16/12/19 M

[This question paper contains 7 printed pages]

**Your Roll No.** : .....

**Sl. No. of Q. Paper** : **7395** **J**

Unique Paper Code : 32171303

Name of the Course : **B.Sc.(Hons.) Chemistry**

Name of the Paper : Physical Chemistry - III : Phase Equilbria and Electrochemical Cells

Semester : III

***Time : 3 Hours*** ***Maximum Marks : 75***

**Instructions for Candidates :**

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(ii) Question No. **1** is compulsory.

(iii) Attempt **six** questions in all, selecting at least **two** questions from each Section.

(iv) Use of scientific calculator is allowed.

Values of constants :

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

$F=96500C\ mol^{-1}$, (2.303 RT/F) at 298 K = 0.0591

P.T.O.

**1.** Explain (any **five**) : 3×5=15

(a) How can liquid junction potential be eliminated ?

(b) Quinhydrone electrode is not suitable for pH measurement more than 8.5.

(c) Difference between electrolytic and galvanic cell.

(d) Use of adsorbent in powdered form.

(e) Slope of fusion curve of water system is inclined towards pressure axis.

(f) Plait point lies either to the left or right of the maximum of the binodal curve in a three component system.

(g) Triethylamine-water system shows lower CST.

## Section - A

**2.** (a) Derive phase rule for a non-reactive system. 4





(b) Show that $NH_4Cl(s) - NH_3(g) - HCl(g)$ system in which $P_{NH3}=P_{HCl}$ is a one component system whereas when $P_{NH3} \neq P_{HCl}$ is a two component system. 4

(c) The vapour pressure of toluene is 59.1 torr at 313.75K and 298.7 torr at 353.15K. Calculate the molar heat of vaporization. 4

**3.** (a) Differentiate between congruent and incongruent melting point system with an example. 4

(b) Metal A and B melts at 110°C and 75°C respectively. They form one compound $A_2B$ which decomposes at 20°C to give a solid and a melt containing 50mole % of B. There is a eutectic point at 5°C and eutectic composition is 70 mole % of B. Sketch the phase diagram and label it. 4

(c) Show that multistage extraction is more economical than single stage extraction. 4

4. (a) Derive Duhem Margules equation as applicable to a binary liquid mixture and show that if one component behaves ideally then other component also behaves ideally. 4

(b) Calculate the degree of freedom at a point which lies any where : 4

(i) Outside the binodal curve

(ii) Within the binodal curve

(c) Write a short note on fractional distillation. 4

5. (a) State and derive the lever rule. 4

(b) Draw a well labelled phase diagram of choloroform-acetic acid- water system. 4

(c) The vapour pressure of aniline and water at 98.5°C are 717mm and 43mm respectively. Molar masses of liquids are 93 and 18. Calculate the relative masses of two liquids in the distillate after the steam distillation. 4

## Section - B

6. (a) How will you determine the accurate value of half-cell potential graphically ? 4





(b) For the following cell : 4

Pb | $PbCl_2(s)$ | $PbCl_2(sol^n)$ | AgCl(s) | Ag.

The potential at 298K is 0.490V and the variation of emf with temperature is given by :

$E = a - (1.86 \times 10^{-4} VK^{-1})(T - 25K)$

Calculate $\Delta G$, $\Delta H$ and $\Delta S$ for the reaction at 298 K.

(c) Describe the construction of hydrogen electrode along with necessary diagram and chemical equations. Give its limitation also. 4

7. (a) What are concentration cells ? Derive the expression for a concentration cell with transference. 4

(b) Calculate the cell potential at 25°C for the cell : 4

Pt | $H_2(p=1\ bar)$ | $HBr(a \pm = 0.2)$ | $Hg_2Br_2(s)$ | Hg

Given $E^0_{Br^-|Hg2Br2|Hg} = 0.1385V$

(c) Construct the galvanic cell for the following reactions and write the expression for the cell potential 4

(i) $Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$

(ii) $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

**8.** (a) Explain : 4

(i) Why chemisorption is monolayer and physiosorption is multilayer.

(ii) Most adsorption process are exothermic in nature.

(b) Derive the following Langmuir Adsorption isotherm : 4

$$\frac{p}{x/m} = \frac{1}{k1k2} + \frac{p}{k2}$$

Explain the various symbols.

(c) From the following reduction reactions and $E^0$ values : 4

$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$ $E^0 = 0.771$ V

$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$ $E^0 = -0.447$ V

Calculate $E^0$ for the half-cell reaction

$Fe^{3+}(aq) + 3e^- \rightarrow Fe(s)$





**9.** Write short note (any **three**) : 4×3=12

(i) Potentiometric titrations

(ii) Reversible and irreversible galvanic cells

(iii) Different types of half cells

(iv) Glass electrode