Total No. of Printed Pages—15

5 SEM TDC CHM M 1 (N/O)

2016

(November)

CHEMISTRY

(Major)

Course : 501

(Physical Chemistry—II)

(New Course)

Full Marks : 48
Pass Marks : 14

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. Select the correct answer : 1×5=5

(a) The rate constant for the reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$ is $3 \times 10^{-5}\ s^{-1}$. If the rate is $2 \cdot 4 \times 10^{-5}$ mol $l^{-1}s^{-1}$, the concentration of N_2O_5 (in mol l^{-1}) is

(i) 1·4

(ii) 1·2

(iii) 0·8

(iv) 0·04

(b) Each substance in a given state has a tendency to escape from that state and this escaping tendency is called

(i) spontaneity

(ii) Gibbs free energy

(iii) fugacity

(iv) activity

(c) Which of the following will have the highest coagulating power for As_2S_3 colloid?

(i) PO_4^{3-}

(ii) SO_4^{2-}

(iii) Al^{3+}

(iv) Na^+

(Continued)

(d) The pair of the solutions which can be expected to be isotonic at the same temperature is

(i) 0·1 *M* urea and 0·1 *M* $CaCl_2$

(ii) 0·1 *M* $Ca(NO_3)_2$ and 0·1 *M* K_2SO_4

(iii) 0·1 *M* NaCl and 0·1 *M* Na_2SO_4

(iv) 0·1 *M* glucose and 0·2 *M* $MgCl_2$

(e) In an adsorption process, unimolecular layer is formed. It is

(i) physical adsorption

(ii) chemical adsorption

(iii) ion-exchange

(iv) chromatographic analysis

2. Answer any *five* questions : 2×5=10

(a) Prove that the half-life period of a first-order reaction is independent of the initial concentration of the reactant.

(b) State and explain Le Chatelier's principle.

(Turn Over)

(c) What is Henry's law? Describe it.

(d) In the reduction of nitric oxide, 50% of reaction was completed in 108 seconds when initial pressure was 336 mm Hg and in 147 seconds when initial pressure was 288 mm Hg. Find the order of the reaction.

(e) Describe Schultz-Hardy rule.

(f) Mention four important uses of adsorption phenomenon.

(g) 5 g of a substance of molar mass 200 is dissolved in 50 g solvent. The molar mass and vapour pressure of the solvent are 60 and 40 cm respectively. Find the vapour pressure of the solution.

UNIT—I

3. Answer any *two* questions : $6\times2=12$

(a) Give one example of consecutive reaction. Discuss the kinetics of first-order consecutive reaction

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

Depict graphically the concentration of A, B and C with time. $1+4+1=6$

(Continued)

(b) (i) Derive the integrated rate expression for the reaction $2A \rightarrow$ products. 3

(ii) Deduce the expression for half-life period of such a reaction. 2

(iii) Give an example of such type of reaction. 1

(c) (i) Discuss any one method of determining the order of a reaction. 3

(ii) Discuss the effect of temperature on the rate of a chemical reaction. 3

UNIT—II

4. Answer any *one* question : 5

(a) (i) Deduce the relation between osmotic pressure and vapour pressure lowering when a non-volatile solute is dissolved in a solvent. 3

(ii) Calculate the value of van't Hoff's factor of potassium ferricyanide solution when it is 50% dissociated. 2

(Turn Over)

(b) (i) State Nernst distribution law. How is the law modified when the solute undergoes association in one of the solvents? 3½

(ii) What thermodynamic function is responsible for osmosis and how? 1½

UNIT—III

5. Answer any *two* questions : 3½×2=7

(a) Explain the term 'chemical potential'. Derive Gibbs-Duhem equation for two-component system. 1+2½=3½

(b) Discuss the effects of temperature and pressure on chemical potential. 3½

(c) Derive an expression for the change of Gibbs potential for the following gaseous reaction

$$aA + bB + \cdots \rightleftharpoons cC + dD$$ 3½

(Continued)

20

UNIT—IV

6. Answer any *one* question : 4

(a) Explain Freundlich's adsorption isotherm. In what respect Langmuir's isotherm is superior to Freundlich's adsorption isotherm? 3+1=4

(b) (i) Write any two differences between physical adsorption and chemical adsorption. 1

(ii) Discuss the important factors which affect the adsorption of a gas on a solid adsorbent. 3

UNIT—V

7. Answer any *one* question : 5

(a) (i) Discuss the origin of charges on colloidal particles. 2

(ii) Define zeta potential. 1

(iii) Discuss the mechanism of coagulation. 2

(Turn Over)

(b) (i) What are emulsions? Discuss giving example, the role of the emulsifier in the preparation of an emulsion. 1+2

(ii) Explain what will happen if a colloidal solution of $Fe(OH)_3$ is mixed with a colloidal solution of As_2S_3.

(Continued