Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

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 K_2SO_4, its resistance was 325 ohm. Calculate the cell constant and the specific conductance of K_2SO_4 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 cm^3 g^{-1} of gel. Calculate the surface are per gram of the gel if each nitrogen molecule occupies 16.2×10^{-20} m^2. **[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 5.70×10^{-5} dm^3 mol^{-1} s^{-1} at 25°C and 1.64×10^{-4} dm^3 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 KNO_3 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 CH_3COOH against a standard solution of NaOH.
(ii) Write the assumptions of Langmuir theory of adsorption and derive the equation for it. **[2+4+4]**

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