THE OPEN UNIVERSITY OF SRI LANKA

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

FINAL EXAMINATION- LEVEL 5- 2008/2009

CHU 3122/ CHE 5122- ENVIRONMENTAL CHEMISTRY

(2 ½ hours)

Wednesday 1ˢᵗ January 2009	**1.00 p.m.- 3.30 p.m.**

ANSWER ANY **FOUR** QUESTIONS.

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

1. (a) The temperature structure of the atmosphere is given below. The temperature undergoes several inversions within the atmosphere.
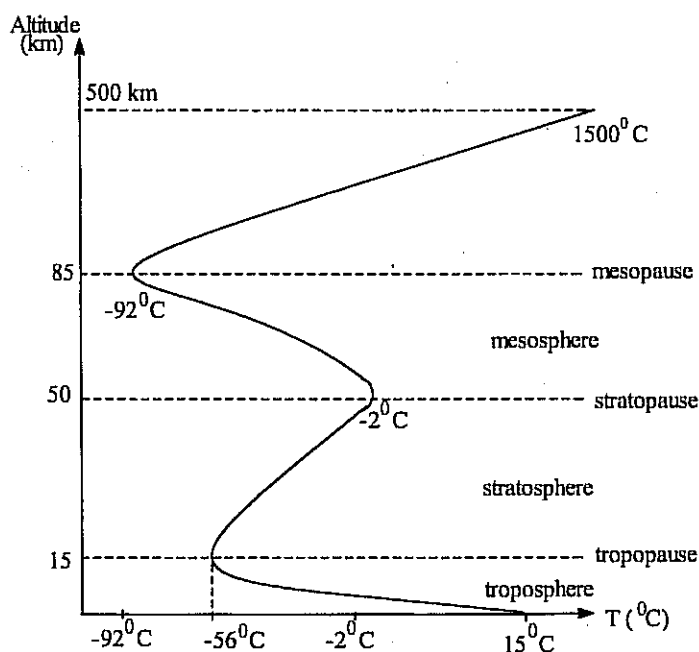
(i) Write the function of the atmosphere

(ii) Explain the variation of temperature up to 50 km.

(iii) Write down the constituents/components in the different regions of the atmosphere.

(iv) Write the sources and sinks of atmospheric oxygen. Identify the anthropogenic activities that can affect the oxygen cycle

(50 marks)

(b) (i) Briefly explain how the concentrations of CO and CH_4 increase in the atmosphere.
(ii) Explain the environmental effects of CO and CH_4.
(iii) What are their major sinks? (30 marks)

(c) Describe the sources and environmental effects of radon and formaldehyde
(20 marks)

2. (a) (i) In the stratosphere ozone is beneficial to human health whereas in the troposphere it is detrimental to human health. Discuss this statement.
(ii) Outline the chemical reactions which lead to the destruction of ozone by CF_2Cl_2 in the stratosphere.
(iii) What harm is done by global ozone depletion? (50 marks)

(b) Three processes in the nitrogen cycle are given below.
Process A - Nitrogen fixing
Process B - Nitrification
Process C - Denitrification

(i) Construct the nitrogen cycle and label these processes.
(ii) Indicate where Process A takes place.
(iii) Write other processes (in addition to bacteria) by which nitrogen fixation occurs.
(iv) Explain what is meant by nitrification and denitrification.
(50 marks)

3. (a) The amount of CO_2 in the atmosphere is slowly increasing.
(i) Suggest two reasons why this is happening.
(ii) Briefly explain the processes involved in "greenhouse effect".
(25 marks)

(b) Catalytic converters are fitted into motor vehicle exhaust systems to reduce the emission of pollutants.
(i) What are the pollutants present in the vehicle exhausts?
(ii) Explain, using equations, how these pollutants are produced in motor vehicles.
(iii) How do catalytic converters treat with the exhaust gases of motor vehicles?
(25 marks)

(c) (i) All rain water is weakly acidic. Explain why this is so.
(ii) Explain how acid rain affects, trees, fish, building materials.
(iii) Briefly describe Photochemical smog, giving the conditions necessary for its formation and its physical characteristics.
(iv) Explain the harmful effects of PAN, aldehydes and O_3.
(50 marks)

4 (a) (i) How are the living organisms in aquatic ecosystems classified? Give examples of each type.
(ii) What do you mean by 'eutrophication'?
(20 marks)

(b) (i) What is meant by the pE of an aqueous solution?
(ii) What does a low pE value imply about the solution?
(iii) How would you expect pE to vary with depth in a stratified lake?
(iv) Calculate the concentration of Fe^{2+} in equilibrium with $Fe(OH)_{3(s)}$ at pH 6.00 and pE 2.58. pE^o for the equilibrium $Fe^{3+} + e \longrightarrow Fe^{3+}$ is 13.2 and the equilibrium constant for $Fe(OH)_3 + 3H^+ \longrightarrow Fe^{3+} + 3H_2O$ is 9.1×10^3.
(40 marks)

(c) (i) State Henry's Law.

(ii) In an enclosed container there is 100 ml of an aqueous solution containing 0.5 g of acetone (CH_3COCH_3). Calculate the equilibrium vapour pressure of acetone above the solution. The value of Henry's constant, K_H for acetone is 3.9×10^{-3} molL^{-1} Pa^{-1}.   (Relative atomic mass for H=1; C = 12 ; O = 16)

(30 marks)

(d) Write two reasons as to why soap is environmentally less harmful than detergents.

(10 marks)

5. (a) (i) What do you understand by the terms " total alkalinity" and "Phenolphthalein alkalinity"?

(ii) A 100.0 cm^3 sample required 15.00 cm^3 of 0.04 mol dm^{-3} H_2SO_4 to reach the phenolphthalein end point and 30.20 cm^3 to reach the methyl orange end point. Calculate the phenolphthalein alkalinity and total alkalinity of the sample.

(50 marks)

(b) (i) Define the term Biochemical Oxygen Demand .

(ii) Calculate the BOD resulting from the discharge of 500 g of n – propanol (C_3H_8O) into the water body of capacity 10^8 liters.

(20 marks)

(c) (i) Briefly describe the types of polyphosphates by giving two examples for each type.

(ii) Write the name of the polyphosphate used in detergent, and the environmental problems that you envisage.

(iii) What is the ultimate product of polyphosphate hydrolysis?

(30 marks)

6. (a) (i) List **four** metal ions and **four** ligands that can be present in wastewater.

(ii) Identify **one** anthropogenic source for each of them.

(40 marks)

(b) Describe the conditions manifested in 'Minamata' disease and 'itai itai' disease and identify the heavy metal responsible and their sources, both natural and anthropogenic.

(30 marks)

(c) Radionuclides are a health concern and with their current use in nuclear industry, it is becoming even more worrying because of nuclear disasters like that in Chernobyl.

(i) What radionuclide(s) would be most dangerous in terms of the half- life?

(ii) Briefly describe the effect(s) of radionuclide on human.

(iii) A sample of water contaminated by the accidental discharge of a radionuclide used for medicinal purposes showed an activity of 12436 counts per second (cps) at the time of sampling and 8966 cps exactly 30 days later. What is the half- life of the radionuclide?

(30 marks)

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