

(c) Describe the different symmetry elements that can be present in a molecule with examples.

(d) Explaining the terms, write down the expression for Maxwell Boltzmann distribution of molecular speeds.

Calculate the values of most probable speed, average speed and root mean square speed for hydrogen gas at 273 K. (2,3,5,5)

6. (a) Correct the statements giving suitable reasons:

(i) The product of pressure and volume of a fixed amount of a gas is independent of temperature.

(ii) It is possible to liquefy an ideal gas.

(iii) Addition of surfactants increase the surface tension of water.

(iv) Face centred cubic crystals have 2 lattice points per unit cell.

(b) Arrange root mean square, most probable and average speeds in the order of decreasing value. Discuss the effects of temperature and pressure on these speeds. (4×3,3)

(1000)

Your Roll No.....

Sr. No. of Question Paper : 1241

D

Unique Paper Code : 2174001011

Name of the Paper : GE7: States of Matter

Name of the Course : B.Sc. (Hons) / B.Sc. Prog.

Semester : I

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **four** questions.
3. Use of scientific calculators is allowed.

1. (a) At 20°C, pure water with an absolute viscosity of $1.002 \times 10^{-3} \text{ N m}^{-2} \text{ s}$ requires 102.2 s to flow through the capillary of an Ostwald viscometer. At 20°C, toluene requires 68.9 s. If the densities of water and toluene be 0.998 and 0.866 g cm^{-3} respectively, calculate the viscosity of toluene.

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- (b) Calculate the critical constants for HCl given the van der Waals constants are $a = 371.843 \text{ kPa dm}^6 \text{ mol}^{-2}$ and $b = 40.8 \text{ cm}^3 \text{ mol}^{-1}$.
- (c) Starting from the postulates of kinetic theory of gases, derive the kinetic gas equation :
- $$pV = \frac{1}{3} m N u^2$$
- (d) Explain the method of X-ray diffraction studies by rotating crystal method. (2,3,5,5)
2. (a) Why is the viscosity of ethanol greater than viscosity of ether?
- (b) Explain, why it is not possible to deduce the position of hydrogen atom from X-ray diffraction.
- (c) Derive the Bragg's equation
- $$n\lambda = 2d \sin \theta$$
- for the reflection of X-rays from the faces of a crystal and show that it can be written as
- $$\lambda = 2d_{hkl} \sin \theta$$
- (d) How does viscosity arise in case of gases? Derive the expression of the coefficient of viscosity of a gas in terms of average speed, mean free path and number of molecules per unit volume. (2,3,5,5)

3. (a) (i) State the law of constancy of interfacial angles.
- (ii) What are the differences between crystalline and amorphous solid?
- (b) Define surface tension. How is the surface tension of a liquid measured using capillary rise method?
- (c) Define mean free path. How does its value depend on temperature and pressure? (2+3,5,2+3)
4. (a) (i) What were the factors that led to the modification of the ideal gas equation?
- (ii) Derive the van der Waals equation of state.
- (b) What is the effect of addition of an impurity on surface tension of water?
- (c) Calculate the Miller indices of crystal planes which cut through crystal axes at
- (i) (2a, 3b, c) (ii) (2a, -3b, -3c) (iii) (1/2a, 1/4b, ∞ c) (3+3,3,6)
5. (a) State the law of corresponding states.
- (b) Why are X-rays used for diffraction studies of crystals?