

2½ hours

Total Marks:75

N.B: (1) All questions are compulsory.

(2) Figures to the right indicate full marks.

(3) Use of logarithmic table/non programmable calculator is allowed.

Physical Constants

$$N = 6.022 \times 10^{23}$$

$$c = 3.0 \times 10^8 \text{ m s}^{-1}$$

$$k = 1.38 \times 10^{-23} \text{ K}^{-1}$$

$$F = 96500 \text{ Coulombs}$$

$$R = 8.314 \text{ J mol}^{-1} \text{K}^{-1}$$

$$\pi = 3.142$$

$$h = 6.626 \times 10^{-34} \text{ J s}$$

$$2.303 R T / nF = 0.05916 \text{ at } 293 \text{ K}$$

1. Attempt any **three** of the following:

- (A) Define: Freezing point. A solution containing 1.44g of non-volatile solute in 100g of water boils at 373.12K. Calculate the molecular weight of the solute. (Given: Boiling point of water=373K,  $K_b=0.512 \text{ K.Kg.mol}^{-1}$ ) 5
- (B) State Gibb's Phase Rule and explain the terms involved in it. 5
- (C) Explain the triangular phase diagram for a three component system. 5
- (D) Discuss the application of the phase rule to the water system with the help of a neat labelled diagram. 5
- (E) Derive Van't Hoff equation for Osmotic pressure. 5
- (F) What concentration of a substance in water is needed, so that the resulting solution boils at 372.09 K. (Given: Boiling point of water=373K,  $K_b=0.512 \text{ K.Kg.mol}^{-1}$ ) 5

2. Attempt any **three** of the following:

- (A) Explain the kinetics of acid catalysed reactions. 5
- (B) Define adsorbate. Explain any two types of adsorption isotherms. 5
- (C) The volume of gas adsorbed reduced to STP was found to be  $126 \text{ cm}^3 \text{ g}^{-1}$  of the adsorbent. Assuming that molecules are closely packed in the first layer, calculate the surface area of the adsorbent if each gas molecule occupies  $16.18 \times 10^{-20} \text{ m}^2$ . 5
- (D) Name the four electrokinetic phenomena and explain in detail any one of them. 5
- (E) (i) Draw the diagram for Stern's model of the electrical double layer and give the expression for zeta potential. 3
- (ii) Explain the terms homogenous and heterogenous catalysis. 2
- (F) Give a detailed classification of surfactants. 5

3. Attempt any **three** of the following:

- (A) Give a detailed classification of cells with suitable examples. 5
- (B) State any three merits and two demerits of quinhydrone electrode. 5

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- (C) A solution is 0.02m with respect to KCl and  $K_2SO_4$  each. Calculate the activity coefficient of KCl in this aqueous solution ( $A=0.509$  at 298 K) 5
- (D) Derive an expression for emf of electrode concentration cell without transference reversible to cations. 5
- (E) What is meant by liquid junction potential? How does it arise? How is it eliminated? 5
- (F) Calculate the solubility of  $PbSO_4$  in  $mol\ dm^{-3}$  in pure water, if the standard oxidation potentials of  $Pb|Pb^{+2}$  and  $Pb-PbSO_4|SO_4^{-2}$  are  $-0.124V$  and  $-0.352V$  respectively. 5

4. Attempt any **three** of the following:

- (A) Derive Bragg's equation. 5
- (B) In a polymer sample 20 % of the molecules have molecular weight 20,000, 30 % have 45,000 and the rest have molecular weight 40,000. Calculate weight average and number average molecular weights. 5
- (C) Write a short note on light emitting polymers. 5
- (D) Name the laws of crystallography. Write with the help of diagrams, explain (i) Axis of Symmetry. (ii) Centre of symmetry. 5
- (E) The angle of reflection for first order diffraction pattern from (110) plane of a cubic crystal is  $9.4^\circ$ . Calculate the inter planar distance between two (110) planes, if the wavelength of the incident X-ray front is  $2 \times 10^{-10}$  m. 5
- (F) Explain the terms (i) relative viscosity (ii) specific viscosity (iii) intrinsic viscosity (iv) Mark-Houwink Equation. 5

5.(A) State **True** or **False**:- 4

- (a) Sulphur has four triple points.
- (b) When solute particles associate  $i$  is less than unity.
- (c) In Pb-Ag system the eutectic composition of Ag is 2.6% at  $303^\circ C$
- (d)  $CaCO_3$  system is a three component system.

OR

(A) Match the following:- 4

- | Column A                      | Column B                    |
|-------------------------------|-----------------------------|
| (p) Isotonic solution         | (i) boiling point elevation |
| (q) freezing point depression | (ii) $F = C - P + 1$        |
| (r) Condensed phase rule      | (iii) same osmotic pressure |
| (s) Colligative property      | (iv) $K_f m$                |
| (v) $F = C - P + 2$           |                             |

(B) State **True** or **False**:- 4

- (a) Lyophilic colloids are more stable than lyophobic colloids.
- (b) A catalyst lowers the energy of activation.
- (c) Alkyl sulphonic acids are an example of colloidal electrolytes.
- (d) Promoters when added improve the catalytic activity of the catalyst.

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OR

(B) Match the following:-

4

Column A

Column B

- (p) Langmuir's adsorption isotherm  
 (q) BET  
 (r) acid catalysis  
 (s) Enzyme catalysis  
 (v) Hydrolysis of methyl acetate

- (i) Michaelis constant  
 (ii) monomolecular adsorption  
 (iii) multimolecular adsorption  
 (iv) Boltzmann constant

(C) State True or False:-

4

- (a) Salt bridge is used to eliminate liquid junction potential.  
 (b) Activity = Concentration x Activity coefficient.  
 (c) Debye Huckel limiting law is applicable to strong and weak electrolytes.  
 (d) In chemical cell the two electrodes are chemically different.

OR

(C) Match the following:-

4

Column A

Column B

- (p) glass electrode  
 (q) quinhydrone electrode  
 (r) salt bridge  
 (s)  $\text{CuSO}_4$   
 (v)  $\mu = 3\text{m}$

- (i) KCl  
 (ii)  $\mu = 4\text{m}$   
 (iii) ion selective electrode  
 (iv) redox electrode

(D) State True or False:-

3

- (a) Polydispersity Index = (weight average molecular weight)/(number average molecular weight).  
 (b) In Frenkel defect hole is formed in the lattice.  
 (c) KCl shows a simple cubic structure.

OR

(D) Match the following:-

3

Column A

Column B

- (p) X-rays  
 (q) Cubic crystal  
 (r) Body Centred Cubic lattice

- (i) 23 elements of symmetry  
 (ii) Coolidge tube  
 (iii) Four atoms belong to unit cell  
 (iv) Two atoms belong to unit cell

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