8. (a) Explain the effect of temperature and pressure on solubility and critical micelleconcentration. (2+2)

(b) Write a short note on the kinetics of micelle formation. (4)

(c) Write short notes on the following terms: (3+3)

(i) Reverse micelle

(ii) Hydrophobic interaction

UNIT-V

9. (a) What is the cause of Schottky defects? Discuss the thermodynamics of the formation of Schottky defects in sodium chloride crystals. (2 + 6)

(b) Discuss the effect of temperature on the number of Frenkel defects. (2)

(c) Discuss two factors that govern the number of electrons in the conduction band. (4)

10. (a) Using band theory, discuss the conduction mechanism of Ga-doped silicon. (3)

(b) Explain the effect of temperature on the conductivity of Ga-doped silicon. (2)

(c) What do mean by F-colorcenters? Discuss one method for producing colorcenters. (1+2)

(d) Derive Bragg's equation for X-ray crystallography. (6)

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PG ODD SEMESTER EXAMINATION, 2022

CHEMISTRY

1st Semester

Course No. : CHMCC - 503

(Physical Chemistry- I)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(Answer any five questions, taking one from each unit)

UNIT - I

1. (a) Derive a rate expression of a reaction between ions influenced by the ionic strength. (5)

(b) Show that for a gaseous bimolecular reaction

$$A(g) + B(g) \rightarrow (AB)^{\#} \rightarrow \text{Products},$$

$$E_a = \Delta H_m^{\#} + 2RT$$

Where subscript m stands for molar. (5)

(c) For the first-order isomerization of an organic compound at 130 °C, the activation energy is 108.4 kJmol^{-1} and the rate constant is 9.12×10^{-4} s^{-1}.Calculate the standard entropy of activation of the reaction. (4)

2. (a) Discuss the statistical mechanical derivation of the rate constant of a gaseousbimolecular reaction. (5)

(b) Drive expression for the influence of solvent on the rates of ionic reactions. (5)

(c) 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} $dm^{-3}\ mol^{-1}\ s^{-1}$ 40 °C. Calculate the activation energy and the pre-exponential factor. (4)

UNIT-II

3. (a) What do you mean by fast reactions? Discuss the Flash Photolysis Method for studying the kinetics of fast reactions. (1+3)

(b) What is meant by the term relaxation time? For a general reaction

$$A \rightleftharpoons B + C$$

which is first order in the forward direction and second order in the reverse direction.

Obtain the relaxatio n time expression using the principle of the temperature Jump technique. (1+5)

(c) Calculate the rate constant involved in the dissociation of viz. NH_4OH,

$$NH_4OH \leftrightarrow NH_4^+ + OH^-$$

When a 0.01 molar solution of is subjected to a sudden temperature jump termination at 25°C at which temperature, the equilibrium constant is 1.8×10^{-5} mol dm^{-3}. The observed relaxation time is 0.109 μs and $x_e = 4.1 \times 10^{-4}$mol dm^{-3}. (4)

4. (a) Derive a mathematical relation between the rate and the concentration of the substrate of the enzyme-catalyzed reaction. Discuss the variation of the concentration of the substrate on the rate of the reaction. (3+2)

(b) Discuss the effect of reactants concentrations on the rate of homogeneous acid-catalyzed hydrolysis reaction with a suitable example. (4)

(c) Using the Rice-Herzfeld mechanism for the reaction

$$H_2 + Br_2 \rightarrow 2HBr$$

Derive the rate law expression for the formation of HBr. (5)

UNIT-III

5. (a) With the help of the orbital energy level diagram, distinguish among three basic processes of photoelectron spectroscopy. (6)

(b) Explain the KL_IL_{II} Auger process with a diagram. (5)

(c) Explain the X-ray photoelectron spectrum of Pd metal. (3)

6. (a) Derive BET isotherm for multilayer coverage. Explain how BET isotherm changes with the magnitude of the constant 'c' by taking one specific example. (4 + 2)

(b) Obtain an expression for Gibbs adsorption isotherm. (5)

(c) Explain the Auger electron spectrum for $S_2O_3^{2-}$. (3)

UNIT-IV

7. (a) What are surfactants? Explain the differentclassifications of surfactants giving one example each. (1+3)

(b) Write a short note on the thermodynamics of micelle formation considering phase-separation model. (5)

(c) Explain the factors affecting the critical micelle concentration and micellar size. (5)