

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.

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- 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 ³ /d	2,000	4,500
BOD ₅	mg/L	2,000	3,000
COD	mg/L	4,500	6,500
TKN	mg/L	80	140
TP	mg/L	20	40
Temperature	°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.

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- 5 11. Given the following information:

Clean Water				
Temp.	^o C	10	20	30
C _s	mg/L	11.27	9.02	7.44
K _{Lα}	hr ⁻¹		1.1	
Theta	1.0241			
alpha	0.50			
beta	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.