

**NEWEA Operations Challenge
Process Control Event 2022**

Team Name:
Team Number:
Team Captain:

Written Test points awarded:
MC points awarded:
Simulator points awarded:
Total Event Points:

Simulator - Computer 9 total questions 50 to 300 points per question 1000 max points available
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Multiple Choice - Computer 48 total questions 10 to 20 points per question 720 max points available

Multiple Choice Math - Pages 2 - 5 (4) 20 total questions 40 to 60 full credit points per question 50% partial credit if math is correct but answer is incorrect 0 points is work is not shown 1000 max points available
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Process Scenarios - Pages 6 - 26 (21) 17 total questions 100 full credit points per question 50% partial credit if math is correct but answer is incorrect 0 points is work is not shown 1700 max points available
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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 corresponding to the answer provided for for each question

#	question	Choices	
1	What is the loading BOD loading rate to a WWTF if the influent BOD is 250 mg/l and the the flow is 450,000 gpd? $.450 * 250 * 8.34 = 938 \text{ lbs/day}$	A	1055 lbs/day
		B	938 lbs/Day
		C	112 lbs/day
		D	555 lbs/day
2	What is the percent removal of a primary clarifier if the raw TSS is 210 ppm, the primary EFF TSS is 39 ppm, and the final EFF TSS is 4.5 ppm? $((210-39) / 210) * 100 = 81.4\%$	A	97.80%
		B	18.60%
		C	81.40%
		D	55.20%
3	How many million gallons does a circular tank that is 120 ft in diameter and 16 ft deep hold? $(60 * 60 * 3.14 * 16 * 7.48) / 1,000,000 = 1.35 \text{ MG}$	A	5.41 MG
		B	0.08 MG
		C	0.18 MG
		D	1.35 MG
4	What does a sludge that is 2% solids equal in ppm? $2 * 10,000 = 20,000 \text{ ppm}$	A	20,000 ppm
		B	2,000 ppm
		C	200,000 ppm
		D	200 ppm
5	What is the chlorine demand if the influent contact basin is dosed at 3 mg/l and the effluent contains 1.2 mg/l? $3 - 1.2 = 1.8 \text{ mg/l}$	A	4.2 mg/l
		B	1.8 mg/l
		C	3 mg/l
		D	1.2 mg/l

For graders use only		
work shown=20 points correct+work=40 points		
correct	work?	total
B		

correct	work?	total
C		

correct	work?	total
D		

correct	work?	total
A		

correct	work?	total
B		

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 corresponding to the answer provided for for each question

#	question	Choices	
6	Calculate the sludge volume index if the 30 min settling time is 210 and the MLSS is 2800 mg/l. $210 * 1000 / 2800 = 75$	A	250
		B	85
		C	75
		D	200
7	Calculate the BOD from the following: Volume = 15 ml Initial DO = 9.2 mg/l Final DO = 3.1 mg/l $(9.2 - 3.1) / 15 * 300 = 122 \text{ mg/l}$	A	122 mg/l
		B	152 mg/l
		C	75 mg/l
		D	132 mg/l
8	If a pump at 100% efficient can produce 27 PSI, how many vertical feet can it pump if it is 85% efficient? $27 * 2.31 * .85 = 53 \text{ Ft}$	A	62 ft
		B	33 ft
		C	11 ft
		D	53 Ft
9	If a lift station pumps 2.7 MGD and the pumps run for 10.5 hours per day, what is the flow rate for the pump in GPM? $(2.7 \text{ MGD} * 1,000,000) / (10.5 \text{ H} * 60 \text{ m/h})$	A	3,952 gpm
		B	4,286 gpm
		C	2,572 gpm
		D	3642 gpm
10	What HP motor is needed to pump 1,500 gpm at 39 ft of head? $1,500 * 39 / 3960 = 15 \text{ HP}$	A	10 HP
		B	15 HP
		C	12 HP
		D	50 HP

For graders use only		
work shown=20 points correct+work=40 points		
correct	work?	total
C		

correct	work?	total
A		

correct	work?	total
D		

correct	work?	total
B		

correct	work?	total
B		

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 corresponding to the answer provided for for each question

#	question	Choices	
11	A WWTF treats an annual average flow of 2.3 MGD. If the average sewer user produces 100 gpd per person and the town has 18,000 people, what percentage of the treated flow is assumed to be I/I? $18,000 * 100 = 1,800,000 \text{ gpd}$ $((2.3 \text{ MGD} - 1.8 \text{ MGD}) / 2.3 \text{ MGD}) * 100 = 21.7\%$	A	21.7%
		B	18.5%
		C	42.1%
		D	78.2%
12	If a stabilization pond is 30 acres, how long will it take to raise the level by 3 feet at a flow rate of 0.35 MGD? $(30 * 43,560 * 3 * 7.48) / 1,000,000 = 29.3 \text{ MG}$ $29.3 \text{ MG} / 0.35 \text{ MGD} = 83.7 \text{ Days}$	A	14.7 Days
		B	10.2 Days
		C	83.7 Days
		D	97.6 Days
13	What is the velocity in ft/sec in an 8" force main carrying a flow of 1250 gpm? $1250 / 7.48 / 60 = 2.78 \text{ ft}^3/\text{sec}$ $8 / 12 = .67 \text{ ft}$ $0.33 * 0.33 * 3.14 = 0.35 \text{ ft}^2$ $2.78 / 0.34 = 7.94 \text{ ft/sec}$	A	10.51 ft/sec
		B	4.97 ft/sec
		C	6.54 ft/sec
		D	7.94 ft/sec
14	What is the organic loading rate in lbs/1000 ft on a 10 ft deep, 80 ft diameter trickling filter if the influent flow is 2.2 MGD, the BOD is 195, and the media contains 5.5 ft2 per ft3? $(40 * 40 * 3.14 * 10 * 5.5) / 1,000 = 276 \text{ 1,000 ft}^2$ $2.2 * 195 * 8.34 = 3578 \text{ Lbs/day}$ $3,578 / 276 = 13 \text{ lbs/day/1,000 ft}^2$	A	$\frac{13}{\text{lbs/d/1,000 ft}^2}$
		B	$\frac{71}{\text{lbs/d/1,000 ft}^2}$
		C	$\frac{45}{\text{lbs/d/1,000 ft}^2}$
		D	$\frac{56}{\text{lbs/d/1,000 ft}^2}$
15	A WWTF plant treats 2 MGD with 50 lbs/day of sodium hypochlorite. If the effluent Cl2 residual is 1.2 mg/l, what is the demand? $50 / 2 / 8.34 = 3 \text{ mg/l}$ $3 \text{ mg/l} - 1.2 \text{ mg/l} = 1.8 \text{ mg/l}$	A	2.2 mg/l
		B	1.8 mg/l
		C	48.8 mg/l
		D	3.0 mg/l

For graders use only		
work shown=30 points correct+work=60 points		
correct	work?	total
A		

correct	work?	total
C		

correct	work?	total
D		

correct	work?	total
A		

correct	work?	total
B		

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 corresponding to the answer provided for for each question

#	question	Choices	
16	What percent capacity of a 8 ft stick of 12" pipe is an 12 ft stick of 8" pipe? $0.33 * 0.33 * 3.14 * 12 = 4.1 \text{ ft}^3 \text{ in } 8" \text{ pipe}$ $0.5 * 0.5 * 3.14 * 8 = 6.3 \text{ ft}^3 \text{ in } 12" \text{ pipe}$ $(4.1 / 6.3) * 100 = 65\%$	A	100%
		B	50%
		C	65%
		D	112%
17	1,500 gpm is needed at 17 psi. Motor eff = 91%, pump eff = 89%. What HP motor is needed? $17 \text{ PSI} * 2.31 = 39 \text{ ft}$ $1,500 * 39 / (3960 * 0.91 * 0.89) = 18 \text{ HP}$	A	18 HP
		B	15 HP
		C	12 HP
		D	25 HP
18	What is the detentions time of a 60 ft circular clarifier with a sidewall depth of 11 ft and a center depth of 16 ft if the flow is 1.6 MGD? $30 * 30 * 3.14 * 11 = 31,086 \text{ ft}^3$ $30 * 30 * 3.14 * 0.33 * 5 = 4,663 \text{ ft}^3$ $(31,086 + 4,663) * 7.48 / 1,000,000 = 0.267 \text{ MG}$ $0.267 \text{ MG} / 1.6 \text{ MGD} * 24 = 4 \text{ hours}$	A	8 hours
		B	4 hours
		C	3 hours
		D	6 hours
19	An aeration tank is 1.2 MG in volume and has an MLSS concentration of 2,600 mg/L. If the WAS concentration is 2.2%, how many gallons need to be wasted daily to achieve an MRCT of 8 days? $1.2 * 2,600 * 8.34 = 26,021 \text{ lbs}$ $26,021 / 8 \text{ days} = 3,253 \text{ lbs/day}$ $3,253 / 0.022 / 8.34 = 17,729 \text{ gpd}$	A	16,752 gpd
		B	19,442 gpd
		C	18,455 gpd
		D	17,729 gpd
20	A WWTF has two circular secondary clarifiers. A 65ft and an 85 ft. What is the solids loading rate if the flow is 833 gpm and the MLSS is 0.25%? $(32.5 * 32.5 * 3.14) + (42.5 * 42.5 * 3.14) = 8,988 \text{ ft}^2$ $833 * 1440 * 0.0025 * 8.34 = 25,009 \text{ lbs/day}$ $25,009 / 8,988 = 2.8 \text{ days}$	A	3.0 lb/d/ft2
		B	0.8 lb/d/ft2
		C	2.8 lb/d/ft2
		D	1.2 lb/d/ft2

For graders use only		
work shown=30 points correct+work=60 points		
correct	work?	total
C		

correct	work?	total
A		

correct	work?	total
B		

correct	work?	total
D		

correct	work?	total
C		

Process Scenario 1: Activated Sludge

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

Operational Data

	Influent Avg:	Permit Limit:	Aeration Data		Clarifier Data	
Flow	2.98 MGD	6.5 MGD	# of Tanks	2	# of Tanks	2
Temp	15 Deg C	NA	Length	120 Ft	Diameter	85 Ft
BOD	215 mg/l	50 mg/l	Width	40 Ft	Depth	16 Ft
TSS	210 mg/l	50 mg/l	Depth	16 Ft	Blanket Dept	2 Ft
NH3	26 mg/l	5 mg/l	MLSS	2650 mg/l	RAS Conc	6500 mg/l
pH	7.3 s.u.	6.0 - 8.0 s.u.	MLVSS	77%	WAS Conc	2.10%
Alkalinity	150 mg/l	NA	30 Min Sett	210	WAS Rate	32,000 gpd

Process Scenario 1: Activated Sludge

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

<p>Based on the provided data, calculate the following. Enter numerical answers. (Must get all three correct and show work for full credit)</p> <p>Total Solids Inventory</p> <p>F/M</p> <p>MCRT (assume effluent TSS is at permit limit)</p> <p>1</p> <p>TSI: $(2 * 120 * 40 * 16 * 7.48) / 1,000,000 = 1.149 \text{ MG} * 2650 * 8.34 = 25,392 \text{ lbs}$ $(2 * 42.5 * 42.5 * 3.14 * 2 * 7.48) / 1,000,000 = 0.17 \text{ MG} * 6500 * 8.34 = 9,199 \text{ lbs}$ $25,392 + 9,199 = 34,591 \text{ lbs}$</p> <p>F/M: $(2.98 * 215 * 8.34) / (25,392 * 0.77) = 0.27$</p> <p>MCRT: $34,591 / ((32,000 * 0.021 * 8.34) + (2.98 * 50 * 8.34)) = 5 \text{ days}$</p>			For Graders Only	
			Points 50/100	Answer
	TSI	34,591		
	F/M	0.27		
	MCRT	5 Days		

Process Scenario 1: Activated Sludge

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

	The operator has determined that the reason why the effluent TSS quality is poor and the facility is unable to meet its effluent requirements for NH3 is that the MCRT is too low. The operator determines that adjusting the MCRT to meet the requirement for nitrification will also improve the TSS and assumes the new effluent TSS value will be 10 mg/l. If the facility runs wasting at a constant speed 24/7, what flow rate should the WAS pump flow rate be set at to achieve a 20 day MCRT?	For Graders Only	
		Points 50/100	Answer
			B
		A	8450 GPM
		B	6 GPM
		C	12 GPM
		D	32 GPM
2	<p>MCRT for nitrification at 15 Deg C is 20 days.</p> <p>$34,591 / 20 = 1,729 \text{ lbs/day}$</p> <p>$1,729 - (2.98 * 10 * 8.34) = 1480 \text{ lbs/day WAS}$</p> <p>$1,480 / 0.021 / 8.34 / 1440 = 6 \text{ gpm}$</p>		

Process Scenario 1: Activated Sludge

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

	<p>After making the change to the MCRT, effluent quality improved, but the facility is still not meeting its permit for NH₃. The operator determined that the reason must be an alkalinity deficiency. If the operators goal is to maintain an effluent alkalinity of at least 50 mg/l CaCo₃, how many lbs per day of suplimental alkalinity need to be added in order to get the NH₃ down to the limit?</p>	For Graders Only	
		Points 50/100	Answer
			C
3	<p>7.14 parts alkalinity per part NH₃</p> <p>26 - 5 = 21</p> <p>(21 * 7.14) + 50 - 150 = 50 mg/l</p> <p>50 * 2.98 * 8.34 = 1242 lbs/day</p>	A	500 lbs/day
		B	755 lbs/day
		C	1250 lbs/day
		D	2550 lbs/day

Process Scenario 1: Activated Sludge

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

	<p>Increasing the target MCRT has improved nitrification, but the increase in total system lbs has created a new challenge when it comes to settling solids in the clarifier during periods of high flow caused by rain events. The facility is now violating its permit for TSS every time it rains. At an MCRT of 20 days, the MLSS has increased to 3,800 mg/l and the clarifier blanket has risen to 4 ft (at the same concentration). The facility is considering installing a biomag system to introduce magnetite into the process to increase settling rates. The magnetite will increase the volume of wasted solids by 7%, but 95% will be recovered from the waste stream before dewatering. How many more lbs of solids will have to be dewatered yearly with the biomag system?</p>	For Graders Only	
		Points 50/100	Answer
			D
		A	2,290 lbs
		B	5,550 lbs
		C	7,540 lbs
		D	3,650 lbs
4	<p>TSI:</p> $(2 * 120 * 40 * 16 * 7.48) / 1,000,000 = 1.149 \text{ MG} * 3,800 * 8.34 = 36,411 \text{ lbs}$ $(2 * 42.5 * 42.5 * 3.14 * 4 * 7.48) / 1,000,000 = 0.17 \text{ MG} * 6500 * 8.34 = 18,398 \text{ lbs}$ $36,411 + 18,398 = 54,409 \text{ lbs}$ <p>WAS Lbs:</p> $54,409 / 20 = 2,740 \text{ lbs/day without biomag}$ $2,740 * 0.07 = 191 \text{ lbs}$ $191 * 0.05 = 9.6 \text{ lbs}$ $2740 + 9.6 = 2750 \text{ lbs/day with biomag}$ $(2,750 - 2,740) * 365 = 3,650 \text{ lbs}$		

Process Scenario 2: Anaerobic Digestion and Energy Recovery

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

Operational Data

The Lewiston Auburn Water Pollution Control Authority operates two (2) mesophilic anaerobic digesters, each with a volume of 92,245 cubic feet. On average, the facility pumps 50,000 gallons per day of combined Primary and Thickened Waste Activated Sludge (TWAS) with a 5.5% solids concentration and 70% Volatile Solids. The digester feed solids average 212 mg/l of Volatile Acids and 1255 mg/l of Alkalinity. The facility averages 50% Volatile Solids destruction, and produces 12.5 cubic feet of biogas for every pound of Volatile Solids it destroys. The biogas fuels two (2) Combined Heating & Power (CHP) units capable of producing 230 kW of power. The engines require 1 Cubic Feet per Minute (CFM) of biogas for every 3-kW of power produced.

Process Scenario 2: Anaerobic Digestion and Energy Recovery

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

	How many average pounds of total volatile solids are pumped to the digester daily?	For Graders Only	
		Points 50/100	Answer
			D
1		A	22,935 lbs/day
		B	45,870 lbs/day
		C	18,420 lbs/day
		D	16,055 lbs/day
		E	7,868 lbs/day
	50,000 gals/day x 8.34 lbs/gal water x 5.5% solids = 22,935 total pounds of solids		
	22,935 total pounds of solids x 0.70 % = 16,055 pounds of volatile solids		

Process Scenario 2: Anaerobic Digestion and Energy Recovery

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

	What is the total detention time?	For Graders Only	
		Points 50/100	Answer
			E
2	(92,245 ft ³ x 2 digesters x 7.48 gallons/ft ³) / 50,000 gpd = 27.6 days	A	13.8 days
		B	6.5 days
		C	10.7 days
		D	38.5 days
		E	27.6 days

Process Scenario 2: Anaerobic Digestion and Energy Recovery

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

	What is the Volatile Acid to Alkalinity ratio, and is this acceptable?	For Graders Only	
		Points 50/100	Answer
			A
3	<p>212 mg/l volatile acid / 1255 mg/l Alkalinity = 0.16</p> <p>Yes, less than 0.35 is acceptable</p>	A	0.16, Yes
		B	0.16, No
		C	5.77, Yes
		D	5.77, No

Process Scenario 2: Anaerobic Digestion and Energy Recovery

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

	How much average biogas is produced daily?	For Graders Only	
		Points 50/100	Answer
			C
4	<p>16,055 pounds of volatile solids fed x 50% destruction = 8027.50 VS pounds destroyed</p> <p>8027.50 VS lbs destroyed x 12.5 ft³ biogas/ lb. VS destroyed = 100,344 cubic feet biogas produced</p>	A	8,027 ft ³ /d
		B	200,688 ft ³ /d
		C	100,344 ft ³ /d
		D	300,587 ft/d
		E	355,948 ft/d

Process Scenario 2: Anaerobic Digestion and Energy Recovery

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

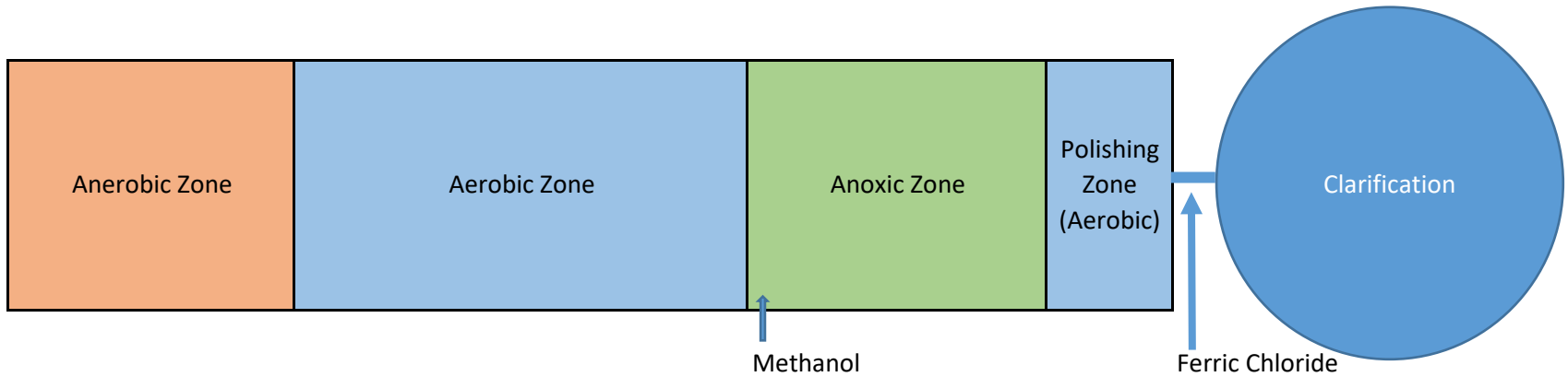
	What is the average kW of power that can be produced daily from the two CHP units based on the volume of gas produced at the facility?	For Graders Only	
		Points 50/100	Answer
			A
5	$(100,344 \text{ ft}^3 \text{ biogas} \times 3 \text{ kW/CFM}) / 1440 = 209 \text{ Kw}$	A	209 kW
		B	301,032 kW
		C	418 kW
		D	212,555 kW
		E	560 kW

Process Scenario 3: Chemical Addition for Nutrient Removal

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

Operational Data

	Influent Avg:	Aerobic Zone Effluent:	Anoxic Zone Effluent:	Permit Limit:
Flow	6.5 MGD	6.5	6.5	10 MGD
Temp	15 Deg C	15.5 Deg C	15 Deg C	NA
BOD	215 mg/l	5.5 mg/l	5.5 mg/l	10 mg/l
TSS	210 mg/l	2,500 mg/l	5.5 mg/l	10 mg/l
Total N	37 mg/l	37 mg/l	1.5 mg/l	542 Lbs/day
TKN	35 mg/l	1.3 mg/l	1.3 mg/l	NA
NH3	33 mg/l	0.1 mg/l	0.1 ml/l	1.0 mg/l
Total P	10 mg/l	2 mg/l	4 mg/l	55 Lbs/day
pH	7.3 s.u.	6.7 s.u.	7.2 s.u.	6.0 - 8.0 s.u.
Alkalinity	280 mg/l	30 mg/l	155 mg/l	NA



Additional Information:

Methanol required for denitrification: 1.9 grams per gram of NO ₃
BOD required for denitrification: 2.86 grams per gram of NO ₃
Ferric Chloride required to remove Total P: 5.2 pounds per pound of Total P
Ferric Chloride \$0.41 per pound

Process Scenario 3: Chemical Addition for Nutrient Removal

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

	How many lbs/day of methanol are currently being used to to achieve the anoxic effluent nitrogen level? Assume NO2 levels are insignificant.	For Graders Only	
		Points 50/100	Answer
			C
1		A	589 lbs/day
		B	1277 lbs/day
		C	2265 lbs/day
		D	3675 lbs/day
	<p>37 mg/l TN - 1.3 mg/l TKN = 35.7 mg/l NO3</p> <p>35.7 mg/l * 1.9 mg/l = 67.8 mg/l</p> <p>67.8 mg/l * 6.5 * 8.34 = 3,675 lbs/day</p>		

Process Scenario 3: Chemical Addition for Nutrient Removal

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

	<p>In an attempt to reduce cost, the operator wants to install a pump to side stream a portion of the influent to use as a carbon source for denitrification. If a pump that operates at 1200 gpm is installed and piped directly from the influent into the anoxic zone, how many lbs per day of methanol will be needed to reach the permit limit for TN at the average daily flow? Assume no changes to nitrification.</p>	For Graders Only	
		Points 50/100	Answer
			B
		A	75 lbs/day
		B	589 lbs/day
		C	272 lbs/day
		D	425 lbs/day
2	<p>542 lbs/day / 6.5 MGD / 8.34 = 10 mg/L TN in effluent</p> <p>37 TN - 1.3 TKN - 10 = 25.7 mg/l NO3 to be removed</p> <p>25.7 * 6.5 * 8.34 = 1393 lbs/day NO3 to be removed</p> <p>((1200 gpm * 1440) / 1,000,000) * 215 mg/l * 8.34 = 3098 lbs/day BOD sidestream</p> <p>3098 lbs BOD / 2.86 = 1083 lbs NO3 removed with BOD</p> <p>1393 lbs/day - 1083 lbs/day = 310 lbs/day to remove with methanol</p> <p>310 lbs/day * 1.9 = 163 lbs per day of methanol to meet permit</p>		

Process Scenario 3: Chemical Addition for Nutrient Removal

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

	What is the dosage rate in mg/L of Ferric Chloride needed to achieve Total P permit limit at average daily flow?	For Graders Only	
		Points 50/100	Answer
			A
3	<p>55 lbs/day / 8.34 * 6.5 MGD = 1.0 mg/L</p> <p>4 mg/L - 1 mg/L = 3 mg/L Total P needs removal</p> <p>3 mg/L * 8.34 * 6.5 MGD = 163 lbs</p> <p>163 lbs * 5.2 = 848 lbs of Ferric needed</p> <p>848 lbs / 8.34 * 6.5 MGD = 15.6 mg/L</p>	A	15.6 mg/L
		B	20.8 mg/L
		C	10.4 mg/L
		D	25.7 mg/L

Process Scenario 3: Chemical Addition for Nutrient Removal

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

	<p>It has been determined that adding a mixer to the anoxic zone will prevent the phosphorus increase between the aerobic zone effluent and anoxic zone effluent. The cost for adding a mixer will be \$125,000. What will be the mixer cost install pay back be in years with the reduction of ferric chloride required? Assume chemical cost stays the same.</p>	For Graders Only	
		Points 50/100	Answer
			C
		A	2.63 Years
		B	1.95 Years
		C	1.47 Years
		D	1.25 Years
4	<p>55 lbs/day / 8.34 * 6.5 MGD = 1.0 mg/L 4 mg/L - 1 mg/L = 3 mg/L Total P needs removal 3 mg/L * 8.34 * 6.5 MGD = 163 lbs P 163 lbs * 5.2 = 848 lbs of Ferric needed</p> <p>2 mg/L - 1 mg/L = 1 mg/L Total P needs removal with mixer 1 mg/L * 8.34 * 6.5 MGD = 54 lbs P 54 lbs * 5.2 = 281 lbs of Ferric needed with mixer</p> <p>848 lbs - 281 lbs = 567 lbs of Ferric saved 567 lbs * 0.41 * 365 = \$84,852/yr Ferric cost savings \$125,000 / \$84,852 = 1.47 years</p>		

Process Scenario 4: Effluent Filtration

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

Operational Data

Multi- Media Gravity Filter Information		Backwash Flow Rates	
Filter dimensions	(4) 11'-10" x 24'-0"	Water TempDegrees F	B/W Rate GPM/FT²
Air Scour Rate	2.5 SCFM/SQFT	50 or less	15
Air Scour Time	120 seconds	51-55	16
Max. Loading Rate	3500 GPD/SQFT	56-60	17
Gravel (1" x 5/8")	3"	61-65	18.5
Gravel (5/8" x 3/8")	3"	66-70	20
Gravel (3/8" x 3/16")	3"	71-75	21
Gravel (3/16" x #10)	3"	Above 75	22.5
Silica Sand	12"		
Anthracite (1.5 g/cm ³)	22"		
Effluent Temperature	10 – 20 Degrees C		
Backwash Water Source	Filtered Effluent		

Process Scenario 4: Effluent Filtration

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

	<p>Ron has been tasked with ordering replacement anthracite that gets lost during backwashes. After further investigation it was determined that the total combined inches of anthracite media loss to be 22". Anthracite media is sold in bags of 1.0 FT3. How many bags will Ron need to order and what will be the shipping weight?</p>	For Graders Only	
		Points 50/100	Answer
			C
1	<p>11.83' * 24' * 4 tanks = 1135 ft2 22" / 4 tanks = 5.5" 5.5" / 12 = 0.458' 1135 ft2 * 0.458 ft = 521 bags</p> <p>(1.5 g/cm3*16.39 cm3/in3 * 1728 in3/ft3)/454 g/lbs = 93.6 lbs/ft3 (521 bags * 93.6 lbs/ft3)/2000 lbs/ton = 24.3 tons</p>	A	488 Bags, 22.8 Tons
		B	521 Bags, 48.6 Tons
		C	521 Bags, 24.3 Tons
		D	544 Bags, 26.7 Tons
		E	544 Bags, 48.6 Tons

Process Scenario 4: Effluent Filtration

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

	The backwash water pumps are due for replacement and Mark has been asked to create specification for the replacement pumps. What will the maximum required GPM need to be when two filters are in backwash at the same time?	For Graders Only	
		Points 50/100	Answer
			B
		A	8,520 GPM
		B	11,360 GPM
		C	5,680 GPM
		D	4,260 GPM
		E	12,780 GPM
2	<p>Max effluent temp is 20 deg c, so 20 gpm/ft2 pump needed for 66-70 deg F based on backwash flow rates chart</p> <p>11.83' * 24' * 2 tanks = 568 ft2</p> <p>568 ft2 * 20 GPM/ft2 = 11,360 GPM</p>		

Process Scenario 4: Effluent Filtration

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

	Filter #3 will need to be taken off line for service. Amy is concerned that the remaining online filters will not handle the current effluent flow of 1.7 MGD. What will the online filters have for a surface loading rate at the current flow?	For Graders Only	
		Points 50/100	Answer
			E
3	<p>1.7 MGD * 1,000,000 = 1,700,000 GPD 11.83' * 24' * 3 tanks = 852 ft² 1,700,000 GPD / 852 ft² = 1995 GPD/FT²</p>	A	3063 GPD/FT ²
		B	2025 GPD/FT ²
		C	1850 GPD/FT ²
		D	2560 GPD/FT ²
		E	1995 GPD/FT ²

Process Scenario 4: Effluent Filtration

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

	Filters have been requiring more backwashes with #3 filter offline, backwashes are up to three per day per filter from one per day per filter. What will be the increased CF total for the day with one filter offline?	For Graders Only	
		Points 50/100	Answer
			D
4	<p>11.83' * 24' * 4 tanks = 1135 ft²</p> <p>1135 ft² * 2.5 SCFM/ft² * 2 mins * 1 per day = 5675 CF</p> <p>11.83' * 24' * 3 tanks = 852 ft²</p> <p>852 ft² * 2.5 SCFM/ft² * 2 mins * 3 per day = 12,780 CF</p> <p>12,780 CF - 5675 CF = 7105 CF increase</p>	A	3,720 CF
		B	5,550 CF
		C	8,520 CF
		D	7,100 CF
		E	4,200 CF