

2018

( Pre-CBCS )

( 5th Semester )

**CHEMISTRY**

SEVENTH PAPER (CHEM-353)

**( Physical Chemistry—II )***Full Marks : 55**Time : 2½ hours***( PART : A—OBJECTIVE )**

( Marks : 20 )

*The figures in the margin indicate full marks for the questions*

## SECTION—A

( Marks : 5 )

Tick (✓) the correct answer in the brackets provided :

1×5=5

**1.** The third law of thermodynamics states that in the limit  $T \rightarrow 0$ (a)  $G \rightarrow 0$  ( )(b)  $H \rightarrow 0$  ( )(c)  $U \rightarrow 0$  ( )(d)  $S \rightarrow 0$  ( )**2.** On dilution, equivalent conductance of a solution

(a) remains unchanged ( )

(b) decreases ( )

(c) increases and decreases ( )

(d) increases ( )

3. Nernst heat theorem is applicable to
- (a) pure solids only ( )
  - (b) pure gases only ( )
  - (c) solids and liquids ( )
  - (d) pure liquids only ( )
4. The transport number of cation and anion of an electrolyte is
- (a) 1 ( )
  - (b) 0 ( )
  - (c) 2 ( )
  - (d) -1 ( )
5. A tetragonal crystal possesses which of the following axes of symmetry?
- (a) Two-fold ( )
  - (b) Three-fold ( )
  - (c) Four-fold ( )
  - (d) Six-fold ( )

SECTION—B

( Marks : 15 )

Answer the following questions :

3×5=15

1. Describe briefly the effect of temperature on Maxwell's distribution of molecular velocities.
2. Derive a relationship between molar conductance and specific conductance, and hence the unit of molar conductance.
3. Describe the Lindemann theory of unimolecular reactions.
4. Write a note on interfacial angle.
5. Explain with example the enzyme catalysis.

( PART : B—DESCRIPTIVE )

( Marks : 35 )

*The figures in the margin indicate full marks for the questions*

1. (a) Define the following : 2  
(i) Most probable velocity  
(ii) Mean-free-path  
(b) Give an account of Maxwell distribution of molecular velocities. 3  
(c) Calculate the root-mean-square velocity of nitrogen at 27 °C and 70 cm pressure. Density of Hg = 13.6 g cm<sup>-1</sup>. 2

**OR**

2. (a) State and explain the law of equipartition of energy. 3  
(b) What is meant by degree of freedom of a molecule? 2  
(c) Explain the term 'collision diameter'. 2  
3. (a) Describe Nernst heat theorem. 3  
(b) What is residual entropy? 1  
(c) Derive Gibbs-Helmholtz equation. 3

**OR**

4. (a) State the third law of thermodynamics. 1  
(b) Derive an expression for the variation of chemical potential with temperature. 3  
(c) Derive Gibbs-Duhem equation and give its significance. 3  
5. (a) What is viscometer? Describe Ostwald's viscometer method for the determination of viscosity of liquid. 1+2=3  
(b) Define parachor. 1  
(c) Molecular parachor of decane (C<sub>10</sub>H<sub>22</sub>) is 424.2 and CH<sub>2</sub> group is 39. Calculate the atomic parachor of carbon and hydrogen. 3

**OR**

6. (a) What is enzyme catalysis? Describe some characteristics of enzyme catalysis. 1+2=3  
(b) What are liquid crystals? 1  
(c) Derive the Michaelis-Menten equation for enzyme-catalyzed reaction. 3
7. (a) What are meant by space lattice and unit cell? 1+1=2  
(b) Derive Bragg's equation. 3  
(c) Calculate the Miller indices of a crystal plane which cut through the crystal axis at  $(2a, 3b, c)$  and  $(6a, 3b, 3c)$ . 2

**OR**

8. (a) Define the following : 1×3=3  
(i) Centre of symmetry  
(ii) Plane of symmetry  
(iii) Axis of symmetry  
(b) Define Miller indices and law of rational indices. 2  
(c) What are the different kinds of Bravais lattices in a cubic unit cell? 2
9. (a) Define the terms 'specific conductivity' and 'equivalent conductivity' of a solution. 2  
(b) What is Ostwald dilution law? 2  
(c) The molar conductivities at infinite dilution of NaCl, HCl and CH<sub>3</sub>COONa are  $126.4 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$ ,  $426.1 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$  and  $97.0 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$  respectively at 25 °C. Calculate the molar conductivity at infinite dilution for CH<sub>3</sub>COOH. 3

**OR**

10. (a) State and explain Kohlrausch law. 2  
(b) Describe moving boundary method for the determination of transport number. 3  
(c) Molar ionic conductance at infinite dilution of Na<sup>+</sup> and Cl<sup>-</sup> ions are  $50.11 \times 10^{-4} \text{ Sm}^2 \text{ mol}^{-1}$  and  $76.34 \times 10^{-4} \text{ Sm}^2 \text{ mol}^{-1}$  respectively. Calculate the transport number of Na<sup>+</sup> and Cl<sup>-</sup> ions. 2

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