(iii) Is it possible to liquefy an ideal gas? Explain.

(1)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1057 **D**

Unique Paper Code : 2172011103

Name of the Paper : DSC 3: Gaseous and Liquid State (Physical Chemistry-I)

Name of the Course : **B.Sc. (Hons) Chemistry**

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 **FOUR** questions in all. Question No. 1 is compulsory.
3. The questions should be numbered in accordance to the number in the question paper.

4. Use of Scientific Calculator is permitted.
(R = 8.314 JK^{-1} mol^{-1} k = 1.38 × 10^{-23} JK^{-1}
N_A = 6.023 × $10^{23}mol^{-1}$)

1. Answer **any 5** of the following:

(a) The viscosity of liquids decreases while that of gases increases with rise in temperature. Explain. (3)

(b) Explain the effect of temperature and pressure on collision number of a gas. (3)

(c) Roughly sketch the Maxwell distribution curve for the gas molecules in terms of molecular velocities. Label both axes and explain the effect of temperature on the distribution curve. (3)

6. (a) Describing the origin of viscosity in liquids, define coefficient of viscosity. Write units of viscosity. Derive the expression for determination of viscosity of a liquid by using Ostwald's viscometer method. (5)

(b) The viscosity of a liquid is 6 × 10^{-4} N s m^{-2} at 27 °C and 3 × 10^{-4} N s m^{-2} at 327 °C. Calculate the energy of activation of viscous flow assuming it to be constant over this temperature range. (5)

(c) (i) The viscosity of glycerol is very high as compared to that of water. Explain. (2)

(ii) Comment on the effect of addition of sucrose on the viscosity of water? (2)

5. (a) What do you mean by vapour pressure of a liquid? Explain the effect of temperature on vapour pressure of liquid giving expressions. (5)

(b) The enthalpy of vaporization of cyclohexane at its boiling point 127 °C is 400 J/g. If it is to be distilled at 26 °C to what value must the pressure be reduced? (5)

(c) Calculate the surface tension of liquid benzene and the radius of the capillary tube, if the level of water and benzene rose in the capillary is 9.9 cm and 4.5 cm, respectively. Given surface tension of water at 20 °C = 72.75 dyne cm^{-1}, density of water = 998.2 kg m^{-3} and density of benzene = 900 kg m^{-3}. (5)

(d) The composition of gases in the earth's atmosphere varies with height. Explain. (3)

(e) Discuss the effect of detergent concentration on the surface tension of water giving graphical representation. Why surface tension becomes nearly constant at higher concentrations of detergent? (3)

(f) Explain the dependence of surface tension on temperature and why the surface 3 tension of a liquid becomes zero at its critical temperature. (3)

2. (a) Describe the reasons for deviation of gases from ideal behaviour. Derive van der Waals equation of state for a real gas. (5)

(b) The coefficient of viscosity of CO_2 gas is 148 μP at 20 °C. Calculate its collision diameter and mean free path. (5)

(c) Draw labelled diagram of P-V isotherms of CO_2. Explain these isotherms and continuity of states. (5)

3. (a) Using the van der Waals equation of state, derive the following universal relation:

$$P_r = \frac{8T_r}{3V_r - 1} - \frac{3}{V_r}$$ (5)

(b) Calculate the fraction of methane gas molecules at 27 °C and 1 atm possessing velocities between 450±10 m/s. (5)

(c) Derive an expression for the coefficient of viscosity of a gas, η in terms of the mean free path, λ and show that η of a gas is dependent on temperature, but is independent of pressure. (5)

4. (a) Derive the expression: $P = P_o \exp(-Mgh/RT)$. Explain the effect of temperature of the gas on the variation of pressure with height in the light of this equation. (5)

(b) Determine the molar mass of a gas if its pressure falls to one-third of its value in a vertical distance of 4 meters at 27 °C. (5)

(c) The values of critical constants of a gas are: P_c = 45.6 atm, V_c = 0.0987 dm^3 mol^{-1} and T_c = 190.6 K. Calculate the van der Waals constants and critical compressibility factor. (5)