days
C. 31 days
D. 22 days

28. (III - IV) (21) A circular clarifier that is 50 feet in diameter receives a flow of 2.5 MGD. What is the surface loading rate.

A. 1,274 gpd/sf
B. 15,924 gpd/ft
C. 1,472 gpd/sf
D. 13,423 gpd/ft.

29. (III - IV) (22) A WWTP has two (2) secondary clarifiers that are 40 feet in diameter. The effluent weirs are located 2 feet inside the perimeter of the tanks. If the flow is 3.2 MGD, what is the Weir Overflow Rate?

A. 13,179 gpd/ft.
B. 14,159 gpd/ft.
C. 1,274 gpd/sf
D. 14,159 gpd/sf.

30. (III - IV) (23) The average flow at the Lyon, Mississippi wastewater plant is 0.52 MGD and the influent TSS averages 146 mg/l. The MLSS averages 2580 mg/l. The secondary clarifier is 30 feet in diameter. What is the solids loading rate on the clarifier?

A. 18 lbs./sf
B. 16 lbs./sf
C. 19 lbs.sf
D. 0.9 lbs./sf

31. (III - IV) (24) An activated sludge plant receives a flow of 1.8 MGD that has an influent BOD of 190 mg/l. The plant has two (2) aeration tanks that are each 60 ft. x 25 ft. x 10 ft. deep. Calculate the organic loading.

A. 95 lbs./cf
B. 28 lbs./1000 cf
C. 82 lbs./cf
D. 95 lbs./day/1000 cf

32 (III - IV) (25) The flow to a trickling filter is 0.64 MGD. The filter is 60 ft. in diameter and the media depth is 6 ft. Calculate the hydraulic loading on the filter.

A. 226 gpd/sf
B. 38 gpd/cf
C. 37,870 gpd/1000cf
D. 188 gpd/sf

33. (III - IV) (26) The raw flow to a trickling filter WWTP is 0.86 MGD. If the desired R/Q is 1.5, what would be the total flow to the filter?

A. 1.3 MGD
B. 0.86 MGD
C. 2.15 MGD
D. 1.29 MGD

34. (III - IV) (27) An activated sludge WWTP receives a flow of 0.3 MGD from the main influent pumping station that has a BOD concentration of 189 mg/l. An additional sidestream flow of 50,000 gpd from an industrial park has a BOD of 310 mg/l. What is the concentration of the combined flows?

A. 104 mg/l
B. 206 mg/l
C. 256 mg/l
D. 499 mg/l

35. (III - IV) (27) A stream flowing at 4.5 cfs has an ambient BOD concentration of 4 mg/l. The town of Scott, MS. POTW discharges 2.3 MGD with a BOD of 23 mg/l. What is the BOD of the stream downstream from the plant?

A. 13.6 mg/l
B. 12.4 mg/l
C. 14.2 mg/l
D. 16.3 mg/l

36.- 38. (III - IV) (28) A trickling filter plant receives an average flow of 2.1 MGD. The average combined TSS (raw plus secondary) entering the primary clarifier is 310 mg/l. The primary removes 60% and these solids are pumped to a thickener at a concentration of 2.1%. The solids are then pumped to the digester at a concentration of 5.3%.

36. How many gpd are pumped to the thickener?

A. 30,926 gpd
B. 18,560 gpd
C. 7,364 gpd
D. 23,651 gpd

37. How many gpd are pumped to the digester?

A. 7,364 gpd
B. 18,560 gpd
C. 4,118 gpd
D. 6,789 gpd

38. How many gpd of supernatant are returned to the headworks?

A. 7,364 gpd
B. 11,196 gpd
C. 4,118 gpd
D. 6,789 gpd

39. (III - IV) (29) An operator has determined that he must waste 7,000 gallons of WAS. All of the 10 drying beds are full of dried sludge. Each bed is 20 ft. by 30 ft. in area. If the operator applies the sludge at a depth of 15 inches, how many drying beds must be prepared?

A. 1
B. 3
C. 2
D. 1.5

40. (III - IV) (29) An operator has 6 drying beds that are 30 ft. by 40 ft each. If all of the beds are ready to receive digested sludge, how many gallons of sludge can be wasted from the digester if applied at a depth of 18 inches?

A. 81,000 gals.
B. 13,500 gals.
C. 10,800 gals.
D. 40,500 gals

41. - 42. (III - IV) (30)

41. The desired MLSS to operate at a 21 day S.A. at the Russell WWTP is 3400 mg/l. The RAS concentration is 1.3 %. What would be the Percent Return Sludge in order to maintain the 21 day S.A.?

A. 42%
B. 35%
C. 31%
D. 54%

42. If the average flow is 1.2 MGD, what is the Return Sludge Rate in gpd?

A. 504,000 gpd
B. 420,000 gpd
C. 372,000 gpd
D. 648,000 gpd

43. (III - IV) (31) How many gallons of sludge must be wasted if the desired MLSS is 3200 mg/l and the actual MLSS is 4100 mg/l? The W.A.S. concentration is 1.4% and the aeration volume is 400,000 gallons.

A. 21,314 gals.
B. 0.257 MG.
C. 0.21 MG.
D. 25,714 gals.

44. (III - IV) (31) Calculate W.A.S volume in MG based on the following data:

Average flow- 3.2 MGD
W.A.S. conc. - 1.4%
Effluent TSS - 13 mg/l
Actual MLSS - 6,210 mg/l
Desired MLSS - 4,500 mg/l
Volume of aeration - 3.0 MG

A. 0.63 MG
B. 0.37 MG
C. 0.15 MG
D. 0.31 MG

45. (III - IV) (32) An A.S. WWTP receives an average flow of 0.75 MGD with an average BOD of 154 mg/l. The plant has two blowers, each with a capacity of 980 cfm. If it is desired to apply 2000 cf of air per pound of BOD, how many hours each day must the blowers operate to supply enough air?

A. 12.2 hours
B. 16.4 hours
C. 24 hours
D. 11 hours

46. (IV) (33) Calculate the MCRT based on the following data:

Avg. daily flow - 2.1 MGD
Volume of aeration - 2.0 MG
2 secondary clarifiers - 60 ft. diameter by 10 ft. deep
W.A.S concentration - 1.4%
MLSS - 3260 mg/l
Effluent TSS - 23 mg/l
W.A.S. rate - 16000 gpd

A. 29 days
B. 19 days
C. 24 days
D. 13 days

47. (IV) (34) Calculate daily gas production based on the following data:

Avg. daily flow - 1.3 MGD
Avg. TSS. - 178 mg/l
% removal - 63%
Volatile content- 74%
% reduction in digester - 46%
Gas production rate - 12 cf/lb. volatile matter destroyed

A. 1,216 cf/day
B. 4,966 cf/day
C. 14,590 cf/day
D. 6,544 cf/day

48. (IV) (35) An operator desires to operate an activated sludge plant at a sludge age of 24 days. The average flow is 0.85 MGD and the influent TSS average 176 mg/l. The volume of the aeration basin is 1.0 MG. What MLSS concentration should be maintained to operate at the desired S.A.?

A. 3,287 mg/l
B. 3,591 mg/l
C. 2,697 mg/l
D. 4,109 mg/l

49. (IV) (35) An A.S. WWTP is designed to operate at an F/M ratio of 0.05. The average influent BOD is 146 mg/l. The design flow for the extended aeration plant is 0.5 MGD. In order to operate at the desired F/M ratio at design flow with current influent characteristics, what MLVSS concentration should be maintained?

A. 2,900 mg/l
B. 2,098 mg/l
C. 3,765 mg/l
D. 2,657 mg/l

50. (IV) (37) The Bent Stump WWTP receives flow from an industrial park in such a way that it cannot be sampled. The influent flow from the town averages 0.085 MGD with an average BOD of 149 mg/l. The effluent flow averages 0.125 MGD. The combined influent BOD averages 210 mg/l. How many lbs./day of BOD can the town bill the industrial park for?

A. 340
B. 113
C. 413
D. 163

CHAPTER 2
WASTEWATER CHARACTERISTICS

CHAPTER 2: WASTEWATER CHARACTERISTICS

1. (I - IV) (01) Wastewater is discharged into a sewer from:

   A. Residential users
   B. Commercial users
   C. Industries and institutions
   D. Any of these

2. (I - IV) (01) Municipal wastewater usually consists of:

   A. Domestic wastewater
   B. Groundwater and stormwater
   C. Industrial wastes
   D. All of these

3. (I - IV) (01) The make-up of domestic wastewater is usually:

   A. Highly variable
   B. Variable from community to community
   C. Consistent, since it originates from human sources
   D. Variable from month to month

4. (I - IV) (02) A distinctive musty odor which is slightly offensive is an indication of:

   A. Fresh wastewater
   B. Septic wastewater
   C. Industrial wastewater
   D. Excessive infiltration/inflow

5. (I - IV) (02) Fresh wastewater is generally _____ in color.

   A. Black
   B. Brown
   C. Yellowish
   D. Gray

6. (I - IV) (04) Organisms found in raw sewage that are not harmful to humans but are indicators of diseases are:

   A. Pathogens
   B. Fecal coliform
   C. Total coliform
   D. Bacteria

7. (I - IV) (03) A pH value of 7 is an indication of:

   A. Acidic conditions
   B. Neutral conditions
   C. Alkaline conditions
   D. Caustic conditions

8. (I - IV) (03) Raw wastewater typically has a pH value in the range of:

   A. 1 to 7
   B. 7 to 14
   C. 6.5 to 8.5
   D. 5 to 10

9. (I - IV) (03) The pollution causing component in wastewater is:

A. Suspended solids
B. Settleable solids
C. Biodegradeable matter
D. Organic matter

10. (I - IV) (03) Septic wastewater has a "rotten egg" odor caused by:

A. Sulfuric acid
B. Methane gas
C. Carbon dioxide
D. Hydrogen sulfide

11. (I - IV) (02) The temperature of raw wastewater will typically be:

A. 40 - 60 degrees F.
B. 50 - 90 degrees F.
C. 50 - 70 degrees F.
D. 30 - 70 degrees F.

12. (I - IV) (04) In raw wastewater the principal organism is bacteria. The number of bacteria can be expected to be:

A. 50,000 to 100,000/ml
B. 0.5 to 5.0 million/ml
C. 200 to 400 cols./100 ml
D. 2000 to 10,000 cols/100 ml

13. (I - IV) (02) Wastewater contains a large quantity of solid matter. The term"solids" refers to:

A. Floating matter
B. Suspended matter
C. Dissolved matter
D. All of these

14. (I - IV) (02) The solid matter that can be used as food by the microorganisms is called:

A. Dissolved solids
B. Volatile solids
C. Fixed solids
D. None of these

15. (I - IV) (02) The typical total suspended solids concentration of raw wastewater is:

A. 100 - 300 mg/l
B. 200 - 300 mg/l
C. 200 - 250 mg/l
D. 300 - 400 mg/l

16. (I - IV) (03) The main groups of organic substances found in wastewater are:

A. Animal, vegatable and mineral substances
B. Alchohol, glycerol and fatty acids
C. Proteins, carbohydrates, fats and oils
D. Sugars, starches, cellulose and wood fiber

17. (I - IV) (03) The most common method to evaluate the organic content of wastewater is the 5 day BOD analysis. another method is the:

A. Chemical oxygen demand analysis
B. Volatile solids analysis
C. Total organic carbon analysis
D. Any of these

18. (I - IV) (03) The typical organic content of raw wastewater, in terms of BOD concentrations, is:

A. 100 - 300 mg/l
B. 200 - 250 mg/l
C. 150 - 350 mg/l
D. 150 - 175 mg/l

19. (I - IV) (02) Excessive oil and grease can sometimes cause operational problems. The typical oil and grease content of raw wastewater is:

A. 100 - 150 mg/l
B. 50 - 75 mg/l
C. 80 - 120 mg/l
D. 40 - 60 mg/l

20. (I - IV) (03) In raw watewater, nitrogen exists as organic nitrogen and ammonia nitrogen. In most instances the ratio is:

A. 70% organic and 30 % ammonia
B. 30 % ammonia and 70% organic
C. 60 % organic and 40% ammonia
D. 60% ammonia and 40% organic

CHAPTER 3
PRELIMINARY TREATMENT

CHAPTER 3: PRELIMINARY TREATMENT

1. (I - IV) (01) The purpose of preliminary treatment is to:

   A. Energize the microorganisms in the wastewater.
   B. Remove material that could interfere with biological treatment.
   C. Remove materials that could damage plant equipment.
   D. B and C

2. (I - IV) (01) Preliminary treatment units are located:

   A. At industries that have harmful discharges
   B. Prior to secondary treatment
   C. In the collection system
   D. After primary treatment

3. (I - IV) (02) Bar screens or racks should be cleaned:

   A. At least once per day
   B. Once per shift
   C. As often as needed
   D. Twice per week

4. (I - IV) (02) Material removed from bar screens should be:

   A. Burned to prevent the spread of disease.
   B. Placed in the digester.
   C. Buried on the plant site
   D. Placed in a closed container until disposal at a sanitary landfill.

5. (I - IV) (03) The purpose of comminution is to:

   A. Combine wastewater from different sewers prior to entry into the treatment facility.
   B. Shred large debris and organic material into small particles.
   C. Liquify chunks of grease in order to break it down.
   D. Mix the raw wastewater to distribute the organics.

6. (I - IV) (03) In order for a comminutor to work properly, it must be properly maintained. Which of the following is not a maintenance consideration?

   A. Keeping cutting teeth sharpened or replaced.
   B. Removing grit buildup from the approach channel
   C. Tightening or replacing the packing around the drive shaft.
   D. Lubricating the equipment according to the manufacturer.

7. (II - IV) (04) The velocity of flow through a non- aerated grit chamber should be maintained at an average of:

   A. 0.7 feet/sec.
   B. 2.0 feet/sec.
   C. 1.4 feet/sec.
   D. 1.0 feet/sec.

8. (II - IV) (04) The proper operation of an aerated grit removal process will:

A. Cause material with a specific gravity of greater than 1.0 to settle.
B. Cause sand and other non-organics to settle and keep organic material in suspension.
C. Help to freshen stale or septic wastewater.
D. B and C

9. (I - IV) (05) It is desirable to remove oil and grease prior to secondary treatment because:

A. 1.0 ppm oil and grease is equal to 2.0 ppm BOD
B. Oil and grease may interfere with biological treatment.
C. Large particles of grease can stop up ports or damage equipment.
D. Any of the above.

10. (I - IV) (05) Two common pre-treatment methods for oil and grease removal are:

A. DAF and sedimentation
B. Air floatation and skimming
C. Pre-chlorination and polymers
D. Heat treatment and enzymes

11. (II - IV) (06) Which of the following is not a benefit of pre-aeration in a biological wastewater facility?

A. Freshens stale or septic wastewater.
B. Helps control odors at plant.
C. Helps distribute organics in the raw wastewater.
D. Helps break down oil and grease.

12. (III - IV) (07) Flocculation is the addition of chemicals to wastewater in order to:

A. Adjust the pH of the wastewater
B. Aid settling
C. Improve mixing
D. Improve skimming

13. (I - IV) (08) The influent pH at a wastewater facility is found to be 5.4 SU. What action should the operator take?

A. Add sulfuric acid to neutralize the pH.
B. Add aluminum sulfate to raise the pH.
C. Add lime or caustic soda to neutralize the pH.
D. Do nothing because the bacteria will acclimate.

14. (I - IV) (08) Neutralization is sometimes necessary because:

A. The raw wastewater is too acidic.
B. The raw wastewater is too alkaline.
C. The microorganisms like a neutral (7) pH.
D. Any of the above.

15. (III - IV) (09) Which of the following is not a proper use of chlorine in a treatment process prior to disinfection?

A. Odor control
B. Corrosion control
C. Destroy pathogenic organisms
D. Oil and grease control

16. (III - IV) (09) The typical dosage for the use of chlorine to control slime growth is:

A. 2 - 9 ppm
B. 1 - 10 ppm
C. 4 - 6 ppm
D. 0.1 - 0.5 ppm

17. (III - IV) (10) Flow equalization is a process whereby:

A. Excessive influent flow is allowed to bypass secondary treatment to prevent washout.
B. Pump stations are shut down during periods of heavy rain and wastewater is held in the collection system.
C. Pump controls are set to deliver a constant flow to the treatment plant.
D. Excessive flow is stored in tanks or basins until it can be treated without hydraulically overloading the plant.

18. (I - IV) (11) Which of the following is the most critical component of a good sewer usage ordinance?

A. The legal language with which it is written.
B. Grease trap regulations
C. Strict enforcement
D. Frequent sampling

19. (I - IV) (11) Which of the following is not typically regulated by a sewer usage ordinance?

A. Temperature of liquid discharges
B. Taste or odor producing substances
C. Excessive discoloration
D. BOD of 300 or less

20. (I - IV) (12) In Mississippi, the pre-treatment of industrial wastewater is typically regulated by:

A. U.S.E.P.A.
B. The owner of the treatment facility
C. MDEQ/OPC
D. B and C

CHAPTER 4
PRIMARY TREATMENT

CHAPTER 4: PRIMARY TREATMENT

1. (II - IV) (01) The location of primary clarifiers at a secondary treatment facility is typically:

   A. At the headworks of the plant.
   B. Between pretreatment processes and secondary processes.
   C. After secondary treatment
   D. Prior to pretreatment.

2. (II - IV) (01) Primary treatment consists of two physical processes, they are:

   A. Flocculation and coagulation
   B. Skimming and coagulation
   C. Sedimentation and skimming
   D. Flocculation and sedimentation

3. (II - IV) (01) If a primary clarifier is properly designed and operated, it can remove _____to _____ of suspended solids.

   A. 50 - 65 %
   B. 25 - 40 %
   C. 30 - 50 %
   D. 10 - 20 %

4. (II - IV) (01) Which of the following is not a purpose of a primary clarifier?

   A. Reduce the organic loading on the secondary process.
   B. Prevent clogging of trickling filters
   C. Remove oil and grease
   D. Help control odors in the secondary process

5. (II - IV) (01) A substance that has a" specific gravity" of 1.5 means that:

   A. The substance will float.
   B. The substance is 1 and 1/2 times heavier than water.
   C. The substance is 1 and 1/2 times lighter than water.
   D. The substance is 1.5 times heavier than atmospheric pressure.

6. (II - IV) (01) Primary clarifiers are optional in activated sludge processes. They may be included in order to:

   A. Reduce energy costs
   B. Reduce size of aeration basin
   C. Reduce organic loading on secondary treatment
   D. Any of the above

7. (II - IV) (04) The influent baffle in a circular clarifier is sometimes referred to as:

   A. Stilling well
   B. Influent well
   C. Calming well
   D. A or B

8. (II - IV) (04) Which of the following is not a means of sludge removal from a primary clarifier?

A. Air lift pump
B. Gravity flow
C. Centrifugal pump
D. Screw pump

9. (II - IV) (04) Circular clarifiers have mechanical drives to operate the:

A. Sludge collector
B. Skimmer arm
C. Influent scum trough
D. A and B

10. (II - IV) (04) The length to width ratio for rectangular primary clarifiers is:

A. = to or < 3
B. = to or > 3
C. > 3
D. 4 or >

11. (III - IV) (04) A properly designed and operated primary clarifier should produce settled sludges with concentrations of:

A. 1 to 2 %
B. 4 to 8%
C. 25 to 40%
D. 5 to 12%

12. (III - IV) (04) A primary clarifier is typically designed for _____ hours detention time.

A. 3 to 5 hours
B. 4 - 6 hours
C. 1.5 to 2.5 hours
D. 6 - 8 hours

13. (III - IV) (04) The hydraulic loading factor for the effluent weir in a clarifier is called the weir overflow rate (WOR). What is the WOR for a primary clarifier?

A. 600 - 1000 gpd/ft.
B. 10,000 - 15,000 gpd/sf
C. 15,000 - 20,000 gpd/ft.
D. 10,000 - 15,000 gpd/ft.

14. (III - IV) (04) Primary clarifiers are typically designed with a surface hydraulic loading rate (SLR) of:

A. 600 - 1000 gpd/sf
B. 800 - 1200 gpd/sf
C. 10,000 - 15,000 gpd/sf
D. 400 - 600 gpd/sf

15. (III - IV) (04) A properly designed and operated primary clarifier may reduce the BOD of raw wastewater by as much as:

A. 40 - 60%
B. 25 - 40%
C. 10 - 20%
D. 40 - 60 ppm

16. (III - IV) (05) Unlevel or unclean effluent weirs in a primary clarifier can cause:

A. High effluent BOD
B. High effluent TSS
C. Short circuiting
D. Any of the above

17. (III - IV) (05) The skimmings from a primary clarifier should be pumped to the:

A. Headworks of the plant to be mixed with raw wastewater
B. Final clarifier to mix with secondary scum
C. Digester to be treated with sludges
D. Drying bed or other dewatering device

18. (III - IV) (05) Which of the following is a good maintenance practice for sludge collector mechanisms in primary clarifiers?

A. Periodically shut down the sludge collector and let sludge concentrate.
B. When inspecting the mechanical drive, start and stop several times to try to trip the overload.
C. Periodically drain the clarifier to inspect the collector mechanism.
D. Pour oil around the drive shaft to lubricate intermediate bearings in the clarifier.

19. (III - IV) (05) Which of the following analyses would best determine the septicity of a primary clarifier?

A. pH
B. Turbidity
C. Dissolved oxygen
D. Conductivity

20. (III - IV) (05) Which of the following is not a recommended process control analysis for primary clarifiers?

A. D.O.
B. pH
C. BOD
D. Turbidity

CHAPTER 5
BIOLOGICAL TREATMENT

CHAPTER 5: BIOLOGICAL TREATMENT

1. (I - IV) (01) Biological treatment processes remove organic matter through the natural biological processes of microorganisms. What percent of the organic matter is generally removed through biological treatment methods?

   A. 100%
   B. 75%
   C. 65%
   D. 85%

2. (I - IV) (01) The biological process of converting organic matter into gases and cell tissue is called:

   A. Digestion
   B. Stabilization
   C. Nitrification
   D. Respiration

3. (I - IV) (01) Respiration and synthesis are the two biological processes that occur in the conversion of organic matter. The percentage of organics removed by each process is:

   A. 50% respiration, 50% synthesis
   B. 60% respiration, 40% synthesis
   C. 30% respiration, 70% synthesis
   D. 70% respiration, 30% synthesis

4. (I - IV) (02) The principal microorganism that provides the treatment in biological treatment processes is:

   A. Protozoa
   B. Bacteria
   C. Flagellates
   D. Rotifers

5. (I - IV) (02) Microorganisms may be classified according to Kingdom. Algae and bacteria belong to which Kingdom?

   A. Plant
   B. Animal
   C. Heterotrophic
   D. Protista

6. (I - IV) (02) Microorganisms that obtain carbon and energy through the oxidation of organic matter are called:

   A. Autotrophic
   B. Anaerobic
   C. Facultative
   D. Heterotrophic

7. (I - IV) (03) Which of the following is not a term used to refer to a conventional wastewater treatment lagoon?

   A. Oxidation pond
   B. Facultative lagoon
   C. Stabilization pond
   D. Aerobic lagoon

8. (I - IV) (03) The effluent from a conventional lagoon should be withdrawn:

   A. Off the surface
   B. Six to eighteen inches below the surface
   C. Near the bottom
   D. Intermittently

9. (I - IV) (03) During the process of algal photosynthesis:

A. Chlorophyll converts sunlight into energy for growth.
B. Algae produces oxygen
C. Algae converts CO_2, NH_3, and PO_4, into additional algae cells
D. All of the above

10. (I - IV) (03) At night algae in a conventional lagoon will:

A. Cease to produce oxygen
B. Produce less oxygen
C. Consume oxygen
D. Increase the pH of the lagoon contents

11. (I - IV) (03) At what level should a conventional lagoon be operated in winter if there is excess I & I?

A. 4 ft. to enhance photosynthesis
B. 5 ft. to increase detention time
C. Maximum depth to provide maximum detention time
D. Minimum depth to increase storage capacity

12. (I - IV) (03) Which of the following is not a recommended action to control burrowing animals in a lagoon?

A. Remove aquatic vegetation from around levees.
B. Frequently raise and lower the water level.
C. Check with local game officials regarding using poison bait.
D. Check with local game officials about trapping animals.

13. (I - IV) (03) One method of adding oxygen to a lagoon is through chemical aeration. Which of the following chemicals is preferred for this purpose?

A. Ammonium nitrate
B. Ammonia nitrate
C. Sodium hydroxide
D. Sodium nitrate

14. (I - IV) (03) Which of the following is not a recommended method for routinely controlling excess algae in the lagoon effluent?

A. Draw off effluent below the water surface
B. Dose lagoon with small amounts of copper sulfate
C. Operate multiple ponds in series
D. Upgrade lagoon with sand or rock filters

15. (I - IV) (03) A hydrographic controlled release (HCR) lagoon typically has a storage cell that is sized for _____ to _____ days storage capacity.

A. 30 to 40
B. 90 to 120
C. 60 to 100
D. 100 to 200

16. (I - IV) (03) Intermittent sand filters should periodically be taken out of service, be allowed to dry and have the surface raked or scarified to break up algal solids. This should be done:

A. Every 3 months
B. When treatment efficiency drops
C. When ponding occurs
D. Any of these

17. (I - IV) (03) Effluent from a lagoon system can be further treated by a wetlands environment through:

A. Filtration and vegetative nutrient uptake
B. Vegetative nutrient absorption and sedimentation
C. Physical sedimentation, filtration and bacterial activity
D. Any of these

18. (II - IV) (04) Which of the following is not an advantage of an aerated lagoon over a conventional lagoon?

A. Less land area required
B. Not dependent on climate for effective treatment
C. Does not keep all solids in suspension
D. More operational control

19. (II - IV) (04) Detention time in an aerated lagoon is typically:

A. 12 - 18 days
B. Minimum of 40 days
C. 4 - 8 days
D. 8 - 12 days

20. (II - IV) (041) BOD reduction in a properly designed and operated aerated lagoon can be expected to be:

A. 75 - 85%
B. 65 - 75 %
D. 80 - 90%
C. 85 - 95%

21. (II - IV) (04) The size of the aerators in an aerated lagoon should be sufficient to assure adequate oxygen dispersal. This usually requires:

A. 10 - 15 hp/mg
B. 8 - 10 hp/mg
C. 8 - 10 hp/mgd
D. 10- 15 hp/mgd

22. (II - IV) (04) With regard to types of bacteria present in an aerated lagoon, it is considered a/an:

A. Aerobic process
B. Facultative process
C. Anaerobic process
D. Anoxic process

23. (II - IV) (04) As a general rule, at least _____ mg/l of dissolved oxygen should be maintained in an aerated lagoon.

A. 2
B. 1.5
C. 3
D. > 3

24. (II - IV) (04) Most floating aerators in an aerated lagoon can supply approximately _____ pounds of oxygen per horsepower per hour.

A. 2
B. 3
C. 1.5
D. 2.5

25. (II - IV) (04) Operators of aerated lagoons should operate the aeration equipment:

A. All the time to get maximum efficiency
B. Manually (by hand) to increase operational control
C. Through the use of timers to conserve energy
D. Based on the amount of volatile TSS in the influent

26. (II - IV) (04) Influent sample lab data indicates an increase in the influent BOD concentrations and flow. What should an operator of an aerated lagoon do:

A. Call MDEQ/OPC industrial pre-treatment section.
B. Inform mayor that plant upgrade may be required in the future.
C. Run aerators continuously.
D. Re-calculate run time of aerators based on current BOD loading.

27. (I - IV) (05) Anaerobic lagoons must have a thick crust cover to contain odors and keep out oxygen. The source of these odors is from:

A. Methane gas
B. Carbon hydroxide gas
C. Sulfurous hydroxide
D. Hydrogen sulfide

28. (I - IV) (05) The minimum detention time required for anaerobic decomposition of organic waste in an anaerobic lagoon is:

A. 48 hours
B. 72 hours
C. 15 days
D. 4 days

29. (II - IV) (06) The primary organisms responsible for treating wastewater in the trickling filter process are:

A. Anaerobic bacteria
B. Facultative bacteria
C. Anoxic bacteria
D. Aerobic bacteria

30. (II - IV) (06) The four (4) basic components of all tricking filter treatment processes are:

A. Pre-treatment, primary treatment, secondary treatment, sludge treatment
B. Pre-treatment, primary clarifier, trickling filter, secondary clarifier
C. Primary clarifier, trickling filter, secondary clarifier, recirculation
D. Primary, trickling filter, secondary clarifier, digester

31. (II - IV) (06) Which of the following is not a term used to describe the biological solids washed off of the media in a trickling filter process?

A. Humus
B. Sloughings
C. Secondary sludge
D. Primary sludge

32. (II - IV) (06) The operator's primary operational control tool in a trickling filter process is:

A. Sludge removal
B. Distributor arm speed
C. Controlling sloughing
D. Recirculation

33. (III - IV) (06) The type of trickling filter most common in municipal applications is the high rate. Which of the following is the recommended organic loading rate for high rate filters?

A. 100 - 1000 lbs. BOD/1000 cf
B. 25 - 100 lbs. BOD/cf
C. 100 - 250 lbs. BOD/cf
D. 25 - 100 lbs. BOD/1000 cf

34. (II - IV) (06) In the trickling filter process, R/Q stands for:

A. Raw flow divided by quantity of recirculated flow
B. Recirculated flow divided by quantity of digester supernatant
C. Recirculated flow divided by the raw flow
D. Rotations quotient

35. (II - IV) (06) Which of the following is not a benefit of recirculation in the trickling filter process?

A. Dilutes high strength or toxic wastes.
B. Helps prevent septic conditions in trickling filter
C. Helps prevent excessive sloughing
D. Helps control odors, ponding and filter flies

36. (II - IV) (06) The solids concentration of trickling filter sludges vary but typically will be:

A. Greater than 3%
B. Less than 2%
C. Greater than 2%
D. 1 - 4%

37. (III - IV) (07) Rotating biological contactors operate based on the same biological principles as:

A. Aerated lagoons
B. Activated sludge systems
C. Sequencing batch reactors
D. Trickling filters

38. (II - IV) (08) The four (4) basic components of every activated sludge treatment system are:

A. Primary treatment, secondary treatment, clarification and disinfection
B. Pre-treatment, aeration, clarification and disinfection
C. Aeration, sedimentation, return sludge and waste sludge
D. Pre-treatment, primary treatment, secondary treatment and disinfection

39. (II - IV) (08) The basic objective in the activated sludge process is to maintain balanced conditions in the aeration tank, this balance is called:

A. Endogenous respiration
B. Equilibrium status
C. Food/microorganism ratio
D. Mass balance ratio

40. (III - IV) (08) Mean cell residence time (MCRT) represents the theoretical time that a microorganism stays in the activated sludge system. The typical values for most activated sludge processes are:

A. 3 - 30 days
B. 5 - 15 days
C. 3 - 15 days
D. 5 - 20 days

41. (III - IV) (08) An activated sludge process that has a desired F/M ratio of 0.05 and a sludge age of 30 days is what type of activated sludge process modification?

A. Extended aeration
B. Complete mix
C. Conventional
D. Oxidation ditch

42. (II - IV) (08) The three (3) most common types of aeration equipment used in the activated sludge system are:

A. Blowers, floating aerators, diffused aerators
B. Fine bubble, coarse bubble, sock type
C. Diffused aeration, mechanical aeration, disc or brush aeration
D. Slotted pipe, porous tube, slotted disc

43. (II - IV) (08) The volume of settled sludge in the 30 minute settleability (ml/l) times 1000, divided by the MLSS concentration is called:

A. Sludge Volume Index
B. Sludge Mass Ratio
C. Sludge Age
D. Mean Cell Residence Time

44. (II - IV) (08) Two major operational difficulties which sometimes occur in activated sludge secondary clarifiers are:

A. Low D.O. and algae growth
B. Short circuiting and scum accumulation
C. Rising sludge and bulking sludge
D. Long D.T. and short S.A.

45. (II - IV) (08) A thick, scummy, dark tan foam on the surface of an activated sludge aeration tank is an indication of:

A. Aeration tank is underloaded (high MLSS)
B. Aeration tank is overloaded (low MLSS)
C. Excess grease in raw wastewater
D. Excess phosphates (detergents) in raw wastewater

46. (III - IV) (09) There are five (5) operational steps that must be implemented sequentially in the operation of a sequencing batch reactor. Which of the following is not one of these steps?

A. Fill
B. Aerate
C. Idle
D. Digest

47. (I - IV) (10) Supervisory and management positions at wastewater facilities should be staffed with only:

A. College graduates
B. High school graduates
C. The most experienced personnel
D. Certified or licensed personnel

48. (I - IV) (10) Laboratory data at small wastewater facilities:

A. Is usually not necessary
B. Should be generated on site
C. May be more economically feasible if determined by a contract laboratory.
D. Should be sent to the Mayor's office to be filed

49. (I - IV) (10) The two (2) most critical factors regarding the successful operation of any wastewater facility are:

A. 1. Staffing 2. O&M
B. 1. Design/Construction 2. Operation/Management
C. 1. Sampling 2. Preventive maintenance
D. 1. Accurate lab data 2. Preventive maintenance

50. (I - IV) (10) The top priority of managers of wastewater facilities should be:

A. Operation and maintenance (O&M)
B. Housekeeping and groundskeeping
C. Records and reports
D. Safety

CHAPTER 6
ADVANCED TREATMENT

CHAPTER 6: ADVANCED TREATMENT

1. (III - IV) (01) Total Kjeldahl Nitrogen (TKN) consists of:

   A. 40% Nitrite plus 60% Ammonia
   B. 40% Organic N plus 60% Ammonia N
   C. 40% Ammonia N plus 60% Organic N
   D. 40% Nitrate N plus 60% Ammonia N

2. (III - IV) (02) Many NPDES permits limit the amount of ammonia nitrogen that can be discharged into a stream because:

   A. Ammonia exerts an oxygen demand in the stream
   B. Ammonia can be toxic to aquatic life
   C. Ammonia reacts with chlorine which can interfere with disinfection
   D. Any of these

3. (III - IV) (02) In Mississippi, biological nitrification is the most common method of removing ammonia nitrogen. Another method is:

   A. Breakpoint chlorination
   B. Selective ion exchange
   C. Air stripping
   D. Any of these

4. (III - IV) (02) The biological nitrification process is carried out by bacteria that convert ammonia nitrogen to nitrate nitrogen. the two (2) specific groups of bacteria that perform this conversion are:

   A. Nitrosomonas and nitrobacter
   B. Flagellates and crawling ciliates
   C. Flagellates and swimming ciliates
   D. Crawling ciliates and swimming ciliates

5. (III - IV) (02) In biological denitrification, bacteria convert nitrate nitrogen into nitrogen gas through a process in which chemically bound oxygen in the nitrate replaces molecular oxygen in the respiratory processes of the bacteria. This process is known as:

   A. Anaerobic respiration
   B. Nitrate dissimilation
   C. Nitrite Dissimilation
   D. Anaerobic dissimilation

6. (III - IV) (02) Biological denitrification requires _____ conditions.

   A. Aerobic
   B. Anaerobic
   C. Anoxic
   D. Facultative

7. (III - IV) (02) In a typical biological nitrification system, an oxygen demand of _____ parts oxygen per part of ammonia oxidized is exerted in the nitrification process.

   A. 2.37
   B. 3.27
   C. 5.47
   D. 4.57

8. (III - IV) (02) The optimum sludge age for biological nitrification to occur is:

A. 10 - 20 days
B. 20 - 30 days
C. 15 - 20 days
D. 30 - 40 days

9. (III - IV) (03) In the breakpoint chlorination method of ammonia nitrogen removal, _____ parts of chlorine are required for each part of ammonia removed.

A. 3.0
B. 7.6
C. 6.7
D. 2.0

10. (III - IV) (03) A method of reducing the ammonia where lime is used to raise the pH of the wastewater to between 10.8 and 11.5 is called:

A. Selective ion exchange
B. Air stripping
C. Two stage biological nitrification
D. Lime stabilization

11. (IV) (04) The typical concentration of phosphorous in raw wastewater is about:

A. 20 mg/l
B. 10 mg/l
C. 15 mg/l
D. 30 mg/l

12. (IV) (04) In certain locations it is desirable to remove phosphorous because:

A. It creates an undesirable foam in the stream
B. It creates an oxygen demand in the stream
C. It provides nutrients for aquatic plants
D. Any of these

13. (IV) (04) The principal compound or flocculation agent used to precipitate phosphorous from wastewater is:

A. Ferric chloride
B. Hydrated lime
C. Aluminum sulfate
D. Ferric sulfate

14. (IV) (04) One important factor to be considered in the chemical precipitation of phosphorous is:

A. Temperature
B. pH
C. Mixing
D. BOD/Phosphorous ratio

15. (IV) (04) Phosphorous is found in wastewater as:

A. Orthophosphate
B. Polyphosphate
C. Organic phosphorous
D. Any of these

16. (IV) (06) In the physical-chemical treatment of wastewater, the most common processes used are:

A. Chemical filtration, physical clarification, carbon adsorption
B. Physical filtration, chemical clarification, carbon absorption
C. Neutralization, filtration, reverse osmosis
D. Chemical clarification, filtration, carbon adsorption

17. (IV) (06) Oxidation ditches may be adapted for denitrification by the addition of:

A. Carbon adsorption
B. Anoxic zones
C. Flocculation basins
D. Sand and carbon filtration

18. (IV) (06) The desired contact time for wastewater to pass through carbon columns in the physical-chemical treatment process is:

A. 15 - 30 minutes
B. 30 - 60 minutes
C. 45 - 90 minutes
D. 1 - 2 hours

19. (IV) (06) Attached growth processes that can be added as tertiary treatment for lagoon and activated sludge systems for ammonia removal are called:

A. Trickling Filters
B. Biological Contact Reactors
C. Activated Biocells
D. Tertiary Filters

20. (IV) (06) The physical-chemical treatment process utilizes carbon granules to remove soluble organics from wastewater. This material must be periodically cleaned and regenerated. One method used for this is to:

A. Backflush the carbon column with salt water
B. Heat in a steam furnace to 1750 degrees F.
C. Remove carbon and wash with strong detergent
D. Any of these

CHAPTER 7
DISINFECTION

CHAPTER 7: DISINFECTION

1. (I - IV) (01) The pathogenic organisms of greatest concern with regard to human exposure are:

   A. Enteric bacteria
   B. Viruses
   C. Intestinal parasites
   D. Any of these

2. (I - IV) (01) The fundamental purpose of disinfection is to:

   A. Destroy fecal coliform bacteria
   B. Destroy all bacteria
   C. Destroy pathogenic organisms
   D. Protect downstream users from waterborne diseases

3. (I - IV) (03) When chlorine is added to wastewater it reacts with various substances to form various products. Which of the following has the greatest disinfecting properties?

   A. Chloramines
   B. Chloride
   C. Chloro-organics
   D. Free chlorine

4. (I - IV) (03) The amount of chlorine used to disinfect after all of the chemical reactions have taken place is known as :

   A. Chlorine dosage
   B. Chlorine demand
   C. Chlorine residual
   D. Combined chlorine residual

5. (I - IV) (03) It is important to monitor the amount of chlorine in treatment plant effluents. The parameter commonly used in Mississippi for this purpose is:

   A. Total chlorine residual
   B. Free chlorine residual
   C. Combined chlorine residual
   D. A and B but not C

6. (I - IV) (03) The most common de-chlorinating agent used to reduce residual chlorine is:

   A. Sodium sulfite
   B. Sulfur dioxide
   C. Sulfur salts
   D. Sodium thiosulfate

7. (I - IV) (03) In order to ensure disinfection, sufficient contact time must be provided. The minimum recommended contact time is:

   A. 30 minutes
   B. 45 minutes
   C. 15 minutes
   D. 60 minutes

8. (I - IV) (03) The typical dosage for disinfecting an activated sludge effluent is:

A. 5 - 25 mg/l
B. 2 - 8 mg/l
C. 3 - 15 mg/l
D. 5 - 20 mg/l

9. (I - IV) (03) Hypochlorinators are devices that:

A. Feed gaseous chlorine directly into the effluent
B. Blend chlorine gas and water to form a chlorine solution
C. Feed dry solid chlorine compounds into the effluent
D. Convert liquid chlorine into chlorine gas

10. (I - IV) (03) The chlorine residual at a treatment plant has been calculated to be 12 pounds per day. How many pounds per day of sulfur dioxide should be applied to de-chlorinate the effluent?

A. 6
B. 12
C. 24
D. 1.2

11. (I - IV) (04) Photoreactivation is a phenomenon that may occur with effluents disinfected with ultraviolet irradiation. Photoreactivation causes:

A. Excessive algae growth
B. Sterilization of the effluent
C. Repair of organism's damaged cellular material
D. Imprinted images of solids and organisms to appear on quartz sleeves

12. (I - IV) (04) Disinfection through the use of ultraviolet light is a _____ process.

A. Chemical
B. Physical
C. Biological
D. None of these

13. (I - IV) (04) Residual U.V. irradiation is measured by:

A. Iodometric titration
B. Ion selective electrode
C. Specific ion electrode
D. There is no residual U.V. irradiation

14. (III-IV) (05) Two components combine to produce ozone, they are:

A. A hallogenic gas and oxygen
B. Carbon monoxide and oxygen
C. Electrical energy and oxygen
D. Hydrogen and oxygen

15. (III-IV) (05) Ozone is commercially available in:

A. 150 lb. cylinders only
B. 100, 150 and 2000 lb. cylinders
C. 100 and 150 but not 2000 lb. cylinders
D. Ozone cannot be stored and must be generated on site

16 (III-IV) (05) Ozone has a pungent odor that is detectable at concentrations of:

A. 0.015 - 0.1 mg/l
B. 0.5 - 1.0 mg/l
C. 0.05 - 0.15 mg/l
D. 0.005 - 0.015mg/l

17. (I - IV) (03) Chlorine is detectable in air at a concentration of 3.5 mg/l. What is the maximum concentration that may be breathed for one hour without adverse effects?

A. 40 mg/l
B. 15 mg/l
C. 4 mg/l
D. 30 mg/l

18. (I - IV) (05) Aqua ammonia is useful in locating leaks of:

A. Chlorine
B. Sulfur dioxide
C. Ozone
D. Chlorine and sulfur dioxide but not ozone

19. (I - IV) (04) A condition caused by staring at ultraviolet light that is painful to the mucous membranes of the eyes is commonly called:

A. Flash blindness
B. Welder's flash
C. Sunburned eyes
D. Corneal burns

20. (I - IV) (05) Pulmonary edema, hemorrhage, congestion and possible death can occur with exposure to as little as _____ to _____ mg/l of ozone:

A. 50 to 100
B. 1.0 to 10
C. 500 to 1000
D. 0.1 to 1.0

CHAPTER 8
SLUDGE TREATMENT

CHAPTER 8: SLUDGE TREATMENT AND DISPOSAL

1. (II - IV) (02) Which of the following most accurately describes the term "secondary sludge"?

   A. Gray in color, offensive odor
   B. Dark brown, musty odor, dewaters easily
   C. Dark brown to black, slight odor, contains gas
   D. Brown, flocculant, little odor, biologically active

2. (II - IV) (01) The purpose of sludge treatment is to:

   A. Reduce the organic content
   B. Reduce the volume
   C. Aid in dewatering
   D. All of these

3. (II - IV) (01) Solids concentrations in sludges may be expressed as mg/l or % solids. What would be the % solids of a sludge that has a concentration of 23,000 mg/l?

   A. 23%
   B. 2.3%
   C. 0.23%
   D. 230%

4. (III - IV) (03) If 1000 gallons of 1% sludge were thickened to 5% solids, how many gallons of sludge would there be?

   A. 500
   B. 50
   C. 200
   D. 5,000

5. (III - IV) (03) The two (2) most common methods of thickening sludge are:

   A. Primary clarifiers and secondary clarifiers
   B. Gravity thickeners and air floatation thickeners
   C. Centrifuges and gravity thickeners
   D. Centrifuges and air floatation thickeners

6. (III - IV) (03) The expected % solids concentration of sludge from a gravity thickener that is loaded with secondary activated sludge would be:

   A. 7 -9 %
   B. 5 - 8 %
   C. 5 - 6 %
   D. 2.5 - 3 %

7. (II - IV) (04) Sludge stabilization refers to:

   A. Adding lime to sludge
   B. Reducing the organic (volatile) content
   C. Reducing the biological activity
   D. B and C

8. (II - IV) (04) During the first stage of anaerobic digestion, organic matter is converted into:

A. Gases and cell tissue
B. Carbon dioxide and methane
C. Volatile acids
D. Volatile organic gas

9. (II - IV) (04) In an anaerobic digester, temperature is a critical factor. what is the optimum temperature for most anaerobic digesters?

A. 95 degrees C.
B. 85 - 100 degrees F.
C. 95 degrees F.
D. 29 -37 degrees C.

10. (II - IV) (04) In an aerobic digester, sludges are aerated without any additional source of organics. This process forces the microorganisms to feed on their own cell tissue and the cell tissue of other bacteria. This process is known as:

A. Sludge stabilization
B. Endogenous respiration
C. Esoteric digestion
D. Cannabolic respiration

11. (III-IV) (05) The primary purpose of sludge conditioning is to:

A. Stabilize the sludge
B. Reduce the pathogen content
C. Eliminate vector (insect) problems
D. Aid in dewatering sludges

12. (III-IV) (05) Organic chemicals that are used to aid in separating the sludge particles are called:

A. Volatile coagulants
B. Polymers
C. Flocculants
D. Organic separators

13. (II - IV) (06) The oldest and most common method for dewatering sludges is:

A. Belt presses
B. Centrifuges
C. Lagoons
D. Drying beds

14. (II - IV) (06) The amount of sludge applied to a drying bed varies depending on weather conditions and type of sludge, but is usually applied at a depth of:

A. 15 -18 inches
B. 9 - 15 inches
C. 12 - 18 inches
D. 8 - 12 inches

15. (II - IV) (06) A centrifuge uses _____ to separate the water from the solids in the sludge.

A. A continuous bowl
B. A rotating basket
C. A rotating screw
D. Centrifugal force

16. (II - IV) (06) The water that is removed during the use of belt filter presses and vacuum filters is called:

A. Filtrate
B. Pressate
C. Filter effluent
D. Filter supernatant

17. (II-III) (07) Landfilling involves the depositing of stabilized, dewatered sludge into an approved sanitary landfill. A component required for a landfill to be approved to receive sludge would be:

A. Leachate collection
B. Monitoring wells
C. Impermeable liners
D. Any of these

18. (II - IV) (07) Nitrogen exists in municipal sludges in any of four (4) forms, organic, ammonia, nitrite, and nitrate. Which form can not be readily used by plants as nutrients?

A. Ammonia
B. Organic
C. Nitrite
D. Nitrate

19. (II - IV) (07) The practice of utilizing soil bacteria solely to assimilate sludge solids is called:

A. Landfilling
B. Landspreading
C. Landfarming
D. Lagooning

20. (II - IV) (07) The method of disposing of sludge on agricultural lands is called:

A. Landspreading
B. Landfarming
C. Beneficial use disposal
D. Fertilization and soil conditioning

CHAPTER 9
FLOW MEASUREMENT

CHAPTER 9: FLOW MEASUREMENT

1. (I - IV) (01) The principles of flow measurement that we use today sprang from the efforts of ancient _____ and _____.

   A. Greeks and Turks
   B. Egyptians and Greeks
   C. Egyptians and Romans
   D. Romans and Greeks

2. (I - IV) (02) Which of the following is not a reason to monitor flow at a wastewater treatment facility?

   A. Operational control
   B. Permit requirements
   C. Establish costs and levy charges
   D. Calculate efficiency

3. (I - IV) (03) The simplest and most common method of measuring flow in open channels is the use of:

   A. Flumes
   B. Meters
   C. Staff gauges
   D. Weirs

4. (I - IV) (03) Weirs are usually classified according to:

   A. The inventor
   B. The expected volume to be measured
   C. The expected head
   D. The shape of the notch

5. (I - IV) (03) A weir should be constructed using a thin plate of metal (usually stainless steel or aluminum) approximately _____ to _____ inch thick.

   A. 1/8 to 1/4
   B. 1/16 to 1/8
   C. 1/4 to 1/2
   D. 1/2 to 1

6. (I - IV) (03) Flow is measured using a weir by measuring the depth of water flowing over the crest of the weir. This depth is called the:

   A. Spring
   B. Vortex
   C. Head
   D. Crest depth

7. (I - IV) (03) Which of the following is not a common type of weir used in wastewater facilities?

   A. V- notch
   B. Rectangular without end contractions
   C. Palmer-bowlus
   D. Cipoletti

8. (I - IV) (03) The device used to measure the depth of flow over a weir should be located:

A. Next to the notch or opening
B. 2 times the expected head upstream from the weir
C. 2 times the expected head downstream from the weir
D. 4 times the expected head upstream of the weir crest

9. (I - IV) (03) Which of the following is not a common angle of notches used in V- notch weirs?

A. 90 degree
B. 22.5 degree
C. 33 degree
D. 45 degree

10. (I - IV) (03) If the head measured on a 90 degree v-notch weir is 2 1/4 inches, what is the flow in units of MGD?

A. 0.0183
B. 0.0246
C. 0.0320
D. 0.0142

11. (I - IV) (03) The head measured on a two (2) foot rectangular weir with end contractions is 3 1/2 inches. What is the flow as expressed in MGD?

A. 0.60
B. 0.66
C. 0.73
D. 0.68

12. (I - IV) (03) The maximum head recommended for a 60 degree V-notch weir is:

A. 2.0 ft.
B. 20 inches
C. 2.0 inches
D. There is no maximum head

13. (I - IV) (04) Flumes are used to measure flows in:

A. Pipes
B. Manholes
C. Open channels
D. B and C but not A

14. (I - IV) (04) The most common type of flume is the Parshall flume. It was invented by:

A. The Romans
B. The Egyptians
C. Ralph Parshall
D. An Englishman in the early 1900s

15. (I - IV) (03) The dimension upon which a Parshall flume is sized is called the:

A. Conversion area width
B. Converging section width at 2/3 the length
C. Throat width
D. 2/3 converging section length

16. (I - IV) (04) The minimum recommended flow rate for a one (1) foot Parshall flume is:

A. 0.059 mgd
B. 0.078 mgd
C. 2.5 mgd
D. 1.18 mgd

17. (I - IV) (04) If the head flowing through a 6 inch Parshall flume measures 1 3/4 inches, what is the flow in units of MGD?

A. 0.064 MGD
B. 0.565 MGD
C. 0.71 MGD
D. 0.326 MGD

18. (I - IV) (04) The size of Palmer Bowlus flumes are designated according to:

A. The throat width
B. The cross sectional area of the pipe or conduit
C. The diameter of the pipe or conduit
D. The length of the converging area

19. (I - IV) (05) Which of the following is not a method of automatically measuring the head on a weir or flume?

A. Float gauge
B. Venturi tube
C. Ultrasonic sensor
D. Capacitance probe

20. (I - IV) (05) Flow meters must be calibrated to assure accuracy. The minimum recommended frequency of calibration is:

A. Every 6 months
B. Every other year
C. Every 5 years
D. Every year

CHAPTER 10
COLLECTION SYSTEMS

CHAPTER 10: COLLECTION SYSTEMS

1. (I - IV) (02) A sewer system that is designed to transport only wastewater from homes, businesses, institutions and industries is called:

   A. Service sewer
   B. Combined sewer system
   C. Sanitary sewer system
   D. Building sewer

2. (I - IV) (02) A sewer that discharges into a branch or other sewer and has no other public sewer tributary to it is called:

   A. Interceptor sewer
   B. Lateral sewer
   C. Building sewer
   D. Collector sewer

3. (I - IV) (02) Lateral sewers and branch sewers are known collectively as:

   A. Interceptor sewers
   B. Gravity flow sewers
   C. Collector sewers
   D. Combined sewers

4. (I - IV) (03) Which of the following is not a recommended pipe material for constructing gravity sewers of less than 12 inches in diameter?

   A. Reinforced concrete
   B. Ductile iron
   C. PVC
   D. Vitrified clay

5. (I - IV) (03) In areas where pipe strength is critical, such as creek crossings or unstable soil conditions, _____ pipe is generally recommended for the construction of force mains.

   A. 200 psi PVC
   B. Reinforced concrete
   C. Ductile iron
   D. Cast iron

6. (I - IV) (03) Manholes should be placed in sewers:

   A. At points of change in direction
   B. At points in change in grade
   C. At 400 ft. intervals
   D. Any of these

7. (I - IV) (03) Pre-cast concrete manholes are often lined with a bitumastic epoxy coating to:

   A. Help resist corrosion
   B. Prevent exfiltration
   C. Resist infiltration
   D. None of these

8. (I - IV) (04) Sewers should be designed to carry peak flow at :

A. Mid afternoon
B. 1/2 to 2/3 pipe capacity
C. 1/4 to 1/2 pipe capacit
D. Mid morning

9. (I - IV) (04) Gravity sewers should be constructed with a sufficient slope to be self cleansing. The minimum flow velocity should be:

A. 1.0 ft./sec.
B. 3.0 ft./sec.
C. 1.4 ft./sec.
D. 2.0 ft./sec.

10. (I - IV) (04) The typical average flow in gpd/person for residents of trailer parks is:

A. 70 gpd/per.
B. 40 gpd/per.
C. 50 gpd/per.
D. 30 gpd./per.

11. (I - IV) (04) Which of the following is not typically a consideration when planning locations of gravity sewers?

A. Natural drainage areas
B. Existing utilities
C. Easements and rows
D. Size of pipe

12. (I - IV) (05) Groundwater that enters a sewer through cracks, defective joints, pervious materials, etc. is referred to as:

A. Inflow
B. I & I
C. Infiltration
D. Extraneous flow

13. (I - IV) (05) Surface water that enters a sewer through manhole cover vents, broken sewers, abandoned services, etc. is collectively refered to as:

A. Inflow
B. Infiltration
C. Surface runoff
D. Surface inflow

14. (I - IV) (05) Which of the following is not a factor that contributes to infiltration?

A. Root penetration
B. Unstable soil conditions
C. Missing or broken manhole covers
D. High groundwater levels

15. (I - IV) (05) Analyzing and correcting I & I problems are normally carried out in a three (3) phase program. The three phases are:

A. Location, repair and replacement
B. Smoke testing, slip lining and grouting
C. I & I analysis, sewer system evaluation, and rehabilitation/replacement
D. Smoke testing, closed circuit T.V, and repair

16. (I - IV) (06) Which of the following is typically not a part of routine collection system maintenance?

A. Smoke testing
B. Inspections
C. Closed circuit T.V.
D. Chemical dosing

17. (I - IV) (06) Smoke testing is most effective in locating sources of:

A. Infiltration
B. Surface runoff
C. Inflow
D. Roof drains tied onto sewer

18. (I - IV) (CH. 13) When working in the collection system (opening manholes, rodding, etc.), it is recommended that:

A. Leather gloves be worn
B. Rubber gloves be worn
C. Rubberized cloth gloves be worn
D. Disposable gloves be worn

19. (I - IV) (CH 13) A manhole should never be entered alone. At least ____ men should be available "up top" to lift and injured worker.

A. Two
B. Three
C. One
D. Four

20. (I - IV) (CH 13) Prior to entering a manhole, in addition to checking for noxious and combustible gases, what else should be done?

A. Emergency rescue personnel should be on-site
B. One person should enter briefly to check atmosphere
C. Manhole should be ventilated with a positive displacement blower
D. Lower a canary or parakeet into the manhole for 15 minutes

CHAPTER 11
PUMPING

CHAPTER 11: PUMPING

1. (I - IV) (01) Which of the following is not a factor that would require wastewater to be pumped?

   A. Location of treatment facility
   B. Topography of land
   C. Depth of sewers
   D. I & I

2. (I - IV) (01) Most pumps used in wastewater treatment can be categorized in two (2) ways:

   A. Centrifugal and positive displacement
   B. Raw wastewater pumps and process pumps
   C. Collection pumps and treatment pumps
   D. Centrifugal and pneumatic

3. (I - IV) (02) Which of the following is not one of the three (3) basic types of pumps?

   A. Centrifugal
   B. Pneumatic
   C. Air lift
   D. Positive displacement

4. (I - IV) (02) The two components of the centrifugal pump that combine to move liquids are:

   A. Motor and pump
   B. Drive shaft and impeller
   C. Motor and impeller
   D. Impeller and casing

5. (I - IV) (02) A pump casing that gradually increases to the size of the pump discharge is called:

   A. Graduated
   B. Diffusion
   C. Volute
   D. Expanded discharge

6. (I - IV) (02) The type of pump recommended to use when pumping material with a large amount of solids is a:

   A. Centrifugal with shredding impeller
   B. Positive displacement
   C. Pneumatic
   D. Progressive cavity

7. (I - IV) (02) A type of pump that has no internal moving parts is called:

   A. Screw pump
   B. Progressive cavity
   C. Pneumatic
   D. Diaphram

8. (I - IV) (03) Which of the following is not one of the four basic components of a pump station?

   A. Pump
   B. Motor
   C. Wet well
   D. Alarm

9. (I - IV) (03) A pump station that contains four (4) pumps is called a:

A. Duplex
B. Quatroplex
C. Pain in the butt
D. Quadraplex

10. (I - IV) (03) A type of pump station that has a "positive head" or "flooded suction" condition is called:

A. Positive displacement
B. Wet pit/dry pit
C. Submersible
D. Suction lift

11. (I - IV) (03) A type of pump that has a large casing that will hold enough liquid to maintain prime is known as:

A. Suction lift
B. Positive prime
C. Self priming
D. Vacuum priming

12. (I - IV) (03) Which of the following is not a typical type of control system in a pump station?

A. Sealed floats
B. Ultra sonic sensors
C. Bubbler systems
D. Electrodes

13. (I - IV) (04) In a pumping system, the pressure against which a pump must work is typically referred to as:

A. Pounds per square inch
B. Total Dynamic Head (FT)
C. Head in inches
D. PSI

14. (I - IV) (04) Information regarding the horsepower requirements, size impeller and efficiency of a pump can be found:

A. In a manufacturer's catalog
B. On the data plate
C. On a pump curve
D. In the MDEQ/OPC training manual

15. (I - IV) (04) Total Dynamic Head is the head against which a pump must work while pumping liquid. Which of the following is not used in calculating TDH?

A. Elevation of the discharge point
B. Viscosity of the liquid
C. Friction of the force main
D. Wet well water level elevation

16. (I - IV) (04) Pump efficiencies for wastewater pumps are, at best , usually in the range of:

A. 15 - 40%
B. 50 - 60%
C. 60 - 85%
D. 70 - 80%

17. (I - IV) (05) Pump stations should be checked, as a minimum:

A. Weekly
B. Twice a week
C. Daily
D. Twice a day

18. (I - IV) (05) Lubricating a bearing in a drive motor in a pump station is an example of what type of maintenance activity?

A. Corrective maintenance
B. Pro-active maintenance
C. Monthly maintenance
D. Preventive maintenance

19. (I - IV) (05) Where could an operator find out what type of grease to use to lubricate the bearing in the previous question?

A. Oil company's lubricant specifications
B. Data plate on motor
C. Consultant engineer
D. Manufacturer's literature

20. (I - IV) (05) Which of the following would be useful information regarding the operation of a pump station?

A. Run time for pumps
B. Spare part on hand
C. Amperage drawn at load
D. All of the above

CHAPTER 12
RECORDS & REPORTS

CHAPTER 12: RECORDS AND REPORTS

1. (I - IV) (01) A thorough record keeping system:

   A. Can provide data upon which to make decisions.
   B. May be needed in lawsuits or enforcement proceedings.
   C. Is usually indicative of a well operated treatment facility.
   D. Any of the above

2. (I - IV) (01) Which of the following is not a major category of records at a wastewater facility?

   A. Personnel records
   B. Performance records
   C. Immunization records
   D. Physical plant records

3. (I - IV) (02) An O&M manual is which of the following types of records?

   A. Operational
   B. As built
   C. Physical plant
   D. Maintenance

4. (I - IV) (02) Records that show the water elevations in all treatment units in the plant are called:

   A. Water elevation records
   B. Hydraulic profile records
   C. Hydraulic elevation records
   D. High water level records

5. (I - IV) (02) Which of the following is not typically included as part of an equipment record?

   A. Manufacturer
   B. Dates of purchase
   C. Date of manufacture
   D. Identification numbers

6. (I - IV) (02) Manufacturer's literature for all plant equipment is typically a part of the:

   A. Equipment record
   B. As built records
   C. O & M Manual
   D. Maintenance records

7. (I - IV) (03) All daily activities pertinent to the operation of a wastewater plant should be recorded on which of the following?

   A. Monthly summary sheet
   B. Daily diary or log
   C. Weekly summary
   D. Any of these

8. (I - IV) (03) Which of the following is not considered a laboratory record?

A. Date/time sample collected
B. Bench forms
C. Sample preservation
D. Weather information

9. (I - IV) (03) NPDES self monitoring data should be recorded on:

A. Daily log
B. Monthly summary
C. Discharge monitoring report (DMR)
D. All of the above

10. (I - IV) (03) The information that should be included on a monthly summary:

A. Should be written in ink
B. Will vary, depending on type of facility
C. Should be transferred carefully to the DMRs
D. All of these

11. (I - IV) (04) Recommended lubricants and coatings are part of which of the following types of records.

A. Corrective maintenance record
B. Equipment record
C. Preventive maintenance record
D. B and C

12. (I - IV) (04) An operator checks and adjusts the tension on a set of drive belts on a blower. What type of record should he update?

A. Daily log
B. Corrective maintenance
C. Preventive maintenance
D. Equipment inventory

13. (I - IV) (04) An operator repaired an inoperative chlorine booster pump. What type of record should he complete?

A. Equipment control record
B. Preventive maintenance record
C. Budget record
D. Corrective maintenance record

14. (I - IV) (04) Which of the following factors should be considered when determining spare parts inventory?

A. Manufacturer's recommendations
B. Local availability
C. Shipping/delivery time
D. All of these

15. (I - IV) (05) Which of the following should not be included as part of an individual's personnel record?

A. Health history
B. Salary history
C. High school transcript
D. Letters of reference

16. (I - IV) (05) Employees should be evaluated based on:

A. Certifications and awards
B. Experience
C. Education
D. Job performance

17. (I - IV) (05) Operators should be encouraged or required to obtain the highest level of certification possible. Some information that should be included in an employees personnel record is:

A. Certifications held
B. Training and courses taken
C. Continuing education credit
D. All of the above

18. (I - IV) (06) Which of the following is not a typical budget category?

A. Salaries and wages
B. Staff training
C. Chemicals
D. Tools and parts

19. (I - IV) (06) What records should an operator review to prepare his budget requests for maintenance at his facility for next year?

A. This years preventive maintenance records
B. This years corrective maintenance records
C. This years spare parts inventory
D. All of these

20. (I - IV) (06) Who should prepare the budget for the municipal wastewater treatment facility?

A. The Mayor and Board of Aldermen
B. The City Clerk
C. The Certified Operator in charge
D. The City Comptroller

CHAPTER 13
SAFETY

CHAPTER 13: SAFETY

1. (I - IV) (01) The primary responsibility for doing a job safely at a municipal wastewater facility belongs to:

   A. The city Safety Officer
   B. The Certified Operator in charge
   C. The Mayor and Board of Aldermen
   D. The individual plant worker

2. (I - IV) (01) Providing proper tools, equipment, training and a safe working area is the responsibility of:

   A. The Certified Operator in charge
   B. The employer
   C. The individual worker
   D. The city/company Safety Officer

3. (I - IV) (02) When doing collection system work, most accidents occur:

   A. Due to open trenches and excavations
   B. When working in and around manholes
   C. While working in traffic
   D. Because of improper lifting practices

4. (I - IV) (02) When working on electrically powered equipment, the disconnect switch should be:

   A. Open
   B. Closed and tagged
   C. Open and tagged
   D. Open, tagged and locked

5. (I - IV) (02) The best defense for protection from infection from contact with wastewater is:

   A. Regular medical physical exams
   B. Up to date immunizations
   C. Good personal hygiene and prompt medical attention for injuries
   D. Rubber gloves and disinfectant soap

6. (I - IV) (02) Which of the following diseases is least likely to be spread through contact with wastewater?

   A. Cholera
   B. Typhoid fever
   C. HIV (Aids)
   D. Amoebic dysentery

7. (I - IV) (02) Before entering any confined space, which of the following should be done?

   A. The atmosphere of the space should be tested for toxic and combustible gases.
   B. The atmosphere should be tested for oxygen deficiency.
   C. The space should be ventilated with a positive displacement blower.
   D. All of the above

8. (I - IV) (02) The three ingredients necessary for a fire are:

A. Fuel, spark and oxygen
B. Fuel, heat and oxygen
C. Source of ignition, fuel, oxygen
D. B or C

9. (I - IV) (02) The most common cause of accidents involving chlorine are:

A. Carelessness
B. Improper handling practices
C. Over-chlorinating and leaks
D. Inadequate ventilation

10. (I - IV) (02) Chlorine odor is detectable at a concentration in the air of:

A. 15 ppm
B. 3.5 ppm
C. 30 ppm
D. 4 ppm

11. (I - IV) (02) After only five minutes exposure the amount of chlorine that can kill is:

A. 60 ppm
B. 100 ppm
C. 1/10 of 1% concentration
D. 1% concentration

12. (I - IV) (02) Ventilation exhausts in chlorine rooms should be located:

A. Near the ceiling since chlorine is lighter than air
B. Away from normal working areas
C. On the downwind side of the building
D. Near the floor

13. (I - IV) (02) Chlorine cylinders have a fusible plug that melts to prevent the cylinder from rupturing if exposed to heat. The fusible plug will melt at a temperature of:

A. 200 - 210 degrees F.
B. 150 - 160 degrees F.
C. 158 -165 degrees C.
D. 158 - 165 degrees F.

14. (I - IV) (02) Which of the following is the most important thing to remember while working in a laboratory?

A. Never add water to acid
B. Never pipette using your mouth
C. Never handle samples with bare hands
D. Never get in a hurry

15. (I - IV) (02) The acronym "OSHA" stands for:

A. Occupational Safety and Health Association
B. Occupational Safety and Health Agency
C. Occupation, Safety and Health Administration
D. Occupational Safety and Health Administration

16. (I - IV) (02) OSHA sets forth specific requirements for excavation safety in which of the following Code of Federal Regulations (CFR)?

A. 40 CFR
B. 29 CFR
C. 10 CFR
D. 20 CFR

17. (I - IV) (03) As a minimum, equipment used to test the atmosphere of a confined space should be capable of testing for:

A. Hydrogen sulfide, carbon monoxide and carbon dioxide
B. Combustible gases, hydrogen sulfide and oxygen deficiency
C. Carbon monoxide, sulfides and oxygen content
D. Methane, sulfides and oxygen

18. (I - IV) (03) An operator should never attempt to repair a chlorine leak without the following:

A. A canister type gas mask
B. A canister type respirator
C. A self contained breathing apparatus (SCBA)
D. An escape respirator

19. (I - IV) (04) Resuscitation is often necessary after an accident. After the lungs cease to function the heart will stop within:

A. 1 - 2 minutes
B. 6 - 10 minutes
C. 15 - 20 minutes
D. 30 - 60 seconds

20. (I - IV) (04) The favored method of first aid resuscitation is the:

A. Use of pulmotors
B. Use of lung motors
C. Breathing bags
D. CPR

CHAPTER 14
LABORATORY

CHAPTER 14: LABORATORY

1. (I - IV) (05) Which of the following is not always true concerning sample collection?

   A. The sample must be small enough to handle in the lab.
   B. The sample must be representative.
   C. The sample should be analyzed immediately.
   D. The sampled should be handled so that nothing is added or lost in the sample.

2. (I - IV) (05) Which of the following is the preferred type of sample container for most wastewater samples?

   A. Clear glass
   B. Amber glass
   C. Plastic
   D. Sterile

3. (I - IV) (05) The most common preservation technique for wastewater samples is:

   A. Acidify to < 2 SU
   B. Raise the pH to > 10
   C. Pre- treat containers with sodium thiosulfate
   D. Cool to 4 degrees C.

4. (I - IV) (05) When collecting composite samples, a minimum volume of _____mls should be collected with each collection.

   A. 50
   B. 100
   C. 120
   D. 150

5. (I - IV) (02) The hydrogen ion activity of a substance is determined by which of the following analyses?

   A. Hydrogen ion analysis
   B. pH
   C. Specific ion analysis
   D. Amperometric titration

6. (I - IV) (08) Domestic wastewater typically has a pH of:

   A. >7
   B. <7
   C. 6 - 9
   D. <6

7. (I - IV) (08) The preferred method for determining D.O. Concentrations is:

   A. Winkler titration
   B. Membrane electrode
   C. Specific ion electrode
   D. Drop count titration

8. (I - IV) (08) Which of the following is not an approved method for measuring chlorine residual?

A. Specific ion electrode
B. Amperometric titration
C. DPD colorimetric comparator
D. DPD ferrous titrimetric

9. (I - IV) (08) Which of the following is not a precaution when preparing a sample for BOD analysis?

A. The sample must not contain residual chlorine.
B. The sample must be supersaturated with oxygen.
C. The sample should not be of extreme pH.
D. The sample should not be held for more than 48 hours.

10. (I - IV) (08) Which of the following is not a procedure for preparing glass fiber filters to be used to determine TSS?

A. Rinse with tap water
B. Rinse with distilled water
C. Dry in oven at 103 -105 degrees C.
D. Store in desiccator

11. (I - IV) (08) There are several methods of analysis for ammonia nitrogen. Which method requires distillation of the sample?

A. Specific ion electrode
B. Titrimetric
C. Nesslerization
D. All methods, unless it is demonstrated that it isn't needed.

12. (I - IV) (08) The temperature in a water bath incubator used in the membrane filter method for fecal coliform analysis should be maintained at :

A. 20 degrees C.
B. 20 degrees F.
C. 103 - 105 degrees F.
D. 44.5 degrees C.

13. (I - IV) (08) Dilution water used in the BOD analysis should not deplete more than_____ mg/l in 5 days.

A. 0.1
B. 0.2
C. 0.3
D. 1.0

14. (I - IV) (08) To get an accurate BOD, an incubated sample should:

A. Deplete at least 1 mg/l and have at least 1 mg/l remaining
B. Deplete at least 2 mg/l and have at least 2 mg/l remaining
C. Deplete at least 2 mg/l and have at least 1 mg/l remaining
D. Deplete 2% of the initial D.O.

15. (I - IV) (08) Duplicates of TSS analyses should be run on at least ____% of the samples.

A. 5
B. 20
C. 50
D. 10

16. (I - IV) (08) To demonstrate that distillation is not necessary for ammonia nitrogen analyses:

A. Split samples should be sent to OPC lab for distillation.
B. An EPA spiked sample should be analyzed.
C. A distilled and non-distilled sample of the same waste should be analyzed.
D. A letter from the equipment rep. should be kept on file

17. (I - IV) (07) Which of the following rules should be observed when combining acid and water?

A. Always add water to acid.
B. Let the acid flow down the side of the receiving container.
C. Always add acid to water.
D. B and C

18. (I - IV) (07) When pipetting any material:

A. Use a pipette bulb
B. Use a pipette with cotton in the neck
C. Consider all chemicals toxic
D. A and C

19. (I - IV) (07) To neutralize a strong acid on skin or clothing, one should:

A. Apply sodium hydroxide
B. Wash with tap water
C. Apply dilute ammonium hydroxide
D. B and C but not A

20. (I - IV) (07) The following is not a precaution for storing reagents:

A. Store according to compatibility
B. Label all reagents
C. Store on bottom shelves to prevent breakage
D. Store no higher than eye level

CHAPTER 15
MANAGEMENT

CHAPTER 15: MANAGEMENT

1. (I - IV) (04) The Code of Federal Regulations, section 40; part 503 (40 CFR, part 503) relates to:

   A. The discharge of a wastewater effluent.
   B. Surface land disposal of sewage sludges.
   C. Worker safety in the wastewater industry
   D. Disposal of sewage sludges in sanitary landfills

2. (I - IV) (04) The Civil Rights Act of 1964, Title VII prohibits employment discrimination on the basis of race, color, religion and sex for discrimination on the basis of race, color, religion and sex for employers with _____ or more employees.

   A. 10
   B. 15
   C. 20
   D. 2

3. (I - IV) (04) The state of Mississippi has what is commonly referred to as a "Right to Work Law". This law states that:

   A. No person shall be denied employment because of race, sex or religion.
   B. Persons over 40 years of age shall not be discriminated against in recruiting, hiring, compensation and training.
   C. Disabled persons have the "Right to Work" provided they are physically able to do the job.
   D. A person may not be denied employment based on membership in a labor union.

4. (I - IV) (05) Federal and state laws require publicly owned treatment works (POTWs) be operated with revenues generated from user charges. These charges should be periodically evaluated to determine if adjustments are needed to meet expenses. It is recommended that user charges be evaluated:

   A. Annually
   B. Every five (5) years
   C. Every two (2) years
   D. Every three (3) years

5. (I - IV) (05) A developer has proposed a large subdivision which will require an upgrade to increase the capacity of the publicly owned wastewater facility. The recommended method of financing the facility upgrade would be through:

   A. Special taxes
   B. Revenue bonds
   C. General obligation bonds
   D. Impact fees

6. (I - IV) (06) Which of the following factors is not a management consideration for proper operation and maintenance of all wastewater facilities.

   A. Organizational structure
   B. Budgetary controls
   C. Computer data systems
   D. Political concerns

7. (I - IV) (01) Which of the following management considerations would be more likely to affect operation, maintenance and safety at a wastewater facility?

A. Budgetary controls
B. Organizational structure
C. Operating revenue
D. Training

8. (I - IV) (02) Which of the following components of a comprehensive worker safety program is not a management responsibility?

A. Provide proper tools and safety equipment.
B. Employees familiar with safety policy.
C. No one person responsible for administering the safety program. All employees should be safety officers.
D. Employees should be required to demonstrate knowledge of first aid and emergency response procedures.

9. (I - IV) (06) Professional support is often needed to help resolve operational and/or maintenance problems. Professional support refers to the following:

A. Membership in professional operator organizations.
B. Contractors, vendors and suppliers.
C. Engineers, attorneys and accountants.
D. Contract operations firms

10. (I - IV) (08) The main difference between an emergency and a disaster is:

A. Emergencies affect other people, disasters affect you.
B. Disasters always involve a loss of life.
C. Disasters require resources beyond local capabilities.
D. Emergencies are very localized.

11. (I - IV) (08) A risk/hazard assessment rating of three (3) would indicate that an event which could cause an emergency/disaster is:

A. Very likely to occur.
B. Not likely to occur.
C. Very unlikely to occur.
D. Probable.

12. (I - IV) (08) A list of potential problems that may arise due to a specific type of emergency/disaster event, such as a tornado, is considered a:

A. Risk assessment
B. Vulnerability assessment
C. Contingency plan
D. Emergency response plan

13. (I - IV) (08) Actions taken prior to an emergency/disaster aimed at reducing the probability of occurrence or of lessening the effect of the emergency/disaster are which phase of emergency preparedness.

A. Response
B. Preparedness
C. Mitigation
D. Recovery

14. (I - IV) (08) The National Incident Management System (NIMS) command and management structures are based on three (3) organizational systems. They are:

A. Resource Management, Emergency Preparedness, Emergency Operations Centers
B. Emergency Management Assistance Compacts, County EOCs, FEMA
C. Incident Command System, Multiagency Coordination System, Public Information System
D. NIMS Integration Center, State EOC, FEMA Joint Field Office

15. (I - IV) (08) Managers of wastewater facilities should conduct a _____ to determine security deficiencies.

A. Security Assessment
B. Vulnerability Assessment
C. Critical Asset Evaluation
D. Security Evaluation

16. (I - IV) (09) Managers should select individuals who routinely deal with the public, in person or via telephone, that:

A. Can communicate effectively in technical terms.
B. Will not be bullied or intimidated by citizens.
C. Have good personalities and communication skills.
D. Are high enough in the organization to be well informed.

17. (I - IV) (09) Managers should make use of the available media in a community to disseminate information and foster good public relations. When dealing with the media a good manager will:

A. Establish and maintain points of contact.
B. Carefully work and prepare statements to enhance the facilities image.
C. Release only positive information.
D. All of the above.

18. (I - IV) (01) Management may be defined as:

A. The use of sound judgment to accomplish an objective.
B. The act of controlling and directing people to accomplish a mission.
C. The art of working with people to make things happen.
D. Any of these.

19. (IV) (02) A major means of increasing competency, enhancing qualifications, and improving performance among personnel is:

A. Rewards program
B. Training
C. Written personnel policy
D. Any of these

20. (I - IV) (08) Power outages, raw sewage spills, communications problems and transportation problems may occur as a result of which of the following events?

A. Tornado
B. Ice storm
C. Flood
D. Any of these.

STUDY GUIDE ANSWER SHEET

CHAPTER:_____ **DATE:**_____

NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
3.	A	B	C	D	28.	A	B	C	D
4.	A	B	C	D	29.	A	B	C	D
5.	A	B	C	D	30.	A	B	C	D
6.	A	B	C	D	31.	A	B	C	D
7.	A	B	C	D	32.	A	B	C	D
8.	A	B	C	D	33.	A	B	C	D
9.	A	B	C	D	34.	A	B	C	D
10.	A	B	C	D	35.	A	B	C	D
11.	A	B	C	D	36.	A	B	C	D
12.	A	B	C	D	37.	A	B	C	D
13.	A	B	C	D	38.	A	B	C	D
14.	A	B	C	D	39.	A	B	C	D
15.	A	B	C	D	40.	A	B	C	D
16.	A	B	C	D	41.	A	B	C	D
17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

SCORE _____

STUDY GUIDE ANSWER SHEET

CHAPTER:_____ **DATE:**_____

NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
3.	A	B	C	D	28.	A	B	C	D
4.	A	B	C	D	29.	A	B	C	D
5.	A	B	C	D	30.	A	B	C	D
6.	A	B	C	D	31.	A	B	C	D
7.	A	B	C	D	32.	A	B	C	D
8.	A	B	C	D	33.	A	B	C	D
9.	A	B	C	D	34.	A	B	C	D
10.	A	B	C	D	35.	A	B	C	D
11.	A	B	C	D	36.	A	B	C	D
12.	A	B	C	D	37.	A	B	C	D
13.	A	B	C	D	38.	A	B	C	D
14.	A	B	C	D	39.	A	B	C	D
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16.	A	B	C	D	41.	A	B	C	D
17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
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6.	A	B	C	D	31.	A	B	C	D
7.	A	B	C	D	32.	A	B	C	D
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12.	A	B	C	D	37.	A	B	C	D
13.	A	B	C	D	38.	A	B	C	D
14.	A	B	C	D	39.	A	B	C	D
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17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
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24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
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13.	A	B	C	D	38.	A	B	C	D
14.	A	B	C	D	39.	A	B	C	D
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18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
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17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
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8.	A	B	C	D	33.	A	B	C	D
9.	A	B	C	D	34.	A	B	C	D
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14.	A	B	C	D	39.	A	B	C	D
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16.	A	B	C	D	41.	A	B	C	D
17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
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24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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17.	A	B	C	D	42.	A	B	C	D
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20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
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24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
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21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
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24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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17.	A	B	C	D	42.	A	B	C	D
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21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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22.	A	B	C	D	47.	A	B	C	D
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25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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22.	A	B	C	D	47.	A	B	C	D
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25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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22.	A	B	C	D	47.	A	B	C	D
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25.	A	B	C	D	50.	A	B	C	D

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19.	A	B	C	D	44.	A	B	C	D
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25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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17.	A	B	C	D	42.	A	B	C	D
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19.	A	B	C	D	44.	A	B	C	D
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25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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11.	A	B	C	D	36.	A	B	C	D
12.	A	B	C	D	37.	A	B	C	D
13.	A	B	C	D	38.	A	B	C	D
14.	A	B	C	D	39.	A	B	C	D
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16.	A	B	C	D	41.	A	B	C	D
17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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CHAPTER:_____ **DATE:**_____

NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
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6.	A	B	C	D	31.	A	B	C	D
7.	A	B	C	D	32.	A	B	C	D
8.	A	B	C	D	33.	A	B	C	D
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11.	A	B	C	D	36.	A	B	C	D
12.	A	B	C	D	37.	A	B	C	D
13.	A	B	C	D	38.	A	B	C	D
14.	A	B	C	D	39.	A	B	C	D
15.	A	B	C	D	40.	A	B	C	D
16.	A	B	C	D	41.	A	B	C	D
17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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CHAPTER:_____ **DATE:**_____

NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
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12.	A	B	C	D	37.	A	B	C	D
13.	A	B	C	D	38.	A	B	C	D
14.	A	B	C	D	39.	A	B	C	D
15.	A	B	C	D	40.	A	B	C	D
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18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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CHAPTER:_____ **DATE:**_____

NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
3.	A	B	C	D	28.	A	B	C	D
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17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
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8.	A	B	C	D	33.	A	B	C	D
9.	A	B	C	D	34.	A	B	C	D
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14.	A	B	C	D	39.	A	B	C	D
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16.	A	B	C	D	41.	A	B	C	D
17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
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24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
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9.	A	B	C	D	34.	A	B	C	D
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17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
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17.	A	B	C	D	42.	A	B	C	D
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19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
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17.	A	B	C	D	42.	A	B	C	D
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20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
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24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
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25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
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25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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22.	A	B	C	D	47.	A	B	C	D
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25.	A	B	C	D	50.	A	B	C	D

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17.	A	B	C	D	42.	A	B	C	D
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19.	A	B	C	D	44.	A	B	C	D
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24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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19.	A	B	C	D	44.	A	B	C	D
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25.	A	B	C	D	50.	A	B	C	D

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NAME:_____ **CLASS:**_____

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17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

SCORE _____

STUDY GUIDE ANSWER SHEET

CHAPTER:_____ **DATE:**_____

NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
3.	A	B	C	D	28.	A	B	C	D
4.	A	B	C	D	29.	A	B	C	D
5.	A	B	C	D	30.	A	B	C	D
6.	A	B	C	D	31.	A	B	C	D
7.	A	B	C	D	32.	A	B	C	D
8.	A	B	C	D	33.	A	B	C	D
9.	A	B	C	D	34.	A	B	C	D
10.	A	B	C	D	35.	A	B	C	D
11.	A	B	C	D	36.	A	B	C	D
12.	A	B	C	D	37.	A	B	C	D
13.	A	B	C	D	38.	A	B	C	D
14.	A	B	C	D	39.	A	B	C	D
15.	A	B	C	D	40.	A	B	C	D
16.	A	B	C	D	41.	A	B	C	D
17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

SCORE _____

STUDY GUIDE ANSWER SHEET

CHAPTER:_____ **DATE:**_____

NAME:_____ **CLASS:**_____

1.	A	B	C	D	26.	A	B	C	D
2.	A	B	C	D	27.	A	B	C	D
3.	A	B	C	D	28.	A	B	C	D
4.	A	B	C	D	29.	A	B	C	D
5.	A	B	C	D	30.	A	B	C	D
6.	A	B	C	D	31.	A	B	C	D
7.	A	B	C	D	32.	A	B	C	D
8.	A	B	C	D	33.	A	B	C	D
9.	A	B	C	D	34.	A	B	C	D
10.	A	B	C	D	35.	A	B	C	D
11.	A	B	C	D	36.	A	B	C	D
12.	A	B	C	D	37.	A	B	C	D
13.	A	B	C	D	38.	A	B	C	D
14.	A	B	C	D	39.	A	B	C	D
15.	A	B	C	D	40.	A	B	C	D
16.	A	B	C	D	41.	A	B	C	D
17.	A	B	C	D	42.	A	B	C	D
18.	A	B	C	D	43.	A	B	C	D
19.	A	B	C	D	44.	A	B	C	D
20.	A	B	C	D	45.	A	B	C	D
21.	A	B	C	D	46.	A	B	C	D
22.	A	B	C	D	47.	A	B	C	D
23.	A	B	C	D	48.	A	B	C	D
24.	A	B	C	D	49.	A	B	C	D
25.	A	B	C	D	50.	A	B	C	D

SCORE _____

CHAPTER QUIZ ANSWER KEYS

CHAPTER QUIZ ANSWER KEYS

CHAPTER 1: MATHEMATICS

1. C
2. B
3. A. 0.81 MGD
   B. 2.4 MGD
   C. 922,500 GALS
   D. 333,600 Lbs.
4. B
5. B
6. B
7. A
8. D
9. B
10. A
11. B
12. A
13. A
14. B
15. B
16. B
17. B
18. C
19. A
20. C
21. A
22. C
23. A
24. B
25. C
26. B
27. D
28. A
29. B
30. B
31. D
32. A
33. C
34. B
35. B
36. B
37. A
38. B
39. C
40. A
41. B
42. B
43. D
44. B
45. B
46. A
47. B
48. B
49. A
50. B

CHAPTER 2: CHARACTERISTICS

1. D
2. D
3. C
4. A
5. D
6. B
7. B
8. C
9. D
10. D
11. C
12. B
13. D
14. B
15. C
16. C
17. D
18. B
19. C
20. D

CHAPTER 3: PRELIMINARY TREATMENT

1. D
2. B
3. C
4. D
5. B
6. C
7. D
8. D
9. D
10. B
11. D
12. B
13. C
14. D
15. C
16. B
17. D
18. C
19. D
20. D

CHAPTER 4: PRIMARY TREATMENT

1. B
2. C
3. A
4. D
5. B
6. D
7. B
8. D
9. D
10. A
11. B
12. C
13. D
14. A
15. B
16. D
17. C
18. C
19. C
20. D

CHAPTER 5: BIOLOGICAL TREATMENT

1. D
2. B
3. D
4. B
5. D
6. D
7. D
8. B
9. D
10. C
11. C
12. C
13. D
14. B
15. B
16. D
17. C
18. C
19. A
20. C
21. B
22. B
23. C
24. A
25. C
26. D
27. D
28. D
29. D
30. C
31. D
32. D
33. D
34. C
35. C
36. B
37. D
38. C
39. C
40. B
41. D
42. C
43. A
44. C
45. A
46. D
47. D
48. C
49. B
50. D

CHAPTER 6: ADVANCED TREATMENT

1. B
2. D
3. D
4. A
5. B
6. C
7. D
8. B
9. B
10. B
11. B
12. C
13. C
14. C
15. D
16. D
17. B
18. B
19. B
20. B

CHAPTER 7: DISINFECTION

1. D
2. D
3. D
4. B
5. A
6. B
7. A
8. B
9. C
10. B
11. C
12. B
13. D
14. C
15. D
16. A
17. C
18. D
19. B
20. B

CHAPTER 8: SLUDGE TREATMENT

1. D
2. D
3. B
4. C
5. B
6. D
7. D
8. C
9. C
10. B
11. D
12. B
13. D
14. B
15. D
16. A
17. D
18. B
19. C
20. A

CHAPTER 9: FLOW MEASUREMENT

1. C
2. D
3. D
4. D
5. A
6. C
7. C
8. D
9. C
10. B
11. B
12. A
13. D
14. C
15. C
16. B
17. A
18. C
19. B
20. D

CHAPTER 10: COLLECTION SYSTEMS

1. C
2. B
3. C
4. A
5. C
6. D
7. C
8. B
9. D
10. B
11. D
12. C
13. A
14. C
15. C
16. C
17. C
18. C
19. A
20. C

CHAPTER 11: PUMPING

1. D
2. B
3. C
4. D
5. C
6. B
7. C
8. B
9. D
10. B
11. C
12. B
13. B
14. C
15. B
16. C
17. C
18. D
19. D
20. D

CHAPTER 12: RECORDS AND REPORTS

1. D
2. C
3. C
4. B
5. C
6. C
7. B
8. D
9. D
10. D
11. D
12. C
13. D
14. D
15. C
16. D
17. D
18. D
19. D
20. C

CHAPTER 13: SAFETY

1. D
2. B
3. B
4. D
5. C
6. C
7. D
8. D
9. C
10. B
11. C
12. D
13. D
14. D
15. D
16. B
17. B
18. C
19. B
20. D

CHAPTER 14: LABORATORY

1. C
2. C
3. D
4. C
5. B
6. C
7. B
8. C
9. B
10. A
11. D
12. D
13. B
14. C
15. D
16. C
17. D
18. D
19. D
20. C

CHAPTER 15: MANAGEMENT

1. B
2. B
3. D
4. A
5. D
6. D
7. D
8. C
9. C
10. C
11. A
12. B
13. C
14. C
15. B
16. C
17. A
18. D
19. B
20 D