

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

*3 hours duration*

**NOTES:**

1. This examination has **nineteen (19)** questions on 2 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) and one of two calculators is permitted, any 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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- 6 1. You are the consultant to a widget industry producing a process water at a rate of  $0.1 \text{ m}^3/\text{s}$  and containing a non-reactive organic material called X at a concentration of  $3,000 \text{ mg/L}$ . This effluent, if untreated, would be discharged into a river which has a minimum flow-rate of  $10 \text{ m}^3/\text{s}$ . An upstream competitor has already caused a river background level of  $20 \text{ mg/L}$  X under minimum flow-rate conditions. The Provincial Regulatory Agency has set a maximum limit of  $80 \text{ mg/L}$  X in the river (under minimum flow conditions). Based on your knowledge of similar industries you sense that perhaps no or only minimum treatment may be required.

*What are going to recommend to your client?*

Assume that complete mixing occurs in the river.

- 10 2. A small municipality of 9,000 has the following wastewater characteristics:  $400 \text{ Lpcd}$ ;  $\text{BOD}_5$   $190 \text{ mg/L}$ ;  $\text{SS}$   $225 \text{ mg/L}$ . It also has two industries: a cannery producing 4,000 tonnes of whole tomatoes and other canned goods over a seven month season, and a textile mill which produces 2,000 kg of cotton goods per day. Estimate the  $\text{BOD}_5$  and  $\text{SS}$  content of the municipal wastewater (a) with and (b) without these industries being served by the municipal system, and (c) determine the population equivalent (PE) of the cannery in terms of  $\text{BOD}_5$ . Typical domestic per capita contributions of  $\text{BOD}_5$  and  $\text{SS}$  are 76 and 90 gpcpd.
- 5 3. Name 3 substances that may cause toxicity in biological oxidation systems.
- 9 4. Name 9 waste constituents and the reasons why they have to be removed before discharge to a receiving body of water.
- 10 5. Identify (in point form) the steps you would take in conducting an industrial waste survey.
- 6 6. Name four procedures which allow you to estimate the organic content of an industrial wastewater. Identify what each procedure measures.
- 5 7. An industrial wastewater contains  $150 \text{ mg/L}$  ethylene glycol ( $\text{C}_2\text{H}_6\text{O}_2$ ). Calculate the COD and TOC. ( $\text{C} = 12$ ;  $\text{H} = 1$ ;  $\text{O} = 16$ ).
- 4 8. Name 3 basic factors you must address in the selection of a wastewater-treatment process or a combination of processes for an industry.
- 6 9. Name 6 basic purposes when you should consider equalization for an industrial wastewater treatment facility.

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- 4 10. When would you consider using coagulation for an industrial wastewater?
- 5 11. Define:
- a. Hazardous waste
  - b.  $K_{La}$
  - c. polymer
  - d. API separator
  - e. buffer
- 3 12. How are nuclear wastes managed?
- 5 13. Sketch a flow diagram of the fuel cycle for a heavy water reactor from mining to permanent disposal.
- 4 14. Identify a uranium mine tailings management strategy.
- 2 15. What is yellowcake? Describe.
- 3 16. Who in Canada administers the national guideline for biomedical waste management?
- 7 17. Construct a Table showing a summary of disposal options for untreated biomedical waste of Human Anatomical-, Animal-, Microbiology Laboratory-Waste, Human Blood & Body Fluids, Waste Sharps.
- 3 18. Identify 3 strategies that can be used to reduce fish toxicity from wastewater treatment plant effluents.
- 3 19. Identify 3 strategies to limit the discharge of pharmaceuticals and healthcare products to the aquatic environment.

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**100 TOTAL**