2022

(November)

CHEMISTRY

(Honours)

(Chem–H–502)

(Part—A : Physical)

Marks : 37

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. *(a)* Write Maxwell's distribution of molecular speed. What is the effect of temperature on distribution of molecular speed? 4

(b) Explain the following : 1½×2=3

(i) Viscosity of gases

(ii) Limiting density

(c) Calculate the various degrees of freedom of the following molecules : 2

H_2O and CO_2

OR

2. *(a)* Discuss the principle of equipartition of energy. 4

(b) Derive the relationship among most probable velocity, average velocity and root mean square velocity. 3

(c) Calculate the reduced pressure and reduced volume of one mole of methane gas confined to a volume of $5\,dm^3$ under a pressure of 5 atm. The critical constants of methane are—

$V_c = 0{\cdot}0988\ dm^3\ mol^{-1}$;

$P_c = 54{\cdot}6$ atm. 2

3. *(a)* What is surface tension of a liquid? Describe the method for determination of surface tension by capillary rise method. 1+3=4

(b) Calculate the molar refraction of acetic acid at a temperature at which its density is $1{\cdot}046\ g\,cm^3$. The observed value of refractive index at this temperature is 1·3716. 2

OR

4. *(a)* Derive Clausius-Mosotti equation for non-polar molecules. 4

(b) The bond length of H—I is 1·60 Å and its dipole moment is 0·38 D. Calculate the percentage of ionic character of the H—I bond. 2

5. *(a)* Derive Bragg's equation for X-ray diffraction of a crystal. 3

(b) What is symmetry in a crystal? Define plane and axis of symmetry in a simple cubic crystal. 1+2=3

OR

6. *(a)* What are Bravais lattices? How do you calculate the number of atoms per unit cell in a cubic crystal system? 1+3=4

(b) The second-order reflection of X-rays from (100) planes of NaCl occurs at 29·3°. If the wavelength used is 1·54 Å, calculate the distance between two successive (100) planes in NaCl. 2

7. *(a)* Derive phase rule equation from the concept of chemical potential. 4

(b) Explain the following : 1½×2=3

(i) Thermodynamic scale of temperature

(ii) Concept of residual entropy

OR

8. *(a)* Derive Gibbs-Duhem equation for a mixture consisting of i number of components. 4

(b) Explain how the absolute entropy of a substance is determined with the help of third law of thermodynamics. 3

9. *(a)* Derive Michaelis-Menten equation for an enzyme-catalysed reaction. 5

(b) Discuss the collision theory for the kinetics of bimolecular reactions. 4

OR

10. *(a)* Obtain the rate expression for an opposing reaction in which the forward as well as reverse reactions are both first order. 5

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

(i) Homogenous catalysis

(ii) Steady-state approximation

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