

2015

(5th Semester)

CHEMISTRY

SEVENTH PAPER (CHEM-353)

(Physical Chemistry—II)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(Marks : 35)

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

1. (a) Discuss in detail Maxwell's distribution law of molecular velocities. Illustrate the effect of temperature on this distribution. 3
- (b) Explain the term mean free path. 1
- (c) Calculate the root-mean-square velocity of nitrogen at 27 °C temperature and 70 cm pressure. 3

G16/136a

(Turn Over)

OR

2. (a) Explain the principle of equipartition of energy. 2
- (b) Calculate the mean free path for oxygen gas at 25 °C and 1 atmospheric pressure. The collision diameter of oxygen molecule = 361 pm. 2
- (c) Define molar heat capacity at constant volume. Show that heat capacity of any gas at constant volume should be equal to 12.5 J. 1+2=3
3. (a) Define chemical potential. Derive Gibbs-Duhem equation of variation of chemical potential. 1+2=3
- (b) Write the statement of third law of thermodynamics. 1
- (c) Explain how the absolute entropy of substance is determined with the help of third law of thermodynamics. 3

OR

4. (a) Derive Gibbs-Helmholtz equation for the calculation of ΔH at constant pressure. 3
- (b) What is Debye's T^3 law? Show that entropy of any substance at very low temperature when Debye's relation for heat capacities of crystals is valid, is one-third of the molar heat capacity. $1+3=4$
5. (a) What are liquid crystals? Mention their characteristics. 2
- (b) Derive an expression for the determination of surface tension by capillary rise method. 3
- (c) Discuss in detail the collision theory of bimolecular reactions. 2

OR

6. (a) Differentiate clearly between smectic and nematic liquid crystals. 2
- (b) Explain the terms additive property and consecutive property. Give examples. 3
- (c) Differentiate between homogeneous and heterogeneous catalyses. Give examples to illustrate your answer. 2

7. (a) What is turnover number? 1
- (b) Derive Bragg's equation for X-ray crystallography. 2
- (c) Explain the terms—
- (i) elements of symmetry;
 - (ii) plane of symmetry;
 - (iii) centre of symmetry;
- with examples in each case. 4

OR

8. (a) What are different kinds of Bravais lattices in a cubic unit cell? Calculate the number of atoms per unit cell in each of them. 6
- (b) What are Miller indices? 1
- OR
9. (a) Explain the term ionic mobility. 1
- (b) The H^+ ion, because of its heavy hydration and consequent large size and shape, should have a low mobility but its mobility is very high. How would you account for it? 3
- (c) What is meant by transport number of an ion? How would you measure it using Hittorf's method? 1+2=3

OR

10. (a) State and explain Kohlrausch law. 1½
- (b) For the strong electrolytes NaOH, NaCl and BaCl₂, the molar conductivities at infinite dilution are 248.1×10^{-4} , 126.5×10^{-4} and $280 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$ respectively. Calculate the Λ_m° for Ba(OH)₂. 2½
- (c) Write Debye-Hückel-Onsager equation for strong electrolyte. 1
- (d) Write a note on asymmetry effect. 2

2015

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CHEMISTRY

SEVENTH PAPER (CHEM-353)

(**Physical Chemistry—II**)

(PART : A—OBJECTIVE)

(Marks : 20)

The figures in the margin indicate full marks for the questions

SECTION—A

(Marks : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

1. The numbers of translational, rotational and vibrational degrees of freedom, respectively, for H₂O molecules are

(a) 3, 3, 3 ()

(b) 3, 2, 1 ()

(c) 1, 2, 3 ()

(d) 2, 2, 2 ()

2. Nernst heat theorem is applicable to

- (a) pure solids only ()
- (b) solids and liquids ()
- (c) solids, liquids and gases ()
- (d) pure gases only ()

3. An essential condition for mesomorphism to occur is that the molecule must be

- (a) isotropic ()
- (b) anisotropic ()
- (c) both (a) and (b) ()
- (d) None of the above ()

4. How many Na^+ and Cl^- ions are present in the unit cell of NaCl ?

(a) $\text{Na}^+ = 1, \text{Cl}^- = 1$ ()

(b) $\text{Na}^+ = 2, \text{Cl}^- = 2$ ()

(c) $\text{Na}^+ = 3, \text{Cl}^- = 3$ ()

(d) $\text{Na}^+ = 4, \text{Cl}^- = 4$ ()

5. The SI unit of specific conductance is

(a) $\text{ohm}^2 \text{cm}^{-1}$ ()

(b) $\text{ohm} \times \text{cm}$ ()

(c) S m^{-1} ()

(d) $\text{S} \times \text{m}$ ()

(4)

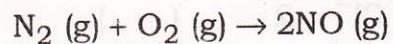
SECTION—B

(Marks : 15)

Answer the following questions :

3×5=15

1. Calculate the standard entropy change of the reaction



Given standard entropies for

$$\text{N}_2 (\text{g}) = 191.62 \text{ JK}^{-1} \text{ mol}^{-1}$$

$$\text{O}_2 (\text{g}) = 205.01 \text{ JK}^{-1} \text{ mol}^{-1}$$

$$\text{NO} (\text{g}) = 210.45 \text{ JK}^{-1} \text{ mol}^{-1}$$

2. Derive a relationship between molar conductance and specific conductance and hence the unit of molar conductance.

(A) $\text{Na}^+ = 1, \text{Cl}^- = 1$

(B) $\text{Na}^+ = 2, \text{Cl}^- = 2$

(C) $\text{Na}^+ = 3, \text{Cl}^- = 3$

(D) $\text{Na}^+ = 4, \text{Cl}^- = 4$

3. The SI unit of specific conductance is

(A) $\text{ohm}^2 \text{cm}^{-2}$

(B) $\text{ohm} \times \text{cm}$

(C) ohm^{-1}

(D) $\text{ohm}^{-1} \text{cm}^{-1}$

3. Write a note on interfacial angles.

Answer: Interfacial angle is the angle between two adjacent faces of a crystal. It is denoted by θ . The interfacial angle is a characteristic property of a crystal and is used to identify it.

4. Calculate the standard entropy change of the reaction



at 298 K. The standard molar entropies are

$$\text{N}_2(\text{g}) = 191.62 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$\text{O}_2(\text{g}) = 205.14 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$\text{NO}(\text{g}) = 210.76 \text{ J K}^{-1} \text{ mol}^{-1}$$

4. Explain with examples the enzyme catalysis.

- (a) Collision diameter
- (b) Collision frequency

CHEMISTRY

SEVENTH PAPER (CHEM-353)

(Physical Chemistry - II)

(PART - I - OBJECTIVE)

(Marks - 20)

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

SECTION - A

(Marks - 5)

For a 20% mark against the correct answer in the

1/5=5

5. The numbers of translational, rotational and vibrational degrees of freedom, respectively, for diatomic molecules are

- (a) 3, 3, 3
- (b) 3, 2, 1
- (c) 1, 2, 3
- (d) 2, 3, 5

5. Define the following :

- (a) Collision diameter
- (b) Collision frequency

- (b) solids and liquids
- (c) solids, liquids and gases
- (d) pure gases only

3. An essential condition for anisotropy to occur is that the molecules must be

- (a) isotropic
- (b) anisotropic
- (c) both (a) and (b)
- (d) None of the above ***