

National Exams December 2004

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) Explain the difference between “carbonaceous biochemical oxygen demand” and “nitrogenous biochemical oxygen demand” using appropriate sketches.

Discuss briefly two other parameters used in quantifying organic content in municipal 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 m³/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) List some of the ecological effects of the following air pollutants on humans/wildlife, plants, soil/microorganisms and climate/atmosphere:
- (a) Sulphur dioxide
 - (b) Nitrogen dioxide
 - (c) Total suspended particulates
- (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.
- (iii) What is the advantage of expressing an air quality standard in ppm compared to mg/m³?

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

(ii) Explain the term “water softening”.

Analytical results of a water sample shows that the concentrations of Ca^{2+} and Mg^{2+} are 120 mg/L and 12 mg/L respectively. Calculate the hardness of this water in mg/L as CaCO_3 .

(iii) Explain the term “alkalinity”.

If a water sample shows that it has 40 mg/L of CO_3^{2-} , 80 mg/L of HCO_3^- and a pH of 9.0, determine the alkalinity of this water in mg/L as CaCO_3 .

[Ca = 40; Mg = 24; C = 12; O = 16; 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) 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) Nitrogen analysis of a wastewater sample gave the following results:

Ammonia	17.0 mg/L
Ammonium	18.0 mg/L
Nitrite	0.46 mg/L
Nitrate	1.24 mg/L
Organic Nitrogen	10.0 mg/L

Calculate the total concentration of nitrogen in the sample, assuming that the atomic weights of N, O and H are 14, 16 and 1 respectively.

5. Write short notes on the following:

- (i) Population momentum
- (ii) Activated sludge process
- (iii) Indicator organisms
- (iv) Biosolids (sludge) treatment
- (v) Stratospheric ozone depletion

6. (i) List and 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 techniques available for quantitative environmental impacts identification.

- (ii) Discuss the environmental impacts of urbanization. Use 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.

National Exams December 2004

98-BS-16, Environmental Engineering

Marking Scheme

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