
State Water Resources Control Board

GRADE III OPERATOR CERTIFICATION EXAMINATION INFORMATION AND SAMPLE QUESTIONS

The Grade III examination contains questions regarding the following subjects: basic safety practices, hazards encountered during wastewater treatment plant operations, sampling and simple analysis of wastewater constituents, operation and maintenance procedures in preliminary and primary treatment unit processes, anaerobic sludge digestion and disinfection. It also includes specific questions on the operation and maintenance of wastewater stabilization ponds and state regulations regarding the classification of wastewater treatment plants and operator certification. Other questions may deal with secondary unit processes (e.g. trickling filters, activated sludge), sludge handling, evaluation of wastewater unit processes as well as overall plant performance and basic supervision. In addition, the Grade III examination includes questions on process control, activated sludge process modifications and tertiary treatment. Examinees will be asked to write essay answers to some questions.

The Grade III examination also contains mathematical questions. Examinees may be asked to write essay answers and calculate a variety of problems including efficiency and loading of solid thickening processes, disinfectant usage, digester loading, pumping efficiency, standard BOD test, hydraulic or organic loading rate, activated sludge wasting rate, MLVSS and MLSS, sludge pumping rate, nitrogenous BOD calculation, F/M ratio and polymer usage. The examinee should be familiar with typical calculations related to the subject matter listed in paragraph 1. Examinees must work out the math problems. Answers to math questions that are not supported by calculations will **NOT** receive credit.

Examinees are given 3 ½ hours to complete the examination. The question format is as follows:

25 True/False Questions	@	1 point each
20 Multiple Choice Questions	@	2 points each
2 Mandatory Essay Questions	@	10 points each
7 Math Problems (Work 7 of 8)	@	<u>8 points each</u>
TOTAL POINTS		141

The following are examples of the types of questions that you would find on the Grade III certification examination (see attached key for answers).

True/False Questions

1. Nitrification is the term used to indicate that ammonia nitrogen is being oxidized to nitrate or nitrite forms.
2. The white, thick, billowing foam common during the start up of an activated sludge wastewater treatment plant is caused by a low F/M ratio.
3. In a facultative pond, a drop in the pH will normally be accompanied by a rise in the dissolved oxygen.
4. The step feed modification of activated sludge distributes the demand for oxygen throughout most of the aeration basin instead of concentrating the demand at the basin inlet.
5. The volatile acids/alkalinity relationship is useful in digester control because it is one of the first indicators that the digestion process is going sour.

Multiple Choice Questions

6. Which of the following gases would cause the least respiratory distress if present in the air we breathe in concentrations at or above 10% by volume?
 - a. Carbon monoxide
 - b. Ammonia
 - c. Nitrogen
 - d. Carbon dioxide
 - e. Hydrogen sulfide

7. Biochemical Oxygen Demand is a measure of:
- The amount of inorganic matter remaining in wastewater.
 - The amount of oxygen present in wastewater.
 - The amount of oxygen that would be consumed by aerobic microorganisms as they feed upon biodegradable organic matter in wastewater.
 - The number of aerobic organisms present per 100 milliliters of wastewater.
 - The amount of biochemical that would be used by aerobic bacteria if incubated at 20°C.
8. Which one of the following is a probable direct result of having too much flow detention time in a primary clarifier?
- Sludge will become stiff and hard to pump.
 - Septic odors will be released.
 - Scum rafts will form and bridge across the skimmers.
 - Algae growths will form in the launders.
 - Sludge scraper drives will cut out on torque overload switches.
9. Which of the following is most likely to be a significant problem when manually cleaned bar screens are left uncleaned too long?
- Anaerobic acids will form to de-galvanize the bars and cause high concentrations of zinc in the plant effluent.
 - Grit will be trapped in the screenings causing excessive wear on the manual “rag rake”.
 - Flow will back up to overflow either the screen channel or upstream manholes.
 - Hydrogen sulfide will be reduced to form zinc sulfide deposits on the bars of the screen.
 - Grease will collect in the trapped rags and cause excessive foaming when the bar screen is subsequently cleaned.
10. Which one of the following is a correct statement about a complete-mix activated sludge plant?
- Because of the complete-mix circumstance, the term “mean cell residence time” has no meaning.
 - Because of the complete-mix circumstance, the F/M ratio can not be calculated.
 - The F/M ratio is significantly higher near the inlet end of the aeration basin than near the outlet of the aeration basin.
 - The rate of oxygen uptake per unit of activated sludge is about the same throughout all of the aeration basin.

MATH PROBLEMS

11. A rectangular primary sedimentation basin is 100 feet long by 20 feet wide with an average liquid depth of 12.5 feet. What volumetric rate of flow (expressed in MGD) can be treated in that basin without exceeding a unit hydraulic loading rate of 850 gallons/day/ft²?
12. A pump was noted to lower the level in a basin by 10 feet in 12 minutes and 20 seconds while a steady flow rate of 180 g.p.m. was entering the basin. The basin diameter was 12 feet. What was the discharge rate of the pump expressed in gallons per minute?
13. An activated sludge plant generally operates well with an F/M Ratio of 0.65 lbs COD/day/lb MLVSS. Given the following information, show a determination of the concentration of MLSS that should be maintained.

Average Plant Flow Rate	4.0 MGD	Normal RAS Flow Rate	2.0 MGD
Aeration Basin Volume	1.25 MG		
Final Clarifier Volume	0.5 MG		
Primary Effl. COD Conc.	300 mg/L	Final Effl. COD Conc.	56 mg/L
Primary Effl. SusSol. Conc.	105 mg/L	Final Effl. SusSol Conc.	20 mg/L
% Volatility of MLSS	70%		

14. In an attempt to correct a filamentous growth in an activated sludge process, you want to inject chlorine into the RAS flow stream at the dosage of 2.5 pounds of chlorine per 1000 pounds of return activated sludge suspended solids. Show the calculations to find the proper chlorinator feed setting (in pounds of chlorine per day), given the following information:

Average Plant Flow Rate	9.0 MGD	MLSS Conc.	2850 mg/L
RAS Flow Rate	3.3 MGD	MLVSS Conc.	2600 mg/L
WAS Flow Rate to DAF	1.2 MGD	RAS Conc.	8500 mg/L

15. A secondary effluent has a total BOD₅ of 45 mg/L. A BOD₅ test is run on this same secondary effluent at the same time using a nitrification “inhibitor”. Using the data for this test is given below, calculate the nitrogenous BOD (Assume a 300 mL BOD bottle is used to run this test).

Sample Size:	<u>30 mL</u>	<u>50 mL</u>	<u>Blank</u>
Initial DO, mg/L	8.9	8.8	9.0
Final DO, mg/L	6.0	4.2	8.9

ESSAY QUESTION

16. You work at a 2 MGD wastewater treatment plant that uses an aerobic digester to treat both primary clarifier sludge and waste activated sludge. Some consideration is being given to plant modifications that would substitute an anaerobic digester for the aerobic digester. Indicate and briefly discuss three ways in which this change might affect energy costs.

ANSWER KEY

GRADE III

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|----------|-------|-----------------|
| 1. True | 6. C | 11. 1.7 MGD |
| 2. False | 7. C | 12. 866 gpm |
| 3. False | 8. B | 13. 2110 mg/L |
| 4. True | 9. C | 14. 585 lbs/day |
| 5. True | 10. D | 15. 16.7 mg/L |

THINGS TO KEEP IN MIND

1. A one-page "Formulas and Equivalents" sheet is included in the front of each examination (see attachment).
2. All multiple choice questions have only one right answer.
3. On the math problems, including the multiple choice math, show all your work so that you might receive partial credit.
4. There are some sections (math on the Grade III) where you have to choose which problems to answer. Read through these sections and decide which problems you want to answer before you begin.
5. When the instructions say to work 7 out of the 8 problems, do not waste time working 8 of these problems – there is no extra credit for extra problems answered.
6. On the math and essay problems, if you only know part of an answer, by all means put it down! **SHOW YOUR WORK.**
7. **REMEMBER:** In order to pass, you must achieve an overall score of at least 70%. Also be aware that you are required, in addition, to score at least 50% on the math section of the examination to pass.

STATE WATER RESOURCES CONTROL BOARD OPERATOR CERTIFICATION EXAMINATION

EQUIVALENTS

1 acre = 43,560 square feet

1 cubic foot of water = 7.48 gallons

1 gallon = 8.34 pounds

1 day = 1,440 minutes = 86,400 seconds

1 million gallons/day = 694 gallons/minute = 1.547 cubic feet/second = 3.069 acre-feet/day

1% = 10,000 mg/L

$\pi = 3.14$

1 in. mercury = 1.133 feet of water

1 psi = 2.31 feet of water

1 HP = 0.746 Kw = 550 ft-lb/sec = 33,000 ft-lb/min

FORMULAS

Area of a rectangle = Length x Width

Area of a circle = $\frac{\pi}{4} \times \text{Diameter}^2 = 0.785 \times \text{Diameter}^2$

Volume of rectangular tank or circular tank with uniform depth = Area x Depth

Volume of cone = $\frac{1}{3} \times \text{Base Area} \times \text{Depth}$

Circumference = $\pi \times \text{Diameter}$

Velocity = $\frac{\text{Flow}}{\text{Area}}$

Detention time = $\frac{\text{Volume}}{\text{Flow}}$

Pounds/day = 8.34 x Flow, mgd x Concentration, mg/L

F/M = $\frac{\text{Pounds of BOD applied per day}}{\text{Pounds of MLVSS under aeration}}$

MCRT = $\frac{\text{Pounds of MLSS in secondary system (aeration tank + clarifier)}}{\text{Pounds of MLSS leaving secondary system per day (effluent + WAS)}}$

Water HP = $\frac{\text{Flow, gpm} \times \text{Total Head, ft}}{3960 \frac{\text{gpm} \cdot \text{ft}}{\text{HP}}}$

Brake HP = Power to electric motor x Motor efficiency
HP

Brake HP = Power to electric motor x Motor efficiency