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Unique Paper Code : 32171303_OC

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

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

Semester : **III**

Duration: 3 Hours Maximum Marks: 75

Instructions for Candidate

Attempt four questions in all, selecting at least two questions from each section.

Use of scientific calculator is permitted

-1-1-1
Values of constant: R = 8.314 JK Mol; F = 96500 C Mol

Section-A

Q.1.a) Derive the Clapeyron equation and then derive Clausius-Clapeyron equation for condensed phase-vapour system. Does this relation hold good for the solid to liquid equillibria? Justify your answer.

+-+-+-,
b) Calculate the number of components in a solution containing H, OH, Na, Cl, Ag, NO3 AgCl (s) & H2O (l). Show all the constituents, reactions & restrictive conditions.

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c) An aqueous solution contains 0.30 g of a solute in 100 cm solution. To this solution 25
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cm of ether is added and the mixture is shaken and allowed to come to equilibrium at 298K. At this temperature, Kd = Cether/Cwater = 4.7

i) How much solute remains in the aqueous solution?

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ii) If the extraction is carried out with two successive 20 cm portions of ether, how much solute remains unextracted?

d) What is Gibbs Duhem equation? Use this equation for a binary solution to derive Duhem-Margules equation.

(5, 5,5,3.75)

Q.2. a) Differentiate between congruent & incongruent melting point systems with an example for each. Why both of them are invariant points?

b) Describe the phase diagram of water with due emphasis on following facts:
i) How many triple points does it have?
ii) Why is sublimation curve steeper than the vaporization curve at triple point?
iii) Why is fusion line almost vertical & slightly tilted to the left?
iv) What is the upper limit of liquid-vapour equilibrium curve?

c) Describe the process of fractional distillation of an ideal binary solution with the help of suitable diagrams along with the principle underlying it.

d) What are azeotropes? Give one example each of maximum boiling & minimum boiling azeotropes. Can they be purified by fractional distillation?

(5,5,5,3.75)

Q.3. a) Plot a labeled phase diagram (with degrees of freedom) of a system with components:
A (M.Pt: 1100 C) and B (M.Pt: 600 C). The eutectic temperature is 400 C and the corresponding composition is 85 mol % of B. Draw the labeled cooling curves for the solutions containing 100 mol% of A, 85 mo% of B & 56 mol% of B.
b) Deduce Gibbs Phase rule for a non-reactive system at equilibrium in which all the components are present in all the phases.

c) State Nernst Distribution Law. Derive the expression for Nernst Distribution Law when the solute undergoes dissociation in one of the phases.
d) Discuss the effect of adding following impurities on CST of phenol-water system:
i) NaCl ii) Succinic Acid

(5,5,5,3.75)

Section-B

Q.4. a) Explain a method to determine the accurate value of half-cell potential graphically.

b) Construct the galvanic cell for the following reaction and write down the expression for the cell potential,
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c) Determine the standard equilibrium constant of the following reaction at 298K

( ) ( ) ( )

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d) Why is the Mercurous Chloride written as Hg2Cl2 not as HgCl?

(5,5,5,3.75)

Q.5. a) Derive the expression for the EMF of a concentration cell with transference.

b) Write the BET equation and derive the Langmuir adsorption isotherm from it.

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c) Determine the cell potential for the following cell at 25C assuming the activity equal to molar concentration

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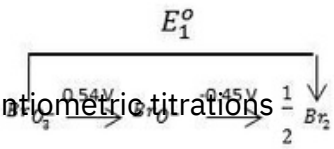
d) Can a voltmeter be used to determine the EMF of a galvanic cell?

(5,5,5,3.75)

Q.6.a) Describe the construction of calomel electrode. Write the half-cell reaction and Nernst equation for it.

b) From the standard potentials shown in the following diagram, calculate the potential( )



c) Write a short note on potentiometric titrations

d) What are the limitations of Quinhydrone electrode for the determination of pH of solution?

(5,5,5,3.75)

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