PG Odd Semester (CBCS) Exam., December—2017

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, selecting **one** from each Unit

UNIT—I

1. *(a)* Discuss the Born model for the calculation of free energy change, enthalpy change and entropy change for the ion-solvent interaction mentioning the assumptions. 10

(b) What are concentration cells? The standard potentials of Cu / Cu^{2} and Cu / Cu are 0·337 V and 0·530 V respectively. What is the equilibrium constant for the reaction

$$2Cu \rightleftharpoons Cu^{2} \quad Cu \ ?$$ 2+2=4

2. *(a)* Clearly stating the assumptions and approximations involved, give a concise account of the Debye-Hückel theory of electrolytic solution. 12

(b) How do you differentiate between electromotive force and electrode potential? 2

UNIT—II

3. *(a)* Define the term 'overpotential'. Obtain an expression showing the relationship between the net current density and overpotential of an electrochemical cell. Give a graphical presentation of overpotential versus current density in the 'high' and 'low' overpotential limits. 2+9=11

(b) With a suitably drawn diagram, explain the terms 'overpotential', 'innerpotential' and 'volta potential'. 3

4. *(a)* Describe the structure of the electrical double layer. What are the three important models that describe the electrical double layers? Explain them with illustrations and discuss their limitations. 11

(b) The corrosion current is related to the cell potential of the corrosion couple by $I_{corr} \quad Aje^{\frac{1}{4}fE}$, where the symbols have their usual meanings. What conclusions will you draw from the above expression? 3

UNIT—III

5. *(a)* Explain different steps involved in the formation of $MgAl_2O_4$. How can the progress of the reaction be monitored? 4+1=5

(b) Explain the defects in crystals. How can you distinguish between Schottky and Frenkel defects? 1+4=5

(c) How are F-centres produced? What is the importance of F-centre? 4

6. *(a)* By considering band theory, explain electronic structure and conductivity of *n*-type and *p*-type semiconductors. 3+3=6

(b) Discuss the factors which influence the solid-state reaction by considering the reaction of MgO and Al_2O_3 in 1 : 1 molar ratio to form $MgAl_2O_4$ spinel. 3

(c) What is a substitutional solid solution? What are the requirements of the substitutional solid solution? 1+4=5

UNIT—IV

7. *(a)* Obtain the expressions relating surface tension to energy and entropy. 4

(b) For water

$$d\ /dT \quad 1\ 64 \quad 10^{\ 4}\ \mathrm{JK}^{\ 1}\ \mathrm{m}^{\ 2}$$

From this and surface tension, calculate the specific surface energy of water at 25 °C. (Given, surface tension of water is $7\ 28 \quad 10^{\ 2}\ \mathrm{J\,m}^{\ 2}$). 3

(c) Obtain an expression relating surface excess concentration of solute with surface tension and discuss its consequences with surface active agent and surface inactive agent. 7

8. *(a)* Discuss the basic principle of Auger photoelectron spectroscopy with the help of the orbital energy diagram. Also discuss the application of Auger spectroscopy for studies of solids. 4+2=6

(b) Obtain an expression of BET isotherm for multilayer coverage. How does the shape of the BET isotherm change with the magnitude of the constant *C*? 6+2=8

UNIT—V

9. *(a)* Write a short note on the thermodynamics of micelle formation considering phase-separation model. 6

(b) What does the term solubilization imply? What are the factors that affect solubilization? 1+2=3

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

(i) Krafft phenomena

(ii) Micellization

10. *(a)* What is meant by critical micelle concentration? What are the factors affecting the critical micelle concentration and micellar size? 1+5=6

(b) Write short notes on the following terms : 2+2+2=6

(i) Hydrophobic interaction

(ii) Microemulsion

(iii) Reverse micelle

(c) What are surfactants? How are they classified? Give one example for each type of surfactants. 2

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