THE OPEN UNIVERSITY OF SRI LANKA

B. Sc . / B. Ed. DEGREE PROGRAMME /STAND ALONE COURSES IN SCIENCE

CHU 3122 / CHE 3122 /CHI 3122/CHI 3122 – LEVEL 5

FINAL EXAMINATION - 2010/2011

(2 ½ hours)

DATE: 12.01 2011 **TIME : 9.30 a.m.– 12.00 noon**

ANSWER ANY **FOUR** QUESTIONS.

IF MORE THAN FOUR QUESTIONS ARE ANSWERED, **ONLY THE FIRST FOUR ANSWERS WILL BE MARKED.**

1. The atmosphere is an envelope of gases surrounding the Earth and forms important functions. It shows different characteristics within different strata. Unfortunately, it has been a reservoir that receives many pollutants, which is the subject of debate at present.

   (a) Identifying the components of the unpolluted atmosphere, indicate the important functions of the atmosphere. (30 marks)

   (b) Explain what is meant by 'greenhouse effect' and **briefly** describe the consequences of global warming. (20 marks)

   (c) Draw and **briefly** explain the temperature structure of the atmosphere up to 50 km. Indicate the characteristics of the region(s) in it. (50 marks)

2. (a)(i) Defining the terms "source" and "sink" as used in environmental chemistry, **briefly** describe the sources, sinks and environmental effects of SO_2, NO_2 and CFC.

   (ii) Draw the oxygen cycle and identify the anthropogenic activities that can affect the oxygen cycle. (80 marks)

   (b) Briefly describe the sources, sinks and health effects of CO in the atmosphere. (20 marks)

3. (a)(i) Giving examples, distinguish between primary air pollutants and secondary air pollutants.

   (ii) Giving the conditions necessary for the formation of photochemical smog, account for the formation of products ozone and PAN in it.

(iii) Write the harmful health effects of ozone and PAN. (70 marks)

(b)(i) What is meant by the threshold limit value, TLV?

(ii) Briefly explain the effects of exposure to mixtures of airborne toxic substances on human health. (30 marks)

4. (a) Write down four unique properties of water. What is the effect of each of these properties on life? (20 marks)

(b)(i) What is meant by 'thermal stratification'?

(ii) Draw a labelled diagram to illustrate stratification of a lake in the summer, showing the typical forms of the main elements. (20 marks)

(c)(i) What is meant by the term "Dissolved Oxygen"(DO)? What is the importance of (DO)?

(ii) Fish need at least 5 ppm dissolved O_2 for survival.

(α) What is this concentration in mol/dm^3?

(β) What partial pressure of O_2 above the water is needed to obtain this concentration at 25^0C? (The Henry's law constant for O_2 at 25 ^0C is $1.3x10^{-2}$ mol dm^{-3} atm^{-1}) (40 marks)

(d)(i) What do you mean by the term 'productivity' of a water body?

(ii) Briefly explain how it is related to water quality. (20 marks)

5. (a)(i) What is meant by acid rain? What are the anthropogenic sources of acid rain?

(ii) The concentration of Al^{3+} in natural waters normally is quite small; however it increases in the presence of acids. What is the adverse effect of high concentration of Al^{3+} on fish? (30 marks)

(b)(i) What is meant by the pE of an aqueous solution?

(ii) What does a low pE value imply about solution?

(iii) Consider the reduction of nitrate ion in an acidic aqueous solution to ammonium ion.

(I) Write a balanced equation for the **one electron half reaction** for the process.

(II) Given that for this reaction, $E^0 = 0.880$ volts, calculate pE^0.

(III) Deduce a relationship between pE and pE^0 for the above half reaction.

(IV) From the expression in part (III), obtain an equation relating pE to pH under conditions in which the concentration of $[NO_3] = [NO_2]$. What will be the pE when pH of the solution is 5? (70 marks)

6. (a) Describe the process of eutrophication. (15 marks)

(b)(i) What is hard water?

(ii) Differentiate between temporary hardness and permanent hardness.

(iii) Permanent hardness can be removed by adding washing soda, $Na_2CO_3 .10H_2O$, to the water to precipitate calcium carbonate which can then be removed by filtration. Calculate the of washing soda required to soften 1000 litres of hard water containing 250 mg L^{-1} Ca^{2+}. (Relative atomic mass: Na = 23, C = 12, O =16 , H = 1 and Ca = 40) (40 marks)

(c) List four metal ions that may be present in a waste water system. Indicate their sources in industry. (20 marks)

(d)(i) In a water treatment process, filter alum $Al_2(SO_4)_3.18H_2O$ is used as a coagulant. What does this process/reaction remove from water?

(ii) Write equations to show its action during the process. (25 marks)

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