

Total No. of Printed Pages—15

**5 SEM TDC CHM M 1 (N/O)**

**2016**  $G = 501$

( November )  $Bof = 501, 505, 50$

**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

Select the correct answer :

$1 \times 5 = 5$

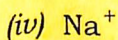
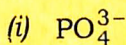
(a) The rate constant for the reaction  $2N_2O_5 \rightarrow 4NO_2 + O_2$  is  $3 \times 10^{-5} s^{-1}$ . If the rate is  $2.4 \times 10^{-5} mol l^{-1} s^{-1}$ , the concentration of  $N_2O_5$  (in  $mol l^{-1}$ ) is

- (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  $\text{As}_2\text{S}_3$  colloid?





(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  $\text{CaCl}_2$

(ii) 0.1 M  $\text{Ca}(\text{NO}_3)_2$  and 0.1 M  $\text{K}_2\text{SO}_4$

(iii) 0.1 M  $\text{NaCl}$  and 0.1 M  $\text{Na}_2\text{SO}_4$

(iv) 0.1 M glucose and 0.2 M  $\text{MgCl}_2$

(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.

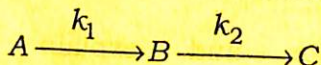
(b) State and explain Le Chatelier's principle.

- (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 : 6×2=12

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



Depict graphically the concentration of A, B and C with time.

1+4+1=6



- (b) (i) Derive the integrated rate expression for the reaction  $2A \rightarrow \text{products}$ . 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

- (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

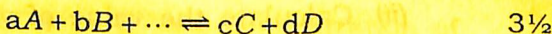
UNIT—III

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



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



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

1+2=3

(ii) Explain what will happen if a colloidal solution of  $\text{Fe}(\text{OH})_3$  is mixed with a colloidal solution of  $\text{As}_2\text{S}_3$ .

2



( Old Course )

Full Marks : 48

Pass Marks : 19

Time : 3 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  
 $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$  is  $3 \times 10^{-5} \text{ s}^{-1}$ . If  
the rate is  $2.4 \times 10^{-5} \text{ mol l}^{-1} \text{ s}^{-1}$ , the  
concentration of  $\text{N}_2\text{O}_5$  (in  $\text{mol l}^{-1}$ ) is

(i) 1.4

(ii) 1.2

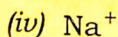
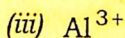
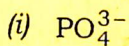
(iii) 0.8

(iv) 0.04

(b)  $\text{NH}_4\text{OH}$  is a weak base, but it becomes  
still weak in the aqueous solution of

(i) 0.1 M  $\text{NH}_4\text{Cl}$ (ii) 0.1 M  $\text{H}_2\text{SO}_4$ (iii) 0.1 M  $\text{HCl}$ (iv) 0.1 M  $\text{CH}_3\text{COOH}$

(c) Which of the following will have the highest coagulating power for  $\text{As}_2\text{S}_3$  colloid?



(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  $\text{CaCl}_2$

(ii) 0.1 M  $\text{Ca}(\text{NO}_3)_2$  and 0.1 M  $\text{K}_2\text{SO}_4$

(iii) 0.1 M  $\text{NaCl}$  and 0.1 M  $\text{Na}_2\text{SO}_4$

(iv) 0.1 M glucose and 0.2 M  $\text{MgCl}_2$

(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

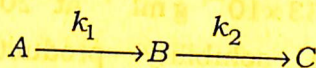
- (a) Prove that the half-life period of a first-order reaction is independent of the initial concentration of the reactant.
- (b) The solubility of  $\text{BaSO}_4$  is  $2.33 \times 10^{-4} \text{ g ml}^{-1}$  at  $20^\circ\text{C}$ . Calculate the solubility product of  $\text{BaSO}_4$  assuming that the salt is completely ionized.
- (c) State and explain Henry's law.
- (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 : 6×2=12

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



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

(b) (i) Derive the integrated rate expression for the reaction  $2A \rightarrow \text{products}$ . 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
- (b) (i) State Nernst distribution law. How is the law modified when the solute undergoes association in one of the solvents?  $3\frac{1}{2}$
- (ii) What thermodynamic function is responsible for osmosis and how?  $1\frac{1}{2}$

## UNIT—III

5. Answer any *two* questions :  $3\frac{1}{2} \times 2 = 7$
- (a) Derive an expression for the pH of an aqueous solution of salt of a strong acid and a weak base.  $3\frac{1}{2}$
- (b) What is buffer solution? Derive an expression for calculating the pH of a basic buffer solution.  $1 + 2\frac{1}{2} = 3\frac{1}{2}$

- (c) (i) Find the relation between solubility and solubility product for  $As_2S_3$ .  $1\frac{1}{2}$
- (ii) Describe the application of solubility product in qualitative analysis with two examples. 2

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



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

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- (ii) Explain what will happen when a colloidal solution of  $\text{Fe}(\text{OH})_3$  is mixed with a colloidal solution of  $\text{As}_2\text{S}_3$ .

2

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