

Total No. of Questions : 6]

SEAT No. :

P1479

[5223]-52

[Total No. of Pages : 3

M.Sc.

**PHYSICAL CHEMISTRY**

**CH-411 : Surface Chemistry and Electro-Chemistry  
(2008 Pattern) (Old) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 80*

*Instructions to the candidates:*

- 1) *Answers to the TWO sections should be written in separate answer books.*
- 2) *All questions are compulsory.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logarithmic tables and calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

**Physico-Chemical Constants**

1.	Avogadro Number	N	= $6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	= $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ = $1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	= $6.626 \times 10^{-27} \text{ erg s}$ = $6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	= $4.803 \times 10^{-10} \text{ esu}$ = $1.602 \times 10^{-19} \text{ C}$
5.	1eV		= $23.06 \text{ k cal mol}^{-1}$ = $1.602 \times 10^{-12} \text{ erg}$ = $1.602 \times 10^{-19} \text{ J}$ = $8065.5 \text{ cm}^{-1}$
6.	Gas Constant	R	= $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ = $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ = $1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	= $96487 \text{ C equiv}^{-1}$
8.	Speed of light	c	= $2.997 \times 10^{10} \text{ cm s}^{-1}$ = $2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		= $4.184 \times 10^7 \text{ erg}$ = $4.184 \text{ J}$
10.	1 amu		= $1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	$\beta_e$	= $-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	$\beta_n$	= $5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	$m_e$	= $9.11 \times 10^{-31} \text{ kg}$

**P.T.O.**

### **SECTION-I**

**Q1)** Attempt any three of the following. **[15]**

- a) Explain the term wetting and nonwetting. Explain wetting as a capillary action phenomenon.
- b) Describe the microtome method for verification of Gibbs adsorption equation.
- c) Describe with a neat sketch, the volumetric method for the study of gas adsorption.
- d) Stating the assumptions, how is the surface area of a solid determined by using B.E.T. equation.
- e) What is flotation? Explain its mechanism.

**Q2)** Attempt any three of the following. **[15]**

- a) Discuss the role of zeolites as a catalyst in industrial processes.
- b) State at least three catalysts with reactions for heterogeneous catalysis. What is the method for naming catalyst?
- c) Explain the phenomenon of hysteresis on the basis of capillary condensation.
- d) Give the comparison between B.E.T. theory and H-J theory.
- e) Write a note on heterohomogeneous catalysis.

**Q3)** Solve any two of the following. **[10]**

- a) The volume of oxygen gas at 0°C and 101 kPa adsorbed on the surface of 1.00g of a sample of silica at 0°C was 0.284 cm<sup>3</sup> at 142.4 Torr and 1.430 cm<sup>3</sup> at 760 Torr. Determine the value of monolayer capacity  $V_{\text{mon}}$ .
- b) An insoluble compound 'X' spreads on water to give a gaseous type film at low concentrations. When 10<sup>-7</sup>g of 'X' is added to 200 cm<sup>2</sup> surface, the surface tension at 25°C is lowered by 0.20 dyne cm<sup>-1</sup>. Calculate the molecular weight of 'X'.
- c) The surface tension of an aqueous solution varies with concentration of solute according to equation  
 $\gamma = 70 - 350 C$ , where  $C = 0.05 \text{ M}$ .  
Calculate the value of K for the variation of surface excess of solute with concentration, where K is defined as  $K = \Gamma \cdot \sqrt{C}$ . The temperature is 25°C.

## SECTION-II

**Q4)** Answer any three of the following. **[15]**

- a) Write Bernal-Fowler equation for heat of solution, explain the terms involved in it.
- b) Explain the Gouy-Chapman diffuse layer theory for electrical double layer.
- c) Explain different way of transport of ions in solution.
- d) Explain the term ionic strength. How does it affect the thickness of ionic atmosphere and mean activity coefficient of an electrolyte?
- e) Write a note on electrosynthesis.

**Q5)** Answer any three of the following. **[15]**

- a) Explain the Wagner and Traud mechanism for corrosion of ultrapure metal.
- b) Derive Einstein relation between the absolute ionic mobility and diffusion coefficient.
- c) Describe with a neat labelled diagram  $H_2$ - $O_2$  fuel cell.
- d) What is passivation? Discuss the general mechanism of passivation.
- e) Explain the terms
  - i) Faradic efficiency
  - ii) Voltage efficiency
  - iii) Overall efficiency
  - iv) Maximum efficiency

**Q6)** Solve any two of the following. **[10]**

- a) The following reaction may be made to operate in fuel cell at 300K  
 $CH_4 + 2O_2 \rightleftharpoons CO_2 + 2H_2O(l)$ ,  $\Delta H_{300} = -890.4 \text{ KJ mol}^{-1}$ ,  
 $\Delta G_{300} = -818.0 \text{ KJ mol}^{-1}$  calculate
  - i) number of electrons transferred in overall cell reaction
  - ii) reversible emf of cell at 300K
  - iii) maximum efficiency
- b) Calculate the thickness of ionic atmosphere at 27°C in 0.05 M solution of LiCl.
- c) Calculate the ionic strength of mixture of 50ml 0.05 M  $ZnCl_2$  and 50 ml 0.15 M  $NH_4Cl$

