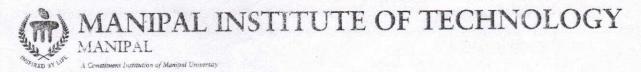
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## IVSEMESTER B.TECH. (CHEMICAL ENGINEERING) END SEMESTER EXAMINATIONS, JUNE 2019

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<sub>2</sub> and 20% O<sub>2</sub>, calculate the proportion of N<sub>2</sub> and O<sub>2</sub> in water. Henry's constant of N<sub>2</sub> and O<sub>2</sub> in H<sub>2</sub>O are  $6.51 \times 10^7$  mm and  $3.30 \times 10^7$  mm respectively.
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- 1B. What is a congruent melting point? Explain the zinc-magnesium system with the help of a suitable phase diagram.
- Derive thermodynamically the Gibbs adsorption isotherm for the adsorption of a solute on the surface of a liquid.
- 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.
- 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 ΔVmix, ΔGmix, ΔHmix and ΔSmix. Assume R = 8.314 J K<sup>-1</sup> mol<sup>-1</sup>.
- 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?
- 3A. The density of a 9.5 % by mass solution of fructose (CeH<sub>12</sub>Oe) is 1.036 g cm<sup>-3</sup> at 293 K. Calculate the esmotic pressure of the solution.

  Given R=0.0821 dm<sup>3</sup> atm K<sup>-1</sup>mol<sup>-1</sup>

- 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 cm³ and 1.0001 cm³, 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.
- 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.
    - ii) Mention any two limitations of phase rule.
- 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.
- **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.
- 5A. Explain collosion theory in the determination of the rate constant of a reaction.
- **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.
- **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<sup>-1</sup> and 0.07 s<sup>-c</sup> respectively. Calculate the activation energy.

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