2022

(February)

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)* Discuss Maxwell's distribution of molecular velocities. What is the effect of temperature on distribution of molecular velocities? 3+1=4

(b) Discuss the principle of equipartition of energy. 3

(c) Calculate the root-mean-square velocity of CO_2 molecule at 27 °C.

[Given, R 8 314 J k ^{1} mol ^{1}] 2

OR

2. *(a)* State the law of corresponding states and derive the reduced equation of state. 3

(b) Calculate the various degrees of freedom of H_2O and CO_2 molecules. 1½+1½=3

(c) Explain the following : 1+1+1=3

(i) Collision frequency

(ii) Mean free path

(iii) Vapour density

3. *(a)* Define surface tension of a liquid. Describe the capillary rise method for determining surface tension of a liquid. 1+3=4

(b) Calculate the molar refraction of acetic acid at a temperature at which its density is 1·046 g cm ^{3}. The refractive index at this temperature is 1·3715. 2

OR

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

(b) Define additive property and constitutive property giving one example for each. 1½+1½=3

5. *(a)* Define the following : 1+1+1=3

(i) Plane of symmetry

(ii) Axis of symmetry

(iii) Centre of symmetry

(b) Calculate the number of atoms present per unit cell in *(i)* primitive cubic, *(ii)* body-centred cubic and *(iii)* face-centred cubic. 1+1+1=3

OR

6. *(a)* Describe the powder method for the determination of crystal structure. 3

(b) Find the interplanar distance in a crystal in which series of planes produce a first-order reflection at an angle of 22·5°, when X-rays of wavelength 1·539 Å are used. 3

7. *(a)* Derive an expression for the chemical potential of a component in an ideal mixture. 4

(b) Explain the following : 1½+1½=3

(i) Residual entropy

(ii) Partial molar quantities

OR

8. *(a)* Derive Gibbs-Duhem equation for a mixture consisting of i number of components. 3

(b) State the third law of thermodynamics. How does the third law help in determining the absolute entropy of a substance? 1+3=4

9. *(a)* Discuss the transition state theory of bimolecular reactions. 5

(b) Write notes on the following : 2+2=4

(i) Opposing reactions

(ii) Homogeneous catalysis

OR

10. *(a)* Derive the Michaelis-Menten equation for an enzyme-catalyzed reaction. 5

(b) Write notes on the following : 2+2=4

(i) Steady-state approximation

(ii) Parallel reactions

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