

National Examination May 2010

**04-Env-B5 Industrial & Hazardous Waste Management**

*3 hours duration*

**NOTES:**

1. This examination has **FIFTEEN (15)** questions on 4 pages.
2. Each question is of the value indicated. There are *100 possible* marks for the examination.
3. This is a **CLOSED BOOK EXAM**. An 8 ½” x 11” aid sheet (both sides) Candidates may use one of two calculators, a Casio or Sharp approved models.
4. **If doubt exists as to the interpretation of any examination question, the candidate is urged to submit with the answer paper, a clear statement of any assumption made for the solution of the examination question.**
5. Clarity and organization of the answers are important.

**04-Env-B5 Industrial & Hazardous Waste Management**

- 3            3            1. What are the minimum nutrient requirements for biological wastewater treatment?
- 3            2. Name **3 (three)** circumstances under which you would select a physical/chemical waste water treatment process train to treat an industrial waste.
- 7            3. Sketch a typical bacterial growth curve and label the axis and the different phases.
- 10           4. You are the wastewater process consultant for seasonal canning industry which is generating a wastewater as the result of their production operations. You have estimated that the industry' average hydraulic load generated is as large as the nearby municipal wastewater treatment plant. You must advise your client on the most cost-effective wastewater management option available to them. Outline in some detail (but point form) the steps you would take to fulfill this assignment and state the rationale for those steps.
- 5            5. Given the following data, calculate the gas production rate from a chicken farm.

  chickens =   **200,000**  
  each hen produces an average of **0.00019** m<sup>3</sup>/d of manure  
  COD,  $C_1$  =   **150,000** g/m<sup>3</sup>  
  HRT of anaerobic reactor =   **12** days  
  growth rate,  $r_g$  =   **600** g/m<sup>3</sup>.d  
  fraction of COD removed,  $COD_{\text{fraction rem.}}$   
  =   **0.79**  
  CH<sub>4</sub> produced/kg COD destroyed =   **0.37** m<sup>3</sup>

- 6            6. An industry is being established and they must treat their wastewater generated from their production of widgets. Since the industry has not been built yet, there are no waste generation data. How would you go about getting the information you need to arrive at waste generation rates and waste characteristics?

**04-Env-B5 Industrial & Hazardous Waste Management**

- 5        7. How do you differentiate between a hazardous and an industrial wastewater? Would you use different waste treatment strategies? If so, outline in point format one (1) example of each.
- 8        8. Give an example when:  
           8.1 Plug-flow for a biological treatment process would be a good process choice.  
           8.2 Complete-mix for a biological treatment process would be a good process choice.
- 15       9. Identify in tabular form the important process design variables for:  
           9.1 a flow equalization tank  
           9.2 a membrane bioreactor  
           9.3 a conventional activated sludge process  
           9.4 an aerobic digester  
           9.5 an anaerobic digester  
           *Also state why each of the identified design variables is important.*
- 10       10. An industrial wastewater has the following characteristics:

PARAMETER	UNITS	50 percentile	90 percentile
Flow	m <sup>3</sup> /d	2,000	4,500
BOD <sub>5</sub>	mg/L	2,000	3,000
COD	mg/L	4,500	6,500
TKN	mg/L	80	140
TP	mg/L	20	40
Temperature	<sup>0</sup> C	24	30
pH	-	8	9

- 10.1 What is the significance of the 50 and 90 percentile information?  
 10.2 How would you approach the design of a wastewater treatment plant for this wastewater?

Make and state (in point form) any assumptions.

**04-Env-B5 Industrial & Hazardous Waste Management**

- 5 11. Given the following information:

Clean Water				
Temp.	<sup>o</sup> C	10	20	30
<b>C<sub>s</sub></b>	mg/L	11.27	9.02	7.44
<b>K<sub>La</sub></b>	hr <sup>-1</sup>		1.1	
<b>Theta</b>	1.0241			
<b>alpha</b>	0.50			
<b>beta</b>	0.95			

Calculate the minimum and maximum amount of oxygen (DO) that could be transferred to a wastewater.

- 6 12. You are asked to advise on a management strategy for waste pharmaceutical products. In point form, list the steps you would take. Are there any treatment options? If so, identify them in point form.
- 3 13. How do you manage liquid radioactive wastes?
- 6 14. A particular industrial waste contains a bio-inhibitory compound. You have determined that biological treatment would be the best process option if this bio-inhibitory compound were not present. Identify, and discuss in point form how you handle this problem.
- 8 15. When we talk about hazardous wastes, hazardous to what? to whom? Identify 6 industries that generate hazardous wastes, liquid and/or solid, the type of hazard they represent, and potential management strategies for them.