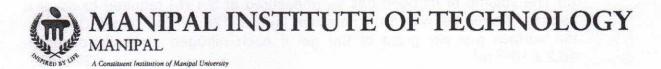
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IV SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2019

SUBJECT: PHYSICAL CHEMISTRY [CHM 2201]

REVISED CREDIT SYSTEM

TIME: 3 HOURS

DATE: 4-05-2019

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.** How are osmotic pressure measurements used for determining molar mass of a nonvolatile solute? Define isotonic solutions.
- 1B. (i) Explain the terms consolute temperature, upper consolute temperature, lower consolute temperature, conjugate solutions and tie line as applied to solubility of partially miscible liquids.
 - (ii) When a conductance cell was filled with a 0.02 mol dm $^{-3}$ aqueous solution of KCl, which had a specific conductance of 0.2767 S m $^{-1}$. It had a resistance of 82.39 ohm at room temperature. When the same cell was filled with a 2.5 x 10^{-3} mol dm $^{-3}$ solution of K₂SO₄, its resistance was 325 ohm. Calculate the cell constant and the specific conductance of K₂SO₄ solution.
- .1C. (i) Derive the equation of collision theory of reaction rates.
 - (ii) A sugar syrup of mass 214.2 contains 34.2 of sugar. Calculate the molality and mole fraction of sugar. (Molecular mass of cane sugar = 342 g mol⁻¹)

[2+4+4]

- 2A. Deduce thermodynamically Gibbs phase rule equation.
- **2B**. (i) Explain the determination of E_{cell} value for redox titration by potentiometric titration method.
 - (ii) Liquid A (molecular mass 46) and liquid B (molecular mass 18) form an ideal solution. At 293 K the vapour pressures of pure A and B are 44.5 and 17.5 mm of Hg respectively. Calculate (a) the vapour pressure of a solution of A in B containing 0.2 mole fraction of A, and (b) the composition of the vapour phase.

- **2C.** (i) Explain the importance of scan rate, supporting electrolyte and selection of potential window in cyclic voltammetry.
 - (ii) The volume of nitrogen gas v_m (measured at S.T.P.) required to cover a sample of silica gel with a unimolecular layer is 129 cm³ g⁻¹ of gel. Calculate the surface are per gram of the gel if each nitrogen molecule occupies 16.2×10^{-20} m². [2+4+4]
- 3A. (i) Draw and discuss the distillation behavior of solutions of Type I.
 - (ii) Calculate the freezing point of a solution containing 0.520 g of glucose $(C_6H_{12}O_6)$ in 80.2 gram of water. (Given K_f for water = 1.86 K kg mol⁻¹ and molecular weight of glucose = 180.)
- 3B. Derive Gibb's adsorption isotherm
- **3C.** (i) Explain with neat plot the conductometric titration of mixture acids against strong base.
 - (ii) The rate constant of a second-order reaction is 5.70 x 10⁻⁵ dm³ mol⁻¹ s⁻¹ at 25°C and 1.64 x 10⁻⁴ dm³ mol⁻¹ s⁻¹ at 40°C. Calculate the activation energy and the Arrhenius pre-exponential factor. [2+4+4]
- 4A. (i) Draw the phase diagram of Pattinson's process and explain it.
 - (ii) At 100°C, the specific volumes of water and steam are respectively, 1 C.C. and 1673 C.C. Calculate the change in vapour pressure of the system by 1°C change in temperature. The molar heat of vaporization of water in this range may be taken as 40584.8 J mol⁻¹ (ΔHv)
- **4B.** (i) 0.1 M solution of KNO₃ has an osmotic pressure of 4.5 atmosphere at 300 K. Calculate the apparent degree of dissociation of the salt.
 - (ii) State and explain Henry's law. Show that if in any solution, the solute obey Henry's law, the solvent obeys Raoult's law.
- **4C**. (i) Write and explain four important reasons for variation of conductance of any given solution.
 - (ii) What is meant by a reaction of second order? Give an example. Derive an expression for rate constant of second order reaction involving one reactant only.

 [2+4+4]
- **5A.** Describe Ostwald and Walker's method for the determination of lowering of vapour pressure.
- 5B. (i) Derive an expression for Gibbs free energy of mixing (ΔG_{mix}) for an ideal solution. Show that for an ideal solution (i) the volume of mixing (ΔV_{mix}) is zero. (ii) the enthalpy of mixing (ΔH_{mix}) is zero.
 - (ii)Draw a labelled phase diagram of Zn-Mg system.
- **5C.** (i) Discuss the principle underlying potentiometric titrations. Explain the potentiometric titration of a solution of CH₃COOH against a standard solution of NaOH.
 - (ii) Write the assumptions of Langmuir theory of adsorption and derive the equation for it. [2+4+4]
