PG Odd Semester (CBCS) Exam., December—2018

CHEMISTRY

(1st Semester)

Course No. : CHMCC–104

(Physical Chemistry—II)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. *(a)* Discuss the Born model for the calculation of free energy for the 'ion-solvent' interaction mentioning the assumptions. 8

(b) Describe how pH of a solution can be determined using electromotive force method. 3

(c) Evaluate the equilibrium constant for the dissolution of AgCl(s) expressing the difference of the half-reactions

$$AgCl(s) \; e \quad Ag(s) \; Cl \; (aq)$$

$$Ag \; (aq) \; e \quad Ag(s)$$

having standard potentials of 0·22 V and 0·80 V respectively. 3

2. *(a)* Describe the general features of the Debye-Hückel theory of electrolyte solution. 8

(b) Deduce an expression for the e.m.f. of a concentration cell with transference. 3

(c) A zinc rod is placed in 0·1 *M* solution of zinc sulphate at 25 °C. Assuming that the salt is dissociated to the extent of 95 percent at this dilution, calculate the potential of the electrode at this temperature. $E^{\circ}_{(Zn^2 \; , \; Zn)}$ 0·76 volt. 3

UNIT—II

3. *(a)* Give a brief schematic presentation of the Helmholtz-Perrin model and Gouy-Chapman model of electrode-solution interface and discuss their limitations. 3+3+2=8

(b) Discuss the chemical origins of corrosion and useful strategies for preventing it. 4+2=6

4. *(a)* Derive an expression for Butler-Volmer equation showing the relationship between the net current density and overpotential of an electrochemical cell. Give a graphical presentation of over-potential versus current density in the 'high' and 'low' overpotential limits. 8+3=11

(b) Calculate the change in cathodic current density at an electrode when the potential difference changes from 1·0 V to 2·0 V at 25 °C.

$\frac{1}{2}$, f $9{\cdot}6485\times10^{4}$ C mol ^{1} 3

UNIT—III

5. *(a)* Why are solid state reactions difficult? Explain with one suitable example. 4

(b) Discuss the Wagner reaction mechanism of the formation of spinel. 4

(c) Distinguish between Schottky and Frenkel defects taking suitable example. 4

(d) What is interstitial solid solution? Explain with one example. 2

6. *(a)* Discuss the thermodynamics of formation of the defect in a crystal. 5

(b) Discuss the conduction mechanism in the intrinsic semiconductor and extrinsic semiconductor. 6

(c) Discuss the parameter that affects the conductivity of metal, semiconductor and insulator. 3

UNIT—IV

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

(b) Illustrate the processes Auger electron ejection in KL_1L_{11} Auger process. 4

(c) Explain how BET isotherm changes with the magnitude of the constant C taking one specific example. 4

8. *(a)* Obtain an expression for Gibbs' adsorption isotherm. 6

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

(c) Explain Auger electron spectra for $S_2O_3^{2}$ ion. 3

(d) For a $1{\cdot}0\times10^{-4}$ *M* aqueous solution of *n*-butanoic acid $\frac{d}{dc}$ $0{\cdot}080\ \mathrm{Nm^{2}\ mol^{-1}}$ at 25 °C. Using Gibbs' adsorption equation, determine the surface excess of butanoic acid and also calculate the average surface area available to each molecule. 2

UNIT—V

9. *(a)* Explain the effect of temperature and pressure on critical micelle concentration and solubility. 2+2=4

(b) Write a short note on the kinetic of micelle formation. 5

(c) Write short notes on the following terms : 2½×2=5

(i) Micelle formation

(ii) Microemulsion

10. *(a)* Write a short note on the thermodynamic of micelle formation considering phase separation model. 5

(b) Explain the important factors affecting the critical micelle concentration of a surfactant and micellar size in aqueous solution. 5

(c) Write short notes on the following terms : 2×2=4

(i) Hydrophobic interaction

(ii) Reverse micelle

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