BINDURA UNIVERSITY OF SCIENCE EDUCATION
CHEMISTRY DEPARTMENT

COURSE: CH424 ENVIRONMENTAL CHEMISTRY

2 HOURS

ANSWER QUESTIONS ONE AND FOUR OTHERS.TWO FROM EACH OF THE SECTIONS, A AND B. EACH QUESTION CARRIES 20 MARKS

1. (a) (i) Define the term renewable energy. [1 mark]

(ii) What is meant by the term carbon debt for fuels? [1 mark]

b) (i) Define the term free radical and give two examples relevant to stratospheric chemistry. [3 marks]

(ii) What type of gases are being phased out according to the Montreal protocol? [1 mark]

(c) Define the following terms:

(i) Geoengineering.

(ii) Solar radiation management. [2×1 marks]

(d) (i) What is meant by the term carbon sequestration? [1 mark]

(ii) Define the two meanings of the term carbon intensity. [2 marks]

(e) Define the following terms:

(i) Biological oxygen demand (BOD).

(ii) Chemical oxygen demand (COD). [2 ×1marks]

(f) (i) What does DBP stand for in the purification of water by chlorination? [1 mark]

(ii) What is meant by reductive degradation in the purification of wastewater? [2 marks]

(g) (i) What is meant by speciation in environmental problems? [2 marks]

(ii) Name two compounds on the United Nations persistent organic pollutant (POP) list. [2 marks]

SECTION A: ANSWER ANY TWO QUETIONS

2. (a) Explain why ozone destruction via the reaction of ozone with atomic oxygen does not occur to a significant extent in the lower stratosphere. [5 marks]

(b) Describe the process by which chlorine becomes activated in the Antarctic ozone hole phenomenon. [5 marks]

(c) (i) What chemical substance initiates the air oxidation of stable molecules? [1 mark]

(ii) How is the chemical substance formed and reformed in the atmosphere in (i) above? [4 marks]

(d) What are the two steps, and the overall reaction, by which X species such as ClO catalytically destroy ozone in the middle and upper stratosphere via Mechanism I? [5 marks]

3. (a) (i) What is meant by positive and negative feedback? [2 marks]

(ii) Give an example of each as it affects global warming. [4 marks]

(b) List the five main global sources of primary commercial energy. [5 marks]

(c) List two advantages and two disadvantages of producing and using biofuel rather than petrodiesel. [4 marks]

(d) Describe how a hydrogen fuel cell works. [5 marks]

4. (a) (i) Explain the chemistry underlying the disinfection of water by chlorination. [5 marks]

(ii) Explain why excess nitrate in drinking water or food products can be a health hazard, include the relevant balanced chemical reaction showing how nitrate becomes reduced. [4 marks]

(b) (i) What are the two important oxidation states of chromium? [2 marks]

(ii) Which one is more toxic? [1 mark]

(c) In what way are organophosphate insecticides considered superior to organochlorines as pesticides? [2 marks]

(ii) In what way are they more dangerous? [3 marks]

(d) Other than the chlorophenols and PCBs, what are some of the other sources of dioxins and furans in the environment? [3 marks]

SECTION B: ANSWER ANY TWO QUESTIONS

5. (a) (i) Define the term environmental estrogen. [2 marks]

(ii) Name the four postulated effects of environmental hormones on human health. [4 marks]

(b) List the three conditions that must be fulfilled if bioremediation of soil is to be successful. [3 marks]

(c) Define phytoremediation and list the three mechanisms by which it can operate. [5 marks]

(d) (i) Define the term leachate. [1 marks]

(ii) Explain how the leachate arises. [1 mark]

(iii) List four components of the leachate. [4 marks]

6. (a) (i) Define the hardness index for water. [1 marks]

(ii) What is the value of the hardness index for a 500 mL sample of water that contains 0.0040 g of calcium ion and 0.0012 g of magnesium ion? [5 marks]

(b) Define the following:

(i) The total alkalinity index.

(ii) The phenolphthalein alkalinity index. [2 × 1 marks]

(c) Calculate the total alkalinity for a sample of river water whose phenolphthalein alkalinity is known to be 3.0×10^{-5} M, pH is 10.0, and bicarbonate ion concentration is 1.0×10^{-4} M. [5 marks]

(d) (i) What is meant by the pE of an aqueous solution? [2 marks]

(ii) Find the pE value for acidic water at which the ratio of concentrations of Fe^{3+} to Fe^{2+} is 100:1. [5 marks]

7. (a) List the four pros and cons of wind power. [4 marks]

(b) (i) Define energy payback. [1 mark]

(ii) State which form of renewable energy has the lowest payback period and the lowest cost at present. [2 marks]

(c) List four environmental /social problems associated with the expansion of hydroelectric power. [3 marks]

(d) (i) What is geochemical energy? [2 marks]

(ii) List four examples of how and where it is tapped. [4 marks]

(e) What are the advantages and disadvantages of solar cells? [4 marks]

END OF EXAMINATION