

**National Exams May 2003**

**98-Civ-A3, Environmental Engineering**

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. Candidates may use one of two calculators, the Casio or Sharp approved models. This is a Closed Book examination.
3. Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
4. All questions are of equal value.

1. (i) “Biochemical Oxygen Demand (BOD) is used as a surrogate parameter in controlling the impacts of wastewater discharges”. Explain this.

List and briefly discuss two other parameters used in quantifying organic content in wastewater discharges.

- (ii) A sewage treatment plant discharges its treated effluent having an ultimate BOD of 25 mg/L and a dissolved oxygen concentration of 2 mg/L into a stream at a rate of 500 L/s. The stream has a background ultimate BOD of 5 mg/L and a dissolved oxygen concentration of 8 mg/L. Calculate the following, assuming that the deoxygenation constant is 0.2/d and the stream flow rate is 10 m<sup>3</sup>/s:
- (a) the ultimate BOD and the reduction in dissolved oxygen concentration in the stream just downstream of the sewage effluent discharge point, and
- (b) the ultimate BOD of the stream 30 km downstream of the outfall, assuming that the stream has a constant cross sectional area and a fixed flow velocity of 0.4 m/s.

State any assumptions that you make.

2. (i) Discuss briefly the following:

- (a) Carbon cycle  
(b) Greenhouse effect  
(c) Chlorofluorocarbons  
(d) Stratospheric ozone depletion

- (ii) The concentrations of carbon dioxide in 1965 and 1990 were 320 and 355 ppm respectively. Assuming a simple exponential growth ( $C = C_0 e^{rt}$ ), determine the year in which the atmospheric concentration of carbon dioxide would be twice the pre-industrialization value of 280 ppm.

3. (i) Discuss the following terms with respect to drinking water treatment:

- (a) Coagulation
- (b) Flocculation
- (c) Filtration
- (d) Disinfection

(ii) Explain the term “water softening”.

Analytical results of a water sample shows that the concentrations of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  are 120 mg/L and 12 mg/L respectively. Calculate the hardness of this water in mg/L as  $\text{CaCO}_3$ .

(iii) The total alkalinity of a water sample is 60 mg/L as  $\text{CaCO}_3$ . Calculate the carbonate, bicarbonate and hydroxide alkalinities (as mg/L  $\text{CaCO}_3$ ), if the pH and the temperature of the sample are 10 and 25°C respectively. Assume that the dissociation constant at 25°C is  $4.8 \times 10^{-11}$  mole/L.

$$[ \text{Ca} = 40; \text{Mg} = 24; \text{C} = 12; \text{O} = 16; \text{H} = 1 ]$$

4. (i) Define the following terms and explain how these are used in assessing the impacts of pollutants on biota:

- (a) Acute toxicity
- (b) Chronic toxicity

(ii) Total ammonia nitrogen in wastewater discharges comprises of ammonia nitrogen ( $\text{NH}_3\text{-N}$ ) and ammonium nitrogen ( $\text{NH}_4^+\text{-N}$ ). If the pH and temperature of a wastewater discharge are 8 and 25°C respectively, calculate the percentage of each of these two forms of nitrogen in the wastewater. Assume that the equilibrium constant is  $1.82 \times 10^{-5}$  at 25°C.

Which of the two nitrogen forms is more toxic to fish in the receiving waters? Why?

(iii) What are the other forms of nitrogen present in wastewater besides total ammonia nitrogen?

5. Write short notes on the following:

- (i) Population pyramid
- (ii) Eutrophication
- (iii) Indicator organisms
- (iv) Rotating biological contactor
- (v) Biosolids (sludge) treatment

6. (i) Discuss the major phases of an environmental impact assessment?

(ii) Briefly outline the intent of any three important Acts or Regulations in your Province used to protect the environment.

7. (i) Describe the various types of environmental conflict resolution.

(ii) Prepare a checklist of potential environmental impacts during construction phase of a transportation project.

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#### Marking Scheme

1.	(i)	10
	(ii)	10
2.	(i)	12
	(ii)	8
3.	(i)	8
	(ii)	4
	(iii)	8
4.	(i)	6
	(ii)	10
	(iii)	4
5.	(i)	4
	(ii)	4
	(iii)	4
	(iv)	4
	(v)	4
6.	(i)	14
	(ii)	6
7.	(i)	10
	(ii)	10