



Manipal Institute of Technology, Manipal





IV SEMESTER B.TECH (CHEMICAL ENGINEERING) END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: PHYSICAL CHEMISTRY [CHM 2201]

REVISED CREDIT SYSTEM

TIME: 3 HOURS

DATE: 14-05-2016

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitable assumed.
- Draw diagrams and write chemical equations wherever necessary
- 1A. Write the principle involved in steam distillation. A mixture of water and an organic liquid distil at 95 °C and the distillate contains 1.8 times as much as organic liquid as water by mass. At 95 °C the vapour pressure of water and the organic liquid are 600 mm Hg and 160 mm Hg respectively. Calculate the molecular weight of the organic liquid.
- **1B.** Justify: Camphor is chosen as solvent in Rast method. Explain the determination of depression in the freezing point by the Rast's method. When 20 g of naphthoic acid (mol. Mass 172) is dissolved in 50 g of benzene a freezing point depression of 2 K is observed. ($K_f = 1.72K \text{ kg mol-1}$). Calculate the vant Hoff factor.
- **1C.** Give reason: Reference and indicator electrodes are used in potentiometric titrations. Explain the redox potentiometric titration by taking an example. Also derive an expression for the equivalence potential.

[2+4+4]

- **2A.** The Henry's constant for O_2 gas in water is 4.58 x 10⁴ atm. At 293 K. Calculate the amount of oxygen dissolved in 1 litre of water at 293 K, when gas pressure is 0.40 atm.
- **2B.** Explain with a graphical representation the distillation behavior of solution of type I. The vapour pressure of a solvent is found to be 400 mm Hg at 300K. When a certain amount of a non- volatile solute is added to 50 mol of the solvent its vapour pressure decreases to 360 mm Hg. Find the amount of solute added.
- **2C.** Justify: Cyclic voltammetry is a potentiodynamic electrochemical measurement technique. With relevant plot explain the principle involved in cyclic voltametric measurements. Mention any two of its applications.

[2+4+4]

- **3A.** Calculate the osmotic pressure of a solution (density =1.02g cm⁻³) containing 50 g glucose ($C_6H_{12}O_6$) in 1 kg of water at 300 K.
- **3B.** Mention the merits of phase diagram. Draw the labelled phase diagram for sodium-potassium system and explain it.
- 3C. i) A cell, whose resistance at 30 °C is 195.0 ohm when filled with 0.2 M KCl solution and 6.556 ohm when filled with 3.180 x 10⁻³ M NaCl. The specific conductance of 0.1 M KCl solution is 0.01250 ohm⁻¹ cm⁻¹ at 30 °C. Calculate the cell constant, specific and equivalent conductance of NaCl solution.

ii) Differentiate between collision theory and transition state theory.

[2+4+4]

- 4A. i) Justify: Pure water can be obtained from sea water by reverse osmosis.
 ii) An alloy of A and B contain 73 % A. Find the mass of eutectic in 1 kg of solid alloy, if the eutectic mixture contains 64 % of A.
- **4B.** Sketch the different types of adsorption isotherms with suitable representation and example in each case.
- **4C.** i) Define the term critical solution temperature. Draw and explain the mutual solubility curve of phenol -water system

ii) Discuss any two factors affecting the solubility of gases in liquids.

[2+4+4]

- **5A**. In a second order reaction, the initial concentration of reactants is $0.1 \text{ mol } \text{L}^{-1}$. The reaction is found to be 20 % complete in 40 minutes. Calculate the rate constant and time required to complete 75% of the reaction.
- **5B.** Differentiate between **i**) physical adsorption and chemical adsorption.

ii) ideal and non-ideal solutions.

5C. Describe a method for the measurement of vapour pressure lowering and explain the determination of molar mass of non- volatile solute from it

[2+4+4]
