

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)

CLASS: IMSC  
BRANCH: CHEMISTRY

SEMESTER : V  
SESSION : MO/18

SUBJECT: IMC5001-PHYSICAL CHEMISTRY-I

TIME: 03:00

FULL MARKS: 60

INSTRUCTIONS:

1. The question paper contains 7 questions each of 12 marks and total 84 marks.
  2. Candidates may attempt any 5 questions maximum of 60 marks.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) What do you mean by activity coefficient of an electrolyte? [2]  
(b) Derive an equation which relates electrolyte concentration to electrode potential. [4]  
(c) The e.m.f. of the cell  $\text{Ag(s)} | \text{AgCl(s), KCl (m=0.05)} || \text{AgNO}_3 \text{ (m=0.01)} | \text{Ag}$  is 0.4312 V at 25°C. The mean activity co-efficient of KCl and  $\text{AgNO}_3$  at these concentrations are estimated to be 0.817 and 0.723 respectively. What is the solubility product of AgCl? [6]
- Q.2(a) What is the origin of liquid junction potential? Why solution of KCl is used in salt bridge? [2]  
(b) Derive the expression for pH determination using quinhydrone electrode. [4]  
(c) The EMF of a cell measured by means of a hydrogen electrode against a saturated calomel electrode at 298 K is 0.4188 V. If the pressure of the  $\text{H}_2$  (g) was maintained at 1 atm, calculate the pH of the unknown solution, given potential of reference electrode is 0.2415 V. [6]
- Q.3(a) What do you mean by for buffer index? [2]  
(b) Derive the expression of pH for hydrolysis of salt formed from a strong acid and weak base. [4]  
(c) A solution at 25°C is 0.01 M in acetic acid and 0.025 M in sodium acetate. Find for this solution (a) the degree of ionization of acid and (b) pOH and pH. [Given:  $K_a = 1.8 \times 10^{-5}\text{M}$ ] [6]
- Q.4(a) Why fusion curve is away from the pressure axis in phase diagram of  $\text{CO}_2$  system? Explain it by clausius Clapeyron equation. [2]  
(b) Define Ideal solutions. The vapour pressure of pure  $\text{CCl}_4$  (mol.wt-154) and  $\text{SnCl}_4$  (mol.wt-170) at 25°C are 114.9 and 238.3 mm , respectively. Assuming ideal behaviour, Calculate the total vapour pressure of a mixture containing 10 g of  $\text{CCl}_4$  and 15 g of  $\text{SnCl}_4$ . [4]  
(c) What is non-ideal (real) solution? Discuss briefly the deviations of real solution from their Ideal behaviour through the Vap. Pressure and mole fraction graph for type I, type II and type III solution. [6]
- Q.5(a) What is polymorphism and Enantiotropy? [2]  
(b) Draw the phase diagram of KI- water system. Name and show different line curves and regions. What is cryohydrate? [4]  
(c) Explain the Bi-Cd system by drawing phase diagram. [6]
- Q.6(a) Show that entropy is not a suitable criterion for Spontaneity of a system using other state functions. [2]  
(b) Explain Nernst Heat Theorem graphically. How does it lead to the enunciation of the Third Law of thermodynamics? [4]  
(c) What is free energy? How does free energy depend on temperature? [6]
- Q.7 Write note on : [6+6]  
i. Freezing mixture  
ii. Gibbs-Helmholtz equation