

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 Equilibria 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 :

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

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

P.T.O.



7395

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

7395

(b) Show that  $\text{NH}_4\text{Cl(s)} - \text{NH}_3(\text{g}) - \text{HCl(g)}$  system in which  $P_{\text{NH}_3} = P_{\text{HCl}}$  is a one component system whereas when  $P_{\text{NH}_3} \neq P_{\text{HCl}}$  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  $\text{A}_2\text{B}$  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 anywhere : 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

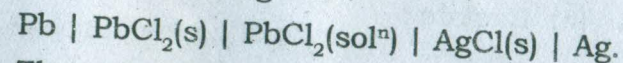
- (b) Draw a well labelled phase diagram of chloroform-acetic acid- water system. 4

- (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



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

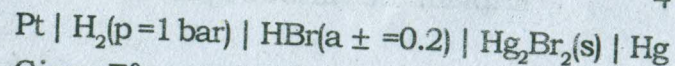
$$E = a - (1.86 \times 10^{-4} \text{VK}^{-1})(T - 25\text{K})$$

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

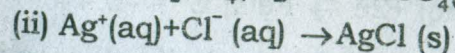
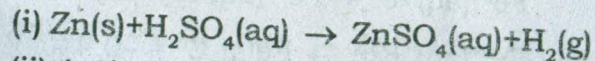
7. (a) What are concentration cells ? Derive the expression for a concentration cell with transference. 4

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



$$\text{Given } E^\circ_{\text{Br}^- \mid \text{Hg}_2\text{Br}_2 \mid \text{Hg}} = 0.1385\text{V}$$

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





8. (a) Explain :

4

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

(ii) Most adsorption process are exothermic in nature.

(b) Derive the following Langmuir Adsorption isotherm :

4

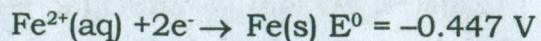
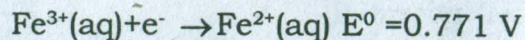
$$\frac{p}{x/m} = \frac{1}{k_1 k_2} + \frac{p}{k_2}$$

Explain the various symbols.

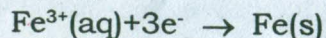
(c) From the following reduction reactions and

$E^0$  values :

4



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



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