National Exams December 2003

98-BS-16, 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) What are the impacts of discharging oxygen-demanding wastewater into a natural receiving waterbody?

Discuss the various parameters that are used to quantify such wastes, explaining their basic differences.

(ii) A stream with a flow of 15 m^3/s and a total phosphorus concentration of 10 ppb feeds into a lake having a surface area of 80 million square metres. In addition, effluent from a sewage treatment plant is also discharged into the same lake. The flow rate and the total phosphorus concentration of the treatment plant effluent are 0.2 m^3/s and 5 mg/L respectively. Assuming that the phosphorus settling rate is estimated at 10 m/year,

(a) Estimate the average total phosphorus concentration of the lake.

(b) What percentage of phosphorus removal is required at the sewage treatment plant if the lake phosphorus concentration is not to exceed 10 ppb?

2. (i) List the ecological effects of air pollutants such as total suspended particulates, sulphur dioxide and nitrogen dioxide on humans, plants, soil/microorganisms and climate/atmosphere.

(ii) (a) An air quality standard for nitrogen dioxide is given as 0.46 mg/m^3 at 1 atm of pressure and at a temperature of 25°C. Express the concentration in ppm, clearly stating all the assumptions that you made.

(b) What is the advantage of expressing an air quality standard in ppm compared to mg/m^3?

[N = 14; O = 16]

3. (i) Discuss briefly the basic unit processes used in the treatment of drinking water, using a typical process schematic.

(ii) Explain the potential for the formation of trihalomethanes (THMs) in the treatment of drinking water supplies.

What steps can be taken to minimize the formation of THMs during the treatment process?

(iii) The analytical results of a water sample are as follows:

CO_3^{2-} 45 mg/L
HCO_3^- 61 mg/L
pH 10

Calculate the alkalinity of this water in mg/L as $CaCO_3$, assuming that the atomic weights are:

Ca = 40; H = 1; C = 12; O = 16.

4. (i) Explain the term "bioassay". List the ideal characteristics for indicator species in bioassays, explaining why each characteristic is important.

(ii) What are the two constituents in a typical sewage treatment plant effluent that are commonly associated with causing toxicity in receiving waterbodies?

Explain the measures that can be implemented at the treatment plants (or in the treatment processes) to reduce or eliminate effluent toxicity.

(iii) Briefly discuss the processes "nitrification" and "denitrification" as used in the treatment of municipal wastewater.

Explain the relative importance of these two processes depending on whether the effluent is discharged to a surface waterbody or into the groundwater.

5. Write short notes on the following:

(i) Water hardness
(ii) Population momentum
(iii) Activated sludge process
(iv) Eutrophication
(v) Landfill leachate control

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

(ii) Describe the various techniques available for quantitative environmental impacts identification.

7. Discuss the environmental impacts of urbanization using a tabular form with atmosphere, hydrosphere, lithosphere and human impacts as environmental components, and population, land use, transportation and services as urban components to facilitate your discussion.

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Marking Scheme

1.	(i)	6
	(ii)	14
2.	(i)	12
	(ii)	8
3.	(i)	7
	(ii)	6
	(iii)	7
4.	(i)	6
	(ii)	4
	(iii)	10
5.	(i)	4
	(ii)	4
	(iii)	4
	(iv)	4
	(v)	4
6.	(i)	6
	(ii)	14
7.		20