Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

IVSEMESTER B.TECH. (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, JUNE 2019

SUBJECT: PHYSICAL CHEMISTRY [CHM 2201]

REVISED CREDIT SYSTEM

Time: 3 Hours | Date: 19-06-2019 | MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. If we assume that air contains 80% N_2 and 20% O_2, calculate the proportion of N_2 and O_2 in water. Henry's constant of N_2 and O_2 in H_2O are 6.51×10^7 mm and 3.30×10^7 mm respectively. 2

1B. What is a congruent melting point? Explain the zinc-magnesium system with the help of a suitable phase diagram. 4

1C. Derive thermodynamically the Gibbs adsorption isotherm for the adsorption of a solute on the surface of a liquid. 4

2A. Justify the following statements:

a) Increase in temperature will decrease the extent of adsorption.

b) In the phase diagram of sulphur system the transition curve slopes away from the pressure axis. 2

2B. a) Explain with a neat diagram the method used in the purification of organic compound such as aniline.

b) One mole of component A and 3 moles of component B are mixed at 300 K to form an ideal binary solution. Calculate ΔV_{mix}, ΔG_{mix}, ΔH_{mix} and ΔS_{mix}. Assume R = 8.314 J K^{-1} mol^{-1}. 4

2C. Discuss in detail the principle of distillation at constant pressure. Which type of binary solutions can be completely separated into their constituents and why? 4

3A. The density of a 9.5 % by mass solution of fructose ($C_6H_{12}O_6$) is 1.036 g cm^{-3} at 293 K. Calculate the osmotic pressure of the solution. 2

Given R=0.0821 dm^3 atm $K^{-1}mol^{-1}$

3B. a) Derive the relation between the elevation in boiling point of a solution and the mole fraction of the dissolved solute.

b) The specific volumes of ice and water at 0° C are 1.1007 cm^3 and 1.0001 cm^3, respectively. What would be the change in melting point of ice per atmosphere increase of pressure? Molar heat of fusion of ice = 6009.9 $Jmol^{-1}$. 4

3C. a) Explain why ethanol-cyclohexane mixture exhibits positive deviation from the Raoult's law while chloroform-acetone mixture exhibits negative deviation.

b) Give reasons for the following.

i) The amount of adsorption of nitrogen on a platinum catalyst at - 195° C increases with increase in pressure. 4

ii) Mention any two limitations of phase rule. 2

4A. Derive the rate constant expression for saponification of ester.

4B. a) Explain with a neat schematic diagram the potentiometric titration of Mohr's salt solution against standard cesium sulphate solution.

b) Redox reactions cannot be studied accurately by conductometric titration. Give reason. 4

4C. a) Show that half-life of a zero order reaction is directly propositional to initial concentration of the reactant.

b) Show that the time required for 99 % completion of a reaction is twice the time required for the completion of 90 % of reaction. 4

5A. Explain collosion theory in the determination of the rate constant of a reaction. 2

5B. a) Explain the experimental procedure to obtain the cyclic voltammogram of potassium ferro cyanide by cyclic voltametry techniques.

b) Explain with a neat schematic representation the conductometric titration of potassium sulphate against standard barium chloride. 4

5C. a) How is activation energy affected by the presence of catalyst and increase of temperature?

b) The rate constants of a reaction at 500 K and 700 K are 0.02 s^{-1} and 0.07 s^{c} respectively. Calculate the activation energy. 4

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