

The Open University of Sri Lanka

B.Sc. Degree Programme 2011/2012

Environmental Chemistry - CHU 3122 / CHE 3122

FINAL EXAMINATION

Two (02) hours



Date: 24.11.2012

Time: 9.30 am – 11.30 am

ANSWER ANY FOUR (04) QUESTIONS

1. a. i. Define the terms primary pollutant and secondary pollutants as applied to environmental chemistry.
 - ii. Classify the following pollutants as primary pollutants or secondary pollutants.
NO, NO₂, CO, O₃ and SO₂.

(20 marks)
- b. Indicating the characteristics of the regions, draw the temperature profile of the atmosphere up to an altitude of 50 km. Explain the variation of temperature within.

(40 marks)
- c. Briefly describe the atmospheric sources, sinks and environmental effects of CO and CH₄.

(40 marks)
2. a. i. Write the conditions necessary for the formation of photochemical smog.
 - ii. Draw and explain the diurnal variation of concentration of components of photochemical smog on a smoggy day.
 - iii. Write equations to show the formation of ozone and PAN.

(60 marks)
- b. i. Draw the Nitrogen cycle.
 - ii. Discuss the important steps involved in nitrogen cycle.
 - iii. How will excessive use of N – based fertilizers affect the natural nitrogen cycle?

(40 marks)

- 3.a. i. What do you mean by acid rain.
 ii. Write the sources and sinks of SO_2 and NO_x
 iii. Briefly describe the effects of acid rain on water bodies and materials.

(50 marks)

- b. i. Draw the variation of concentration of stratospheric ozone.
 ii. Briefly describe the environmental effects of the use of chlorofluorocarbons in industrial applications.

(25 marks)

- c. i. Briefly explain the phenomenon, 'global warming'
 ii. Identifying the major cause(s) of global warming, briefly describe its consequences.

(25 marks)

- 4.a. i. Give the unique properties of water and their significance in biosphere.
 ii. Lakes are generally classified into three types. What are they? What are their characteristics?

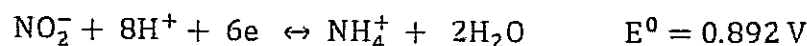
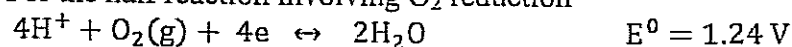
(30 Marks)

- b. i. What is meant by 'thermal stratification' of a lake?
 ii. Draw a labelled diagram to illustrate stratification of a lake in a temperate climate, showing the typical forms of the main elements in it.

(30 marks)

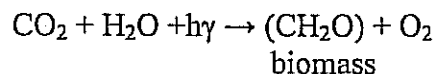
- c. i. Define the term pE.
 ii. What is the use of a pE – pH diagram?
 iii. How does pE vary with depth in a stratified lake? Explain.
 iv. Calculate the equilibrium partial pressure of oxygen (P_{O_2}) in a water sample containing equal concentrations of nitrite, NO_2^- and ammonium ion, NH_4^+ at $\text{pH} = 7$.

For the half reaction of nitrite to ammonia

For the half reaction involving O_2 reduction

(40 marks)

- 5.a. In photosynthesis, Inorganic carbon is converted to biomass according to the following equation.



If the total inorganic carbon concentration (mol dm^{-3}) at $\text{pH} = 7$ and $\text{pH} = 10$ are given as 1.22×10^{-3} and 6.82×10^{-4} respectively, calculate the increase of biomass at high pH. Express your answer in mg dm^{-3} .
[C = 12; H = 1; O = 16]

(30 marks)

- b. i. Write down the mathematical expression for the Henry's Law and identify the terms in it.
- ii. Calculate the pH of a solution of ammonia in equilibrium with NH_3 gas having a partial pressure of 5.06×10^3 Pa at 25°C . For NH_3 , Henry's law constant, K_H is $5.7 \times 10^{-4} \text{ mol dm}^{-3} \text{ Pa}^{-1}$; K_b for $\text{NH}_3 + \text{H}_2\text{O} \leftrightarrow \text{NH}_4^+ (\text{aq}) + \text{OH}^-$ is $1.8 \times 10^{-5} \text{ mol dm}^{-3}$.

(30 marks)

- c. i. Define the terms BOD and COD.
- ii. What is the BOD of water in which 10 mg of sugar (empirical formula, CH_2O) is dissolved in a litre?
- iii. Why do the COD analysis and BOD_5 analysis usually give different results for the same wastewater?

(40 marks)

6. a. i. Define the term 'Alkalinity'
- ii. Titration of 100 ml of river water with 0.100 M HCl solution consumes 2.85 ml HCl to the methyl orange equivalence point. Calculate the total alkalinity in
- equivalent of acid per litre (eq L^{-1})
 - $\text{mg L}^{-1} \text{CaCO}_3$

(30 marks)

- b. i. Write two examples of each of linear and ring poly phosphates.
- ii. Give two uses of polyphosphates in industry.
- iii. Show by chemical equation the ultimate product of polyphosphate hydrolysis.
- iv. Briefly describe the environmental consequence resulting from the presence of significant amount of phosphate in water.

(20 marks)

- c.
- i. What is hard water?
 - ii. Differentiate between temporary and permanent hardness.
 - iii. A 25 cm^3 of tap water is titrated against 0.1 mol dm^{-3} EDTA solution to the Eriochrome black T indicator end point. This requires 14.40 cm^3 of EDTA solution. Calculate the hardness of water in ppm of Ca^{2+} .

(30 marks)

- d. List four metal ions that may be present in a waste water system. Indicate their sources in industry.

(20 marks)