Multiple Choice

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
1	A pathogen is…	A	A bacteria or virus found in wastewater	**B**
		B	Any organism capable of causing disease	
		C	Unable to survive for long periods outside wastewater	
		D	Dependent on TSS to reproduce	
2	Solids that are retained by a 1.2 µm filter paper and are burned away at 550° C in a furnace are:	A	Total dissolved solids (TDS)	**C**
		B	Total volatile solids (TVS)	
		C	Total volatile suspended solids (TVSS)	
		D	Total non-volatile dissolved solids (TVDS)	
3	The biochemical oxygen demand (BOD) test is a measurement of this:	A	Biodegradable organic material	**D**
		B	Percentage of organic suspended solids	
		C	Quantity of live bacteria	
		D	Amount of oxygen needed to stabilize wastewter	
4	Solids that are able to pass through a 1.2 µm filter paper and remain unchanged after spending time in a furnace at 550° C may be described as	A	Dissolved and inorganic	**A**
		B	Suspended and inorganic	
		C	Dissolved and organic	
		D	Suspended and organic	
5	The BOD test is typically incubated for 5 days for this reason.	A	It takes five days for the Thames river to meet the ocean.	**A**
		B	The bottles only hold enough dissolved oxygen for a five day test.	
		C	The bacteria only live for five days.	
		D	All of the organic material is consumed within 5 days.	

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
6	By definition, how much oxygen is required to stabilize or treat 1 lb (kg) of BOD?	A	1 lb (kg)	**A**
		B	2 lb (kg)	
		C	3 lb (kg)	
		D	4 lb (kg)	
7	Which of the following pollutants is most likely to cause an algae bloom in a lake or river?	A	TSS	**C**
		B	BOD	
		C	Phosphorus	
		D	Turbidity	
8	A WRRF has a 30-day monthly average BOD-5 limit of 30 mg/L. Two samples collected in May with results of 28 and 36 mg/L. The operator should:	A	Report only the first result below the permit limit.	**B**
		B	Average the results together and report a permit violation.	
		C	Alter the second result to read 26 mg/L and then average the results together.	
		D	Go back to his/her office and work on resume.	
9	The secondary treatment standards set effluent limits for these parameters:	A	BOD5, CBOD, TSS, and pH	**A**
		B	FOG, BOD5, and TSS	
		C	Nitrogen and phosphorus	
		D	Pathogenic organisms	
10	ABC Corporation manufactures tires in Metro City. All of the process water they generate is discharged to the sewers and is conveyed to the WRRF. What type of discharger is ABC Corperations and who issues their discharge permit?	A	Direct, U.S. EPA	**D**
		B	Indirect, state	
		C	Indirect, U.S. EPA	
		D	Indirect, city WRRF	

Multiple Choice **Page# 3**

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
11	Which of the following processes is an example of a physical treatment process?	A	Grit basin	**A**
		B	Trickling filter	
		C	Chlorine disinfection	
		D	Anaerobic digestion	
12	Most communties have stopped constructing combined sewers and are removing existing combined sewers for this reason.	A	Combined sewers deposit raw wastewater in rivers and lakes	**B**
		B	Combined sewers affect WRRF operation during and after storm events.	
		C	Combined sewers are difficult to keep clean and can generate odors.	
		D	Combined sewers are expensive to construct due to larger pipe sizes.	
13	The velocity of wastewater through a rectangular grit basin should be approximately ____ to allow grit to settle while keeping lighter particles in suspension.	A	0.5 ft/sec (0.15 m/s)	**B**
		B	1.0 ft/sec (0.3 m/s)	
		C	2.0 ft/sec (0.6 m/s)	
		D	5.0 ft/sec (1.5 m/s)	
14	A primary clarifier is capable of removing:	A	Soluble BOD5	**C**
		B	Ammonia	
		C	Total suspended solids	
		D	Colloidal solids	
15	Which of the following processes would be considered biological treatment?	A	Alum addition for phosphorus removal	**B**
		B	Activated sludge	
		C	Belt filter press	
		D	Ultraviolet disinfection	

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
16	A pond system is categorized as this type of treatment:	A	Primary	**B**
		B	Suspended growth	
		C	Fixed growth	
		D	Physical	
17	This term is used to describe a collection of microorganisms growing on and attached to a media surface such as a rock.	A	Floc	**C**
		B	Slime	
		C	Biofilm	
		D	Algae	
18	In a pond treatment system, what is the purpose of the last pond in the series?	A	Increases the risk of short-circuiting	**B**
		B	Removes the biological solids produced in the first two ponds	
		C	Warms the wastewater before discharge	
		D	Acts as a primary clarifier or grit basin	
19	For an activated sludge system, which of the following statements is false?	A	Activated sludge requires less time to treat wastewater than ponds.	**C**
		B	Activated sludge is a suspended growth process.	
		C	Activated sludge uses fungi to treat wastewater.	
		D	Activated sludge holds the biological solids longer than the wastewater.	
20	Which two methods of disinfection are most commonly used in domestic WRRF's?	A	Ozone and chlorine	**B**
		B	Chlorine and UV light	
		C	Bleach and ozone	
		D	Ultraviolet light and boiling	

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
21	Primary sludge consists of	A	Microorganisms grown during treatment	**C**
		B	Rags, plastic, and other heavy materials	
		C	Unprocessed, settleable organic and inorganic solids	
		D	Grit and screenings	
22	Secondary sludge consists of	A	Microorganisms grown during treatment	**A**
		B	Rags, plastic, and other heavy materials	
		C	Unprocessed, settleable organic and inorganic solids	
		D	Grit and screenings	
23	This type of biosolid may be made available for public takeaway	A	Class A	**A**
		B	Class B	
		C	Class C	
		D	Class D	
24	The vector attraction reduction requirement in the biosolids 503 regulations	A	Limit concentrations of heavy metals in biosolids	**C**
		B	Allows screenings and grit to be comingled with digested sludge	
		C	Reduces likelihood that rats and insects will be attracted to finished biosolids	
		D	Prevents application of biosolids near streams and lakes	
25	Sludge thickening and dewatering are performed for this reason:	A	Reducing the total volume of sludge	**A**
		B	Required by the discharge permit	
		C	Reduces the total mass of sludge	
		D	Required by the 503 regulations	

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
26	Anaerobic digester gas contains approximately	A	70% nitrogen and 22% oxygen	**B**
		B	65% methane and 35% carbon dioxide	
		C	70% nitrogen and 30% carbon dioxide	
		D	20% methane and 80% carbon dioxide	
27	An operator must take a piece of equipment out of service for maintenance. They will need to bypass pump wastewater around this piece of equipment during repairs. Assuming the WRRF has a typical diurnal flow pattern for domestic wastewater, when should the work be scheduled to minimize bypass pumping?	A	Midmorning	**D**
		B	After lunch	
		C	Afternoon	
		D	Late evening	
28	Which type of service area is likely to see the greatest variations in influent flow over a single day?	A	Town with 500 residents	**A**
		B	City with separate domestic and storm sewers	
		C	City with more than 5000 residents	
		D	Town without large commercial and industrial users	
29	H2S is a concern for all of these reasons except:	A	Poisonous at low concentrations	**D**
		B	Corrodes concrete and metal	
		C	Potentially explosive	
		D	Smells strongly of garlic	
30	Turbidity is a measurment of:	A	Light scatter	**A**
		B	Cloudiness	
		C	Solids concentration	
		D	Organic matter	

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
31	Alkalinity is a measurement of:	A	pH	**B**
		B	Buffering capacity	
		C	Calcium carbonate concentration	
		D	Hydroxide content	
32	Which of the following pH values would be considered acidic?	A	4.6	**A**
		B	7.1	
		C	8.3	
		D	9.4	
33	If all the alkalinity is consumed, what will the pH be?	A	1.2	**B**
		B	4.5	
		C	7.0	
		D	8.3	
34	An influent sample is analyzed for both COD and BOD. Which of the following statements must be true?	A	A BOD is equal to or greater than COD	**C**
		B	The BOD test was completed before the COD test.	
		C	COD is equal to or greater than BOD	
		D	The COD test was performed at 20° C	
35	The laboratory reported a phosphorus concentration in the final effluent as 2.5 mg/L as $PO_4^{-3.}$ What is this in milligrams per liter of PO_4-P?	A	0.25 mg/L PO_4-P	**B**
		B	0.81 mg/L PO_4-P	
		C	2.5 mg/L PO_4-P	
		D	7.7 mg/L PO_4-P	

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
36	Grit basins typically remove sand, gravel, eggshells, and coffee ground by	A	Placing wire mesh in the flow path as a strainer	**D**
		B	Scooping the surface of the water	
		C	Introducing microorganisms to consume them	
		D	Decreasing the water velocity and allowing them to settle	
37	A WRRF currently has a bar screen with 2 in openings. Operators are concidering replacing it with one that has 1 in openings. How much should they expect the volume of screenings to change?	A	Volume will remain about the same	**C**
		B	Screening volume will double	
		C	Screening volume will increase by a factor of 4	
		D	Screening volume will decrease by 50%	
38	One disadvantage of using comminutors is	A	Reduced potential for clogged pipes and damaged equipment	**C**
		B	Increasing screening disposal costs	
		C	Shredded material reduces treatment capacity down stream	
		D	More frequent overflows of the influent channel	
39	Screens should be cleaned before the head loss across the screen reaches ____ or according to the manufacturer's recommendations.	A	1 in	**B**
		B	3 in	
		C	5 in	
		D	7 in	
40	At a minimum, how often should screens be inspected for visible and audible indications of possible malfuntions?	A	Daily	**A**
		B	Weekly	
		C	Monthly	
		D	Quarterly	

Multiple Choice **Page# 9**

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
41	In a bio-reactor designed to biologically remove phosphorus, where would you find the highest concentration of P?	A	In the influent	**B**
		B	In the anaerobic zone	
		C	In the aerobic zone	
		D	In the final effluent	
42	Which organism is responsible for the oxidation of NH3 to NO2?	A	Nitrobactor	**B**
		B	Nitrosomonas	
		C	Nitrofilamentous	
		D	Nitromaximus	
43	In order to maintain nitrification, as the temperature of the bio-reactor decreases…	A	The MCRT needs to be increased	**A**
		B	The MCRT needs to be decreased	
		C	The MRCT should remain the same	
		D	The temperature has no affect	
44	For every part NH3 converted to NO3,_____ parts alkalinity are lost.	A	1.00	**C**
		B	2.32	
		C	7.14	
		D	9.97	
45	Which of these ORP ranges would denitrification most likely occur at?	A	+ 50 to + 200	**C**
		B	+ 150 to + 350	
		C	- 50 to + 50	
		D	- 50 to - 250	

Multiple Choice **Page# 10**

Select the *best* answer for each question from the choices provided.

Circle the letter corresponding to the correct answer. **Questions are worth 10 points each.**

#	Question		Choices	Answer
46	Which of these options are you NOT likely to find trace amounts of PFAS?	A	soil	**D**
		B	ground water	
		C	your blood	
		D	none of the above	
47	A geometric mean is typically used when reporting _____ on a DMR.	A	pH	**B**
		B	bacteria	
		C	Turbidity	
		D	BOD5	
48	The biomass in the first stage of an RBC is thick and shaggy. This may indicate	A	High rotation speed	**B**
		B	Organic overloading	
		C	Insufficient aeration	
		D	Septic conditions	
49	Low DO conditions may encourage the growth of this nuisance organism.	A	Snails	**C**
		B	Worms	
		C	Beggiatoa	
		D	Rotifiers	
50	A final effluent result for E.coli was reported as 350 MPN/100 ml. What must be true?	A	The sample was filtered during analysis.	**D**
		B	The fecal coliform result must be less than 350 MPN/100 ml	
		C	Results include the Klebsiella and other indicator organisms.	
		D	A statistical table was used to estimate the results.	

Select the ***best*** answer for each question from the list of choices. Some answers could be used for more than one question. Enter the letter corresponding to the correct answer in the box provided for each question. Questions are worth 20 points each.

Choices	
A	Aerobic SRT
B	BOD
C	Bulk wasting
D	Bulking
E	CCB
F	Complete mix
G	Constant MLSS
H	Constant wasting
I	F/M
J	MCC
K	MCRT
L	MLSS
M	MLVSS
N	Plug flow
O	RAS
P	SBR
Q	SRT
R	Step Feed
S	SVI
T	WAS

#	Question	Answer
1	The disadvantage of using _____ for process control is that the operator must predict influent loads	I
2	The disadvantage of using _____ for process control is that it requires more data collection	K
3	The disadvantage of using _____ for process control is that it assumes no solids in the clarifier blanket	Q
4	The disadvantage of using _____ for process control is that if influent loads vary, SRT and F/M will also vary	G
5	The disadvantage of using _____ for process control is that growth of filamentous bacteria are tied to total SRT	A

Extended Multiple Choice

Select the ***best*** answer for each question from the list of choices. Some answers could be used for more than one question. Enter the letter corresponding to the correct answer in the box provided for each question. Questions are worth 20 points each.

Choices	
A	Aerobic
B	Algae
C	Amoeba
D	Anaerobic
E	Archaean
F	Autotrophic
G	Biomass
H	Cytoplast
I	Filamentous
J	Flagellum
K	Fungus
L	Germ
M	Heterotrophic
N	Metazoa
O	Methogen
P	Prokaryote
Q	Protazoa
R	Spore
S	Virus
T	Worms

#	Question	Answer
6	An organism that uses organic matter as its carbon source is considered to be _____	M
7	An organism that uses inorganic matter as its carbon source is considered to be _____	F
8	A rotifer is an example of this type of organism.	N
9	A stalked ciliate is an example of this type of organism.	Q
10	A unicellular organism that lacks a membrane-bound nucleous is a _____	P

Extended Multiple Choice

Select the ***best*** answer for each question from the list of choices. Some answers could be used for more than one question. Enter the letter corresponding to the correct answer in the box provided for each question. Questions are worth 20 points each.

Choices	
A	Aerobic
B	Ammonia
C	Ammonium
D	Anaerobic
E	Anoxic
F	AOB
G	BNR
H	Nitrate
I	Nitric acid
J	Nitrite
K	Nitrobactor
L	Nitrogen
M	NOB
N	ORP
O	Orthophosphates
P	PAO
Q	PFAS
R	PFOA
S	PFOS
T	pH

#	Question	Answer
11	A bio-reactor zone that has at least 0.3 mg/L dissolved oxygen is referred to as	A
12	A bio-reactor zone that has less than 0.3 mg/L dissolved oxygen and has oxygen that is chemically bound to nitrogen is referred to as	E
13	A bio-reactor zone that has no measurable dissolved oxygen or oxygen that is chemically bound to nitrogen is referred to as	D
14	This group of microorganisms help in the removal of phosphorus by releasing stored P when there is no DO, then by absorbing more P than it released when the DO becomes available.	P
15	An operator notices an increase in chlorine demand to meet disinfection needs. After testing the operator determines that the cause of the problem is an increase in _____ due to partial nitrification.	J

Extended Multiple Choice

Select the ***best*** answer for each question from the list of choices. Some answers could be used for more than one question. Enter the letter corresponding to the correct answer in the box provided for each question. Questions are worth 20 points each.

Choices	
A	1.0 to 2.0
B	- 200 to -400
C	0.001 to 0.10
D	0.2 to 0.5
E	1.0 to 10
F	-1.0 to -2.0
G	10 to 20
H	150 to 350
I	2.0 to 14
J	20 to 30
K	3.0 to 5.0
L	3.14 to 7.14
M	4.5 to 6.5
N	-40 to - 200
O	5.0 to 15
P	-50 to +50
Q	500 to 1000
R	6.5 to 7.5
S	6.5 to 9.5
T	7.48 to 8.34

#	Question	Answer
16	The typical disolved oxygen range for the activated sludge process is_____ mg/L	A
17	The typical target sludge age for conventional activated sludge is_____ days.	O
18	The typical pH range for activated sludge process is _____ S.U.	R
19	The typical F/M range for conventional activated sludge is _____ lb/d/lb	D
20	The ORP range that you would find in a healthy aerobic activated sludge process that is oxidizing ammonia is _____ mV	H

Extended Multiple Choice

Select the ***best*** answer for each question from the list of choices. Some answers could be used for more than one question. Enter the letter corresponding to the correct answer in the box provided for each question. Questions are worth 20 points each.

Choices	
A	Biofilter
B	Blockage
C	CCB
D	Clay
E	FOG
F	Metal
G	MLE
H	Overflow
I	Overloading
J	PCP
K	PTB
L	Rubber
M	RBC
N	SBR
O	SBB
P	SOR
Q	Trickling filter
R	Underflow
S	Underloading
T	Wood

#	Question	Answer
21	A fixed film system that consists of a media that is attached to a shaft that rotates as wastewater passes through it is know as a(an) _____	M
22	The media in a fixed film treatment process is typically made of plastic, rock, or _____	T
23	In this activated sludge process, the biological treatment and settling take place in the same tank and the wastewater is treated in batches.	N
24	This process control variable is important to keep the media in a trickling filter from drying out.	P
25	An operator notices that a trickling filter is ponding. What is the most likely cause?	I

Math Multiple Choice

You must show your work(i.e Formulas, intermediate calculations, etc.) to receive full credit even if the answer is correct.

Circle the letter coresponding to the answer provided for for each question

#	question	Choices		For graders use only: work shown=25 points, correct+work=50 points		
				correct	work?	total
1	If a(n) 36 in. pipe and a(n) 42 in. pipe are running full and meet at a manhole, what minimum size outlet pipe will be required? 36 in. x 36 in. x .785 = 1,017.4 in2 42 in. x 42 in. x .785 = 1,384.7 in2 1017.4 + 1384.7 = 2402.1 / .785 D2 = 3060 in2 D = √3060 **D = 55.32 or 56 inch**	**A**	**56 inch**			
		B	**44 inch**			
		C	**71 inch**	Proper Answer:		
		D	**78 inch**			
				correct	work?	total
2	What capacity blower is required to ventilate a manhole 48 in. in diameter and 62 feet deep, if 3 air change(s) is required every 6 minutes? 48" = 4 ft 4 X 4 .785 x 62 = 778.7 ft3 $\frac{778.7}{6\ \text{min}}$ = 129.8 ft3 129.8 x 3 = **389 ft3/Min**	**A**	**130 ft3/Min**			
		B	**389 ft3/Min**			
		C	**2336 ft3/Min**	Proper Answer:		
		D	**934 Ft3/Min**			
				correct	work?	total
3	A Wetwell is 10 ft deep by 17 ft in diameter. When the pump is not running the well rises 31 inches in 2 minutes 48 seconds. If the level rises 5.2 inches in 16 minutes when the pump is running. What is the pump rate in GPM 31 in = 2.6 ft 2 min 48 sec = 2.80 min 5.2 in = 0.4 ft 17 x 17 x .785 x 2.6 x 7.48 = 4383.79 gal 4383.79/2.8 = 1566 gpm pump off 17 x 17 x .785 x .4 x 7.48 = 735.35 gal 735.35 / 16 = 46 gpm **1566-46 = 1520 gpm**	**A**	**1612 gal/min**			
		B	**1520 gal/min**			
		C	**1797 gal/min**	Proper Answer:		
		D	**9209 gal/min**			
				correct	work?	total
4	37 mg/l. of chlorine is required to treat a flow of 50.0 MGD. The solution available to you, however,is only 74% of chlorine. How many lbs./day of solution are requires to treat the flow? 50 x 37 x 8.34 = 15,429 lbs/day 15,429 lbs/day /.74 = 20,850 lbs/day	**A**	**85,403 lbs/day**			
		B	**20,850 lbs/day**			
		C	**15429 lbs/day**	Proper Answer:		
		D	**1,024,012 lbs/day**			

Math Multiple Choice

You must show your work(i.e Formulas, intermediate calculations, etc.) to receive full credit even if the answer is correct.

Circle the letter coresponding to the answer provided for for each question

#	question		Choices	For graders use only: work shown=25 points, correct+work=50 points		
				correct	work?	total
5	If 15 gallons of a 10% solution are added to 50 gallons of a 0.8% solution. What is the percent strength of the solution mixture. (Assume the 10% solution weighs 10.2 lbs /gallon and the 0.8% solution weighs 8.8 lbs/gal). $\frac{15 \times 10.2 \times .1 + 50 \times 8.8 \times .008}{15 \times 10.2 + 50 \times 8.8} \times 100$ $\frac{15.3 + 3.5}{153 + 440} \times 100 \quad \frac{18.8}{593} \times 100$ **= 3.2%** Strength	A	**3.0%**			
		B	**3.2%**			
		C	**6%**	Proper Answer:	**B**	
		D	**6.2%**			
				correct	work?	total
6	The monthly average grit removal is 3 Ft3/MG. If the monthly average flow is 2,800,000 gpd, how many ft3 must be available for grit disposal if the disposal pit is to have a 90 day capacity. 3 x 2.8 = 8.4 ft3/day 8.4 x 90 = 756 Ft3 $\frac{756 \text{ ft3}}{27 \text{ ft3/yd3}}$ **= 28 Ft3 yds**	A	**28 yd3**			
		B	**29 yd3**			
		C	**18yd3**	Proper Answer:	**A**	
		D	**31 yd3**			
				correct	work?	total
7	The sludge from a primary clarifier has a solids content of 2.8%. The primary sludge is pumped at a rate of 4510 gpd to a thickener. If the thickened sludge has a solids content of 5.2% what is the anticipated gpd sludge flow from the thickener. Assume 8.34 lb/gal for the sludges. 4510 x 8.34 x .028 = (X) x 8.34 x 0.052 $\frac{4510 \times .028}{0.052}$ **X = 2428 gpd thickened sludge**	A	**2248 gpd**			
		B	**2828 gpd**			
		C	**1828 gpd**	Proper Answer:	**D**	
		D	**2428 gpd**			
				correct	work?	total
8	Given the following calculate the volume to be wasted and the waste pumping rate. Mass of solids in the process - 21000 lbs, desired mlss - 20000 lbs, RAS/WAS conc.-6000 mg/l was pump volume 20-50 gpm variable speed. Wasting period - 16 hours. Vol. = 1000lbs / 6000*8.34 = 0.02 mg 0.02/1000000 = **20,000 gal** **20,000 gal / 960 minutes = 21 gpm**	A	**25,000 gal 23 gpm**			
		B	**20,000 gal 21 gpm**			
		C	**27,000 gal 25 gpm**	Proper Answer:	**B**	
		D	**20,000 gal 14gpm**			

Math Multiple Choice

You must show your work(i.e Formulas, intermediate calculations, etc.) to receive full credit even if the answer is correct.

Circle the letter coresponding to the answer provided for for each question

#	question	Choices		For graders use only: work shown=25 points, correct+work=50 points		
				correct	work?	total
9	A sludge flow of 9500 gallons has a solids concentration of 2.7%. If the concentration is increased to 3.8% as a result of thickening, what is the anticipated flow rate of the thickened sludge to the digester. Assume sludges are 8.34 lbs /gal 9500 x 2.7 x 8.34= (X) x 3.8% x 8.34 $\frac{9500 \times 0.027}{0.038} = X$ **X = 6750 gpd**	**A**	67,500 gpd			
		B	66,000 gpd			
		C	6,750 gpd	Proper Answer: **C**		
		D	16,750 gpd			
10	A composting facility has an available capacity of 5500 cubic yd. If the composting cycle is 21 days, calculate how many lbs/day wet compost can be processed by this facility and how many tons/day is this? Assume a compost bulk density of 950 lbs/yd3 $21 = \frac{5500}{X/950}$ $\quad 21 = \frac{5500 \times 950}{X}$ $X = \frac{5500 \times 950}{21}$ $\quad X = 248{,}810$ lbs/day $\frac{248{,}810}{2000}$ **= 124 tons/day**	**A**	102 tons/day	correct	work?	total
		B	112 tons/day			
		C	118 tons/day	Proper Answer: **D**		
		D	124 tons/day			

Process Scenario #1: Lagoons

Use the scenario information for all questions and circle the correct answer for each.

You must show your work to receive full credit even if the answer is correct.

The Woodard & Curran Wastewater plant in Ellsworth, New York has a wastewater lagoon that recieves a flow of 2.4 MGD. The surface area of the pond is 15 acres. The B.O.D concentration is 800 mg/l. The TSS content is 400 mg/l.

Each correct answer is worth 30 points. You must give an explanation of lagoon type to receive credit.

1	List the 4 types of lagoons and how they differ. **Aerobic**: Aerobic lagoons use no mechanical equipment to supply air. Dissolved oxygen is present through much of the depth of the lagoon. They are shallower than other types of lagoons so sunlight and oxygen from air and wind can better penentrate the wastewater. Thet are better suited to warm sunny cliamates where they are less likely to freeze. **Aerated**: Aerated Lagoons are common in small communities . They use machanical aerators to mix the contents of the pond and add oxygen to the wastewater. They are typically 10 fet deep or less and have a 1-5 day detention time. **Facultative**: Have both aerobic and anaerobic conditions also called stabilization ponds. They are the most common lagoon for small communities. They have adetention time of 20 - 150 days and are typically 3 - 8 ft deep. **Anaerobic**: Anaerobic lagoons use microbes that survive in an environment with no Oxygen. They are the deepest of the 4 usually measuring 8 to 15 feet and also have a detention time of 20 - 50 days.

For Graders Only	
Points 60/120	Proper Answer

You must show all work to receive full credit even if the answer is incorrect.

Max points 120

2

If the surface area of the pond is 15 acres what is the hydraulic loading in inches/day.

A	0.5 in/day
B	6 in/day
C	0.6 in/day
D	6.5 in/day

15 * 43,560 = 653,400ft2

2,400,000 gpd / 7.48 = 320,856 ft3

320,856 ft3 / 653,400 ft2 = 0.5 ft/day

0.5 * 12 = 6 inches / day

For Graders Only	
Points 60/120	Proper Answer
	B

You must show all work to receive full credit even if the answer is incorrect.

Max points 120

3

If the population equivalent is 0.2 lbs/BOD/day/person what is the population equivalent of this wastewater flow.

A	8064 people
B	3203 people
C	80,064 people
D	40,144 people

800 * 2.4 * 8.34 = 16013 lbs

16013 / 0.2 = 80,064 people

For Graders Only	
Points 60/120	Proper Answer
	C

You must show all work to receive full credit even if the answer is incorrect.

Max points 120

4

If the average depth of the lagoon is 5 ft. and the width is 802 feet wide what is the detention time of the lagoon in days?

A	1.36 days
B	10.18 days
C	13.6 days
D	3.36 days

653,400 ft2 * 5 * 7.48 = 24,437,160 gal

24,437,160 / 2,400,000 = 10.18 days

For Graders Only	
Points 60/120	Proper Answer
	B

Process Scenario #1: Lagoons

You must show all work to receive full credit even if the answer is incorrect.

Max points 120

5

What is the Organic Loading on the Lagoon in lbs/day/acre

A	1067 lbs/day/acre
B	100.3 lbs/day/acre
C	124 lbs/day/acre
D	858.6 lbs/day/acre

2.4 MGD * 800 mg/l BOD * 8.34 = 16013 lbs/day BOD

16,013 */15 = 1067 lbs/day/acre BOD

For Graders Only	
Points 60/120	Proper Answer
	A

Process Scenario #2: Activated Sludge

Use the scenario information for all questions and circle the correct answer for each.

You must show your work to receive full credit even if the answer is correct.

Influent Avg:		Aeration Data		Clarifier Data	
Flow	2.32 MGD	Length	120	Diameter	85 ft
Temp	15° C	Width	40	Depth	16 ft
BOD	195 mg/L	Depth	15	# of tanks	2
pH	7.2 S.U.	# of tanks	2	Blanket Depth	1.5 ft
NH3	22 mg/L	MLSS	2600 mg/L	RAS Conc	0.80%
		MLVSS	78%		

Max Points 120

1

What is the current F/M ratio? At this rate, is the process considered High rate, Conventional, or low rate. Provide justification for your answer. (select 2 answers)

AB Vol = (120ft X 40ft X 15ft X 2 tanks X 7.48) / 1000000 = 1.077 MG

AB MLVSS Lbs = 1.077 MG X 2600 mg/L X 8.34 X .78 = 18217 lbs

Lbs BOD = 2.32 MGD X 195 mg/L X 8.34 = 3773 Lbs

F/M = 3773 Lbs / 18217 Lbs = **0.21**

0.21 falls between the 0.2 to 0.5 range for **conventional** activated sludge

High rate = 0.5 to 1.5

Conventional = 0.2 to 0.5

Low rate = 0.05 to 0.15

A	0.16
B	0.02
C	0.41
D	0.21
E	High Rate
F	Conventional
G	Low Rate

For Graders Only	
Points 60/120	Proper Answer
	D and F

You must show all work to receive full credit even if the answer is incorrect.

Max points 200

2	The facility removes waste sludge at a consistant rate 24/7. What does the wasting rate need to be set at to meet an MRCT target of 9 days? Include clarifier solids with all tanks in service. AB Vol = (120ft X 40ft X 15ft X 2 tanks X 7.48) / 1000000 = 1.077 MG AB Lbs = 1.077 MG X 2600 mg/L X 8.34 X = 23354 Lbs Clar Vol = (42.5ft X 42.4ft X 3.14 X 1.5ft blanket X 2 tanks X 7.48) / 1000000 = 0.127 MG Clar Lbs = 0.127 MG X (0.8 X 10000) X 8.34 = 8473 Lbs Total Lbs = 23354 + 8473 = 31827 Lbs WAS Lbs = 31827 Lbs / 9 days = 3536 Lbs WAS Gal = 3536 Lbs / 0.008 / 8.34 = 52998 Gal/Day Rate = 52998 Gal/day / 1440 min/day = **36 gpm**	A	36 gpm
		B	72 gpm
		C	18 gpm
		D	25 gpm

For Graders Only	
Points 60/120	Proper Answer
	A

You must show all work to receive full credit even if the answer is incorrect.

Max points 120

3

If solids inventory is 25000 lbs and the wasting rate is set to 42 gpm , what will the MCRT be? Will this be long enough for the facility to fully nitrify? Provide justification for your answer.

WAS Lbs = 42 gpm X 1440 X .008 X 8.34 = 4035 Lbs/day

MCRT = 25000 Lbs / 4035 lbs/day = **6.2 days**

Minimum 8 day MCRT required at 15 deg C. 6.2 < 20, so **No**

A	21 days
B	18 days
C	9 days
D	6 days
E	Yes
F	No

For Graders Only	
Points 60/120	Proper Answer
	D and F

You must show all work to receive full credit even if the answer is incorrect.

Max points 200

4

The RAS pumping system had to be taken offline for 4 hours for repairs. Durring this time no RAS was pumped. What would you expect to see the blanket level rise to durring this time?

A	1.5 Feet
B	2.5 feet
C	3.0 feet
D	6.0 feet

SLR = (2.32 MGD / 24) X 2600 X 8.34 = 2096 Lbs/Hour

2096 Lbs/Hour X 4 hours = 8384 Lbs

8384 lbs / 0.008 / 8.34 = 125659 Gal

125659 Gal / 7.48 = 16800 Ft3

16800 Ft3 / (42.5 X 42.5 X 3.14 X 2 tanks) = 1.48 Ft increase

1.5 ft existing blanket + 1.48 ft increase = **3 ft**

For Graders Only	
Points 100/200	Proper Answer
	C

You must show all work to receive full credit even if the answer is incorrect.

Max Points 120

5

Based on the following data, what is the percent removal for total nitrogen?

	TKN	NH3	NO2	NO3
INF	35	22	0.02	0.5
EFF	8	2	0.15	21

A	91%
B	77%
C	18%
D	9.90%

INF TN = 35 + 0.52 = 35.52

Eff TN = 8 + 21.15 = 29.15

((35.52 - 29.15) / 35.52) X 100 = **17.9 %**

For Graders Only	
Points 60/120	Proper Answer
	C

Use the scenario information for all questions and circle the correct answer for each.

You must show your work to receive full credit even if the answer is correct.

The Woodard & Curran Wastewater plant in Ellsworth, New York has has an average flow of 24 mgd with a peak flow of 40 mgd . It has twelve .4 MGD aeration tanks and 9 .3 mgd secondary clarifiers. It also has two 180,000 gallon contact tanks. The influent B.O.D is 400 mg/l and the TSS is 300 mg/l. The MLss is 2400 mg/l. Assume all tanks on line. 1 mg/l of Nitrite consumes 5 mg/l of Chlorine.

Max points 120

1

What is the detention time in minutes at peak flow for the contact tanks if both are in service and does it meet the 15 minute chlorine contact time at peak flow standard. Calculate your answer circle the correct letter and then circle yes or No if it meets or doesn't the 15 minute standard.

A	24 min
B	14.5 min
C	13 min
D	18 min
E	Yes
F	No

360,000 gal * 24 hr / 40000000 = .22 hours

0.22 * 60 = 12.96 minutes

For Graders Only	
Points 60/120	Proper Answer
	C and F

You must show all work to receive full credit even if the answer is incorrect.

Max points 120

2

If the chlorine demand is 10 mg/l and the desired residual is 2 mg/l. How many pounds of hypochlorite should be fed each day. The hypoochlorite has 70% available chlorine.

A	2401 lb/day
B	3431 lbs/day
C	1200 lbs/day
D	3208 lbs/day

For Graders Only	
Points 60/120	Proper Answer
	B

24 MGD * 12mg/l (demand+Residual) * 8.34 = 2401 lbs/day

2401 / .7 (% chlorine)= 3431 lbs per day

You must show all work to receive full credit even if the answer is incorrect.

Max points 120

3

If you fed 3500 lbs of chlorine during a peak flow event what was the demand in mg/l? Assuming you met the 2 mg/l residual target.

A	13 mg/l
B	17 mg/l
C	8.5 mg/l
D	12 mg/l

3500 lbs / (40 MGD * 8.34) = 10.5 mg/l Dosage

10.5 mg/l dosage - 2 mg/l residual = 8.5 mg/l demand

For Graders Only	
Points 60/120	Proper Answer
	C

You must show all work to receive full credit even if the answer is incorrect.

Max points 200

4

If you are capable of feeding a maximum 6500 lbs/day of chlorine at what Nitrite concentration in mg/l wouild you exceed you ability to chlorinate the effluent at average flow. Demand is 10mg/l and you need at least a .5 mg/l residual.

A	1.5 mg/l
B	3 mg/l
C	2.4 mg/l
D	4.4 mg/l

For Graders Only	
Points 100/200	Proper Answer
	D

<u>6500 lbs hypochlorite max</u>

24 MGD * 10.5 (demand + Residual) * 8.34 = 2102 lbs/day for demand and residual

6500 max hypochlorite feed - 2102 = 4400 lbs Hypochlorite for nitrite consumption

1 mg/l nitrite consumes 5 mg/l of chlorine

24 MGD * 5 mg/l * 8.34 = 1001 lbs chlorine/day/mg/l of nitrite

4400 lbs available Hypo / 1001 lbs / mg/l of Nitrite = 4.4 mg/l