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(October)

CHEMISTRY

(Honours)

(Part-A : Physical)

(Chem–H–502)

Marks : 37

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. (a) Using Maxwell's law of distribution of molecular velocities, show that the most probable velocity of a molecule is $\sqrt{\dfrac{2RT}{M}}$, the terms having their usual meanings. **4**

(b) Explain the following terms : **1½×2=3**
   (i) Degrees of freedom of motion
   (ii) Continuity of state

(c) Calculate the root-mean-square velocity of CO_2 molecule at 27 °C. (Given, $R = 8·314$ J-K^{-1} mol^{-1}) **2**

(Turn Over)

(2)

OR

2. (a) Define mean free path of a molecule. What are the effects of increase of temperature and pressure on the mean free path? 4

(b) Draw $P\text{-}V$ isotherm of carbon dioxide and mention the salient features of the isotherm. 3

(c) The van der Waals' constants of a gas are $a = 0.751 \, dm^6 \, atm \, mol^{-2}$ and $b = 0.0226 \, dm^3 \, mol^{-1}$. Calculate its critical volume and critical pressure. 2

3. (a) Describe the method for determination of viscosity by Ostwald's viscometer. 3

(b) Define additive property and constitutive property giving one example for each. $1\frac{1}{2}+1\frac{1}{2}=3$

OR

4. (a) Define dipole moment. How are dipole moments used to distinguish between cis- and trans-isomers of dichloro-ethylene? $1+2=3$

(3)

(b) Calculate the molar refraction of acetic acid (CH_3COOH) at a temperature at which its density is $1.046 \, g \, cm^{-3}$. The experimentally observed value of refractive index at this temperature is 1.3715. 3

5. (a) Describe the powder method for the determination of the crystal structure of sodium chloride. 3

(b) Calculate the number of atoms contained within (i) a primitive cubic unit cell, (ii) a body-centred cubic unit cell and (iii) a face-centred cubic unit cell. 3

OR

6. (a) Tabulate the seven crystal systems along with their geometrical characteristics. 4

(b) Find the interplanar distance in a crystal in which series of planes produce a first-order reflection from a copper X-ray tube. Given $\lambda = 1.539 \, Å$ at an angle of $22.5°$. 2

7. (a) Derive an expression for the chemical potential of a component in an ideal mixture. 5

(b) State the third law of thermodynamics.   2

OR

8. *(a)* Derive the Maxwell's relation

$$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$$

   3

(b) Explain the following terms :   2×2=4
    (i) Partial molar quántities
    (ii) Residual entropy

9. *(a)* Discuss the collision theory of reaction rates. Mention one of its limitations.   4

(b) Write notes on the following :   2½×2=5
    (i) Homogeneous catalysis
    (ii) Parallel reactions

OR

10. *(a)* Write a note on consecutive reactions and obtain the rate expression for such reactions.   5

(b) Explain briefly the following :   2×2=4
    (i) Opposing or reversible reactions
    (ii) Steady-state approximation

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