

SECOND YEAR B.Sc. DEGREE EXAMINATION, APRIL/MAY 2005

Part III—Subsidiary Chemistry

Paper II—PHYSICAL AND INORGANIC CHEMISTRY

(for students of Physics and Geology Main)

Time : Three Hours

Maximum : 60 Marks

*Answer all questions,
Answer either A or B from each question.*

Section A*Each question carries 2 marks.*

- I. (a) Distinguish between Boyle temperature and critical temperature.
(b) How do real gases deviate from ideal behaviour ?
- II. (a) State law of mass action.
(b) What is the effect of catalyst in chemical equilibrium ?
- III. (a) What are the Miller indices of a plane which make intercepts of $2a$, $3b$ and $2c$ with the axes ?
(b) What are the Miller indices of the standard plane ?
- IV. (a) What is meant by congruent melting point ?
(b) What is meant by Critical solution temperature ?
- V. (a) Calculate the value of equilibrium constant K_p at 298 K for the reaction
 $\text{Co}_{2(g)} + \text{Cl}_{2(g)} \rightleftharpoons \text{CoCl}_{2(g)}$. The value of standard free energy change is found to be 204 kJ mol^{-1} at 298 K.
(b) If one mole of H_2O and one mole of CO are taken in a 10 litre vessel and heated to 725 K, at equilibrium 40 mass percentage of water reacts with CO according to the equation.
$$\text{H}_2\text{O}_{(g)} + \text{CO}_{(g)} \rightleftharpoons \text{H}_{2(g)} + \text{CO}_{2(g)}$$

Calculate the equilibrium constant for the reaction.
- VI. (a) Distinguish between Order and Molecularity of a reaction.
(b) What is meant by zero order reaction ? Give an example.
- VII. (a) Explain the term 'spin-spin coupling' in NMR spectrum.
(b) What is meant by hyperfine splitting in ESR spectrum.
- VIII. (a) What is an Ore ? Give two example each for oxide ores and sulphide ores.
(b) What are the important Ores of Titanium ? Give their formulae.

- IX. (a) What is meant by 'green house effect' ?
 (b) What is the importance of ozone layer ?
- X. (a) Draw the structures of *two* metal complexes which find application in quantitative analysis.
 (b) An aqueous solution of Cu(II) is coloured but that of Zn(II) is colourless. Why?

(10 × 2 = 20 marks)

Section B

Each question carries 4 marks.

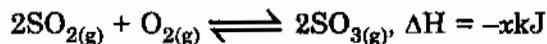
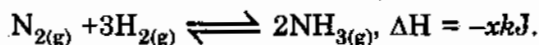
- I. (a) How are critical temperature and pressure of a gas determined ?
 (b) How is critical volume of a substance determined ?
- II. (a) For a certain reaction, the rate constant at 30°C is double its value at 25°C. Calculate the activation energy of the reaction. What will be the rate constant at 45°C ?
 (b) For the decomposition of N_2O_5 (s), $K = 3.46 \times 10^{-5} \text{ s}^{-1}$ at 25°C and $K = 4.87 \times 10^{-3} \text{ s}^{-1}$ at 65°C. Calculate the energy of activation for the reaction.
- III. (a) Discuss the phase diagram of the water system.
 (b) Explain the principle of steam distillation.
- IV. (a) Explain why molecular oxygen is paramagnetic while molecular nitrogen is diamagnetic.
 (b) Explain the underlying principle in an NMR spectrum.
- V. (a) What are detergents ? How do they cause water pollution ? What remedies can be suggested to avoid pollution by detergents ?
 (b) What are pesticides ? Discuss the effects of pesticides on plants.

(5 × 4 = 20 marks)

Section C

Each question carries 10 marks.

- I. (a) 1 What is meant by chemical equilibrium ? Discuss briefly the various factors which influence the equilibrium of a reaction.
 (5 marks)
- 2 Differentiate between K_p and K_c in case of a reversible reaction and under what condition do they become numerically equal ?
 (2 marks)
- 3 One mole of PCl_5 is heated in a closed two-litre vessel. At equilibrium 40 % of the PCl_5 is dissociated. Calculate the equilibrium constant of the reaction.
 (3 marks)
- (b) 1 State and explain Le Chatelier's principle. Discuss its application to the following.



(6 marks)

- 2 At 727°C the equilibrium constant for the reaction, $2\text{SO}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{SO}_{3(g)}$ is $K_p = 3.50 \text{ atm}^{-1}$. If the total pressure in the reaction flask is 1.00 atm, and the partial pressures of O_2 at equilibrium is 0.10 atm, calculate the partial pressures of SO_2 and SO_3 .
(4 marks)

II. (a) What are the chief ores of Nickel? Describe the extraction of the metal from its principal ore.

- (b) 1 Describe the methods for the manufacture of water gas and producer gas.

(8 marks)

- 2 Define the term 'Calorific value' of a fuel.

(2 marks)

[2 × 10 = 20 marks]