2 0 1 7

(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)* What is meant by mean free path?   1

   (b) Discuss the effect of temperature on the distribution of molecular velocities.   3

   (c) Calculate the root mean square velocity, average velocity and most probable velocity of sulphur dioxide (SO_2) at 427 °C.
   ($R = 8 \cdot 314 \times 10^7$ ergs/degree/mole)   3

OR

2. *(a)* What is meant by equipartition of energy?   1

   (b) What is meant by degree of freedom of a molecule? How is this classified into different types?   3

   (c) Using the principle of equipartition of energy estimate the energy of H_2, H_2O and CO_2 at room temperature, assuming that all the degrees of freedom are excited and contribute towards the energy of the molecules.   3

3. *(a)* State the third law of thermodynamics.   1

   (b) Discuss the term Gibbs' free energy.   3

   (c) How does work function vary with temperature and volume?   3

OR

4. *(a)* What is meant by chemical potential?   1

   (b) Derive an expression for the variation of chemical potential with temperature.   3

   (c) Derive Gibbs-Duhem equation.   3

5. *(a)* Define liquid crystal. Write the difference between smectic and nematic liquid crystals.   1+2=3

(3)

(b) What is the effect of temperature on surface tension? 2

(c) What is meant by optical exaltation? 2

OR

6. *(a)* What is acid-base catalysis? 2

(b) Discuss in detail the collision theory of bimolecular reaction. 3

(c) What is meant by viscosity of liquid? 2

7. *(a)* What are the different kinds of Bravais lattices in a cubic unit cell? 2

(b) How many atoms are present within—

(i) simple cubic unit cell;

(ii) face-centred cubic unit cell;

(iii) body-centred cubic unit cell? 3

(c) What is meant by crystal habit and interfacial angle? 2

OR

8. *(a)* What is meant by law of rational indices? 2

(b) The radius of the cation in a solid measures 33 pm and the anion measures 70 pm. Predict the coordination number of cation and structure of the solid. 3

(c) Define centre of symmetry and plane of symmetry. 1+1=2

(4)

9. *(a)* What is meant by equivalent conductance and molar conductance? 2

(b) How will you test the validity of Ostwald dilution law? 2

(c) At 291 K, the molar conductivites at infinite dilution of NH_4Cl, NaOH and NaCl are 12·8, 217·4 and 108·9 ohm^{-1} cm^2 respectively. If the molar conductivity of a centinormal solution of NH_4OH is 9·33 $ohm^{-1}cm^2$, what is the percentage dissociation of NH_4OH at this dilution? 3

OR

10. *(a)* Derive the relationship between the ionic conductance and transport number. 2

(b) Describe moving boundary method for the determination of transport number. 2

(c) Calculate the transport number of H^+ ions and Cl^- ions from the following data obtained by the moving boundary method using cadmium chloride as the indicator electrolyte. 3

Concentration of HCl = 0·1 *N*
Mass of silver deposited in the
 coulometer = 0·1209 gm
Movement of boundary = 7·5 cm
Cross-section of the tube = 1·24 cm^2

★★★

Subject Code : CHEM/V/07

Booklet No. A

Date Stamp ....

2 0 1 7

(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. For a non-linear polyatomic molecule HCHO the vibrational degree of freedom is

    (a)   5   (   )

    (b)   4   (   )

    (c)   1   (   )

    (d)   6   (   )

2. According to the third law of thermodynamics at absolute zero, for a perfect crystal entropy, change is

(a) positive   (   )

(b) negative   (   )

(c) zero   (   )

(d) None of the above   (   )

3. Bragg's equation is

(a) $n\lambda = 2 \sin\theta$ (   )

(b) $n\lambda = 2d \sin\theta$ (   )

(c) $\sin\theta = n\lambda$ (   )

(d) $\lambda = \sin\theta$ (   )

4. The reciprocal of electrical resistance is called

    (a)   conductance   (   )

    (b)   resistivity   (   )

    (c)   molar conductance   (   )

    (d)   specific conductance   (   )

5. The Miller indices of a crystal plane which cuts through the crystal axes ∞, b, ∞ is

    (a)   0, 1, 0   (   )

    (b)   0, 0, 1   (   )

    (c)   1, 1, 0   (   )

    (d)   1, 0, 0   (   )

(4)

SECTION—B

(*Marks* : 15)

Answer the following questions :   3×5=15

1. What is meant by most probable velocity, collision diameter and root mean square velocity?

2. What is meant by additive and constitutive property?

3. X-rays of wavelength equal to 0·314 nm gives a first-order diffraction from the surface ot a crystal when the value of θ is 10·5°. Calculate the distance between the planes in the crystal parallel to the surface ($\sin \theta = 0 \cdot 1822$).

4. What is meant by transport number of an ion? Show that the sum of transport numbers of cation and anion is unity.

5. Calculate the various degrees of freedom for He, HCl and C_6H_6.

★ ★ ★