UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2003/2004

February/March 2004

KAA 508 – Environmental Pollution and Monitoring Techniques

Time : 3 hours

Please make sure that this paper consists of FIVE printed pages before anwering the questions.

Answer **FIVE** questions. Only the first five questions answered by the candidate will be marked.

1. (a) Compare and contrast BOD and COD analyses.

(7 marks)

(b) The following dissolved oxygen (DO) values were found after five days of incubation in 300 mL BOD bottles : 7.7, 7.9 and 7.9 mg/L in three blank samples; 6.5, 4.0 and 0.5 mg/L in bottles containing 2, 5 and 10 mL of sample, respectively. The 0-day dissolved oxygen of the sample was 0.0 mg/L. What was the most probable 5-day BOD of the sample ?

(7 marks)

(c) Analyses for various nitrogen forms were made at three points in a river and the results are as follows :

Point	**Location**	**DO, mg/L**	**Nitrogen Concentration, mg/L**			
			Org-N	**NH_3-N**	**NO_2^--N**	**NO_3^--N**
1	Point of discharge	7	3	4	0	0
2	5 km downstream	2	1	2	1	3
3	10 km downstream	0	1	0	0	2

Explain the relative change in each nitrogen form and the decrease in total nitrogen in moving downstream from point 1 to point 3.

(6 marks)

2. (a) Describe the various metal speciation techniques developed over the years.

(10 marks)

(b) The reaction between a metal complex, ML, (L is a polyfunctional ligand) and chelex ion exchange resin can be expressed as :

$$ML + Chelex \xrightarrow{k_1} M + L + Chelex \xrightarrow{k_2} M - Chelex + L$$

Show that the rate of formation of M-Chelex is determined by the rate of dissociation of ML.

(10 marks)

3. (a) Give an example of actual compound (name or structure) for each of the following type of organic pollutants:

(i) Volatile pollutants
(ii) Hydrocarbons
(iii) Trihalomethane
(iv) GRO-Gasoline Range Organics
(v) DRO-Diesel Range Organics
(vi) Persistent Organic Pollutants
(vii) Organochlorine pesticides (OCP)
(viii) Polynuclear aromatic hydrocarbons (PAH)
(ix) Phthalate esters
(x) Chlorinated phenols.

(10 marks)

(b) Discuss five factors that characterize persistent organic pollutants (POPs).

(5 marks)

(c) Discuss five extraction methods for organic pollutants in water.

(5 marks)

4. The Gaussian dispersion model for the pollutant concentration downwind from a ground-level point source is :

$$C(x, y, z) = \frac{Q}{\pi u \sigma_y \sigma_z} \exp\left[-\frac{1}{2}\left(\frac{y^2}{\sigma_y^2} + \frac{z^2}{\sigma_z^2}\right)\right]$$

where Q is the source emission rate, σ_y and σ_z the horizontal and vertical dispersion coefficients, respectively, and u the wind speed in x direction.

A tanker carrying liquid chlorine was involved in an accident. As a result, chlorine gas was released from a leak in the tanker at 30 kg/min. A 4-storey residential flat is located at a distance of 300 m downwind of the accident. Assume that : (i) the wind speed is 3 m/s, (ii) the threshold value for chlorine is 3 mg/m^3 and (iii) the dispersion coefficients are

$$\sigma_y = 0.36\, x^{0.86}; \quad \sigma_z = 0.33\, x^{0.86}$$

where σ_y, σ_z and x are in km.

(a) Is it necessary for the flat residents to leave the building? Assume that each floor is of 4 m in height.

(8 marks)

(b) Estimate the distance downwind of the accident location which is forbidden to the public.

(6 marks)

(c) The fire department has proposed to douse the tanker with water to prevent explosion. Is this measure effective?

(6 marks)

5. (a) Describe the automatic, active and passive sampling methods in air pollution monitoring. Comment on the advantages and disadvantages of each method.

(10 marks)

(b) Discuss the roles of hydrocarbons, ozone and hydroxyl radical in the formation of photochemical smog.

(10 marks)

6. (a) Describe the preparation and scope of work required for an EIA study on a sewage treatment plant project to be sited at the coastal area.

(12 marks)

(b) Discuss the issues pertaining to the EIA process.

(8 marks)

-ooo O ooo-