

The Open University of Sri Lanka  
B.Sc. Degree Programme / Continuing Education Programme  
Environmental Chemistry- CMU3129/CME5129  
Final Examination- 2015/16  
Duration: 2 hours



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Date: 03.07.2016

Time: 9.30 a.m. – 11.30 a.m.

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ANSWER ANY FOUR (04) QUESTIONS.

If more than four questions are answered only first four answers will be marked.

1.a. Our atmosphere is an extraordinary mixture of gases varying in reactivity and quantity. New materials are being added continuously to the atmosphere due to both natural and anthropogenic activities which have an impact on the environment.

- i. Write down the major constituents in the Earth's atmosphere.
- ii. Identifying the constituents, briefly describe the function of the atmosphere.
- iii. Defining the term 'residence time', relate it to the availability of atmospheric constituents in (i).
- iv. Briefly describe the phenomenon that heats up the troposphere. Draw and explain the temperature profile of the troposphere.
- v. What do you mean by 'thermal inversion'? Draw the corresponding temperature profile. Write an adverse effect of thermal inversion.

(70 marks)

- b.
  - i. What do you mean by 'global warming'?
  - ii. Briefly describe **three** consequences of global warming.
  - iii. Briefly explain **two** steps that can be taken to mitigate global warming.

(30 marks)

- 2.a.
  - i. What do you mean by 'acid rain'?
  - ii. If burning of coal is the only source of acidic oxides, briefly describe the formation of acid rain.
  - iii. Write **three** adverse effects of acid rain on the environment.

(30 marks)

- b. Atmospheric pollution has reached alarming proportions with increasing vehicular emissions in major cities in the developing world. One such pollution phenomenon is photochemical smog.

- i. Write the conditions necessary for photochemical smog
- ii. Write equations for the formation of the chemical constituents of smog
- iii. Identifying each of the constituents, briefly describe their adverse effects.

**(50 marks)**

- c. Water becomes ice at 0 °C and is less dense than its liquid counterpart. As a result, newly formed ice is able to float on the surface of the water bodies, even though it is in a solid state. Describe the significance of this effect in terms of aquatic life.

**(20 marks)**

- 3.a. Define the following terms as applied in Environmental Chemistry.

- i. Productivity of a water body
- ii. Biochemical Oxygen Demand
- iii. Eutrophication
- iv. Hard water

**(20 marks)**

- b. i. State the Henry's Law.

- ii. Calculate the approximate pH of a rain water in an area where the partial pressure of SO<sub>2</sub> in the atmosphere is 10 Pa. For SO<sub>2</sub>, Henry's Law constant,  $K_H = 1.0 \times 10^{-5} \text{ mol dm}^{-3} \text{ Pa}^{-1}$ . For H<sub>2</sub>SO<sub>3</sub>,  $pK_{a1} = 3$ . Assume that SO<sub>2</sub> is the only acidic species present in the atmosphere and the second dissociation of H<sub>2</sub>SO<sub>3</sub> is negligible.

**(30 marks)**

- c. i. Write the equations for the formation and destruction of stratospheric ozone.

- ii. Briefly write the beneficial effect of stratospheric ozone.

**(20 marks)**

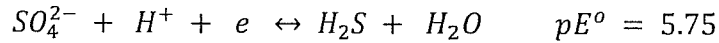
- d. Briefly describe the environmental significance of chelating agents in natural water bodies.

**(30 marks)**

- 4.a. Environmental Chemists use the concept of pE to characterize the extent to which natural waters are chemically oxidizing/reducing in nature.

- i. Define pE.
- ii. A sample from a lake gave a  $pE = -11.2$ . Comment on the chemical condition of this lake.
- iii. Calculate the partial pressure of H<sub>2</sub>S when sulphate ion (SO<sub>4</sub><sup>2-</sup>) concentration is 10<sup>-5</sup> M and the pH is 6.0 for water that is in equilibrium with atmospheric oxygen.

You are given that the partial pressure of  $O_2$  is 0.21 atm and the  $pE^o$  value for the following redox reactions.



Comment on your answer.

**(50 marks)**

- b. Chemical Oxygen Demand (COD) is one of the parameters for the assessment of the quality of an effluent.
- Define COD of a water sample.
  - Describe the method for the estimation of COD.
  - What is the chief limitation of the COD test?

**(30 marks)**

- c. Write short notes on the following.

- Incineration of waste
- Disinfection of water by chlorine

**(20 marks)**

- 5.a.
- Name the important species that can contribute to alkalinity in natural water bodies.
  - What is meant by the statement "The total alkalinity of natural water bodies is  $1 \times 10^{-3}$  equivalents of  $H^+$  per liter (Eq/L)?"
  - What is the total alkalinity in mg  $CaCO_3$  /L for a river water sample requiring 21.25 ml of 0.01 M  $H_2SO_4$ ?

**(30 marks)**

- b.
- Describe clearly the processes involved in the primary and secondary wastewater treatment.
  - Give the substances that are removed during primary and secondary treatment of wastewater?

**(30 marks)**

- c. i. Name **three** major classes of pesticides. Give **one** example for each class.

DDT has been used widely to control mosquitoes. It had been a successful insecticide. However its use was discontinued by many countries.

- ii. What properties made DDT a successful insecticide?
- iii. Why was the use of DDT discontinued in many countries?
- iv. What are the compounds that replaced DDT?

**(20 marks)**

- d. i. Describe the activated sludge process of secondary treatment of wastewater.

**(20 marks)**

- 6.a. i. What is meant by the term 'soil profile'?
- ii. Discuss the characteristic features of different horizons of soil.

**(30 marks)**

- b. i. Define the term 'Cation Exchange Capacity' (CEC) of soil.
- ii. Explain how CEC maintains soil fertility.

**(20 marks)**

- c. i. What is meant by the term 'soil pollution'?
- ii. Give major routes of soil pollution.
- iii. Briefly explain how soil pollution leads to air and water pollution.

**(20 marks)**

- d. Municipal solid wastes usually are rich in organic materials and often wet. Therefore composting is considered as one of the appropriate ways to process municipal waste to a useful product. Composting is a biological process that is influenced by various factors. Explain the effect of the following factors on composting process.

- i. Moisture content
- ii. Temperature
- iii. Carbon to Nitrogen ratio (C: N ratio)

**(30 marks)**

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