[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5038 **L**

Unique Paper Code : 2174001011

Name of the Paper : STATES OF MATTER

Name of the Course : **B.Sc. (H)**

Semester : VIII

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) What do you mean by collision frequency? What is the effect on the number of collisions of (i) doubling the absolute temperature at constant pressure, and (ii) doubling the pressure at constant temperature?
   b) Determine the expressions of van der Waals constants a and b and gas constant R in terms of critical constants P_c and T_c. The critical constants for water are 647 K, 22.09 MPa and 0.0566 $dm^3\ mol^{-1}$. Calculate the values of a, b and R.
   c) What do you understand by 'compression factor Z' of a gas? Draw compression factor Z versus p plots for a) different gases at same temperature and b) for same gas at different temperatures. Explain these graphs.

   (5,5,5)

2. a) Explain the factors which led van der Waals to modify the ideal gas equation and hence derive the van der Waals equation of state
   b) What is meant by most probable velocity? For O_2 gas molecules, the root mean square speed at T_1, the average speed at T_2 and most probable speed at T_3 are all equal to $1.5 \times 10^3\ m\ s^{-1}$. Calculate T_1, T_2 and T_3.
   c) Draw and explain Andrews isotherms. How do these isotherms differ from the isotherms of van der Waals gas?

   (5,5,5)

P.T.O.

3. a) How is surface tension experimentally determined using a stalagmometer? In the determination of the surface tension of a liquid A by the drop number method, equal volumes of A and water gave 60 and 20 drops, respectively. Calculate the surface tension of A if $\rho(A) = 0.896$ g cm^{-3} and $\rho(\text{water}) = 0.964$ g cm^{-3} Given: $\gamma(H_2O) = 72.75 \times 10^{-3}$ N m^{-1}.

   b) Define coefficient of viscosity of a liquid and write down its SI unit. How does the viscosity of liquids depend on temperature? Explain.

   c) (i) The viscosity of glycerol is 0.85 Pa s at 20°C while that of ethanol is 0.0012 Pa s at the same temperature. Why?

   (ii) What is the meaning of cohesive and adhesive forces in context to surface tension?

(5,5,5)

4. a) Derive 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 $\lambda = 2d_{hkl} \sin\theta$

   b) Explain, why in the powder method, the crystallites in the powder crystal must have an average dimension of a few microns. What would happen if the size were too large or too small?

   c) Compute the Miller indices for a face having intercepts on the three axes as

   (i) $a, b, \infty c$ (ii) $2a, 3b, 4c$

(5,5,5)

5. a) What is the effect of addition of (i) NaCl and (ii) ethanol on the surface tension of water? Explain on the basis of molecular interactions.

   b) Given, the edge length for Fe and Pd crystals structures are 286 nm and 388 nm respectively while their densities are 7.86 g cm^{-3} and 12.16 g cm^{-3} respectively. Use this data to find the type of cubic lattice to which these crystals belong.

   c) Explain in detail, the different types of symmetry elements present in molecules.

(5,5,5)

6. write notes on any *three* of the following:
   a) Defects in crystals
   b) Kinetic theory of gases
   c) Screw axis and glide plane
   d) Cleansing action of soaps

(5,5,5)