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(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

(*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

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 $BaCl_2$, the molar conductivities at infinite dilution are $248 \cdot 1 \times 10^{-4}$, $126 \cdot 5 \times 10^{-4}$ and 280×10^{-4} S m^2 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

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(5th Semester)

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 H_2O molecules are

   (a) 3, 3, 3   ( )

   (b) 3, 2, 1   ( )

   (c) 1, 2, 3   ( )

   (d) 2, 2, 2   ( )

/136

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   (   )

V/CHEM (vii)/**136**

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

    (a) $Na^+ = 1$, $Cl^- = 1$ (   )

    (b) $Na^+ = 2$, $Cl^- = 2$ (   )

    (c) $Na^+ = 3$, $Cl^- = 3$ (   )

    (d) $Na^+ = 4$, $Cl^- = 4$ (   )

5. The SI unit of specific conductance is

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

    (b) $ohm \times cm$ (   )

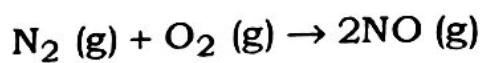   *(c)* $S\ m^{-1}$ (   )

    (d) $S \times m$ (   )

SECTION—B

(*Marks* : 15)

Answer the following questions :   3×5=15

1. Calculate the standard entropy change of the reaction

$$N_2 (g) + O_2 (g) \rightarrow 2NO (g)$$

Given standard entropies for

$N_2 (g) = 191 \cdot 62 \, JK^{-1} \, mol^{-1}$

$O_2 (g) = 205 \cdot 01 \, JK^{-1} \, mol^{-1}$

$NO (g) = 210 \cdot 45 \, JK^{-1} \, mol^{-1}$

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

3. Write a note on interfacial angles.

4. Explain with examples the enzyme catalysis.

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5. Define the following :

    (a) Collision diameter

    (b) Collision frequency

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