States Of Matter Gases & Liquids

Short Answer Type Questions

1. If 1 gram of each of the following gases are taken at STP, which of the gases will occupy (a) greatest volume and (b) smallest volume? CO, H_2O, CH_4, NO
2. Physical properties of ice, water and steam are very different. What is the chemical composition of water in all the three states.
3. The behaviour of matter in different states is governed by various physical laws. According to you what are the factors that determine the state of matter?
4. Use the information and data given below to answer the questions (a) to (c):
    - Stronger intermolecular forces result in higher boiling point.
    - Strength of London forces increases with the number of electrons in the molecule.
    - Boiling point of HF, HCl, HBr and HI are 293 K, 189 K, 206 K and 238 K respectively.
        - (a) Which type of intermolecular forces are present in the molecules HF, HCl, HBr and HI?
        - (b) Looking at the trend of boiling points of HCl, HBr and HI, explain out of dipole-dipole interaction and London interaction, which one is predominant here.
        - (c) Why is boiling point of hydrogen fluoride highest while that of hydrogen chloride lowest?

5. What will be the molar volume of nitrogen and argon at 273.15K and 1 atm?
6. A gas that follows Boyle's law, Charle's law and Avogadro's law is called an ideal gas. Under what conditions a real gas would behave ideally?
7. Two different gases 'A' and 'B' are filled in separate containers of equal capacity under the same conditions of temperature and pressure. On increasing the pressure slightly the gas 'A' liquefies but gas B does not liquify even on applying high pressure until it is cooled. Explain this phenomenon.
8. Value of universal gas constant (R) is same for all gases. What is its physical significance?
9. One of the assumptions of kinetic theory of gases states that "there is no force of attraction between the molecules of a gas." How far is this statement correct?
   Is it possible to liquefy an ideal gas? Explain.

10. The magnitude of surface tension of liquid depends on the attractive forces between the molecules. Arrange the following in increasing order of surface tension :
    water, alcohol (C_2H_5OH) and hexane [$CH_3(CH_2)_4CH_3$)].
11. Pressure exerted by saturated water vapour is called aqueous tension. What correction term will you apply to the total pressure to obtain pressure of dry gas?
12. Name the energy which arises due to motion of atoms or molecules in a body. How is this energy affected when the temperature is increased?
13. Name two intermolecular forces that exist between HF molecules in liquid state.
14. One of the assumptions of kinetic theory of gases is that there is no force of attraction between the molecules of a gas.
    State and explain the evidence that shows that the assumption is not applicable for real gases.
15. Compressibility factor, Z, of a gas is given as
    Z = (pV/nRT)
    (i) What is the value of Z for an ideal gas?
    (ii) For real gas what will be the effect on value of Z above Boyle's temperature?
16. The critical temperature (Tc) and critical pressure (pc) of CO_2 are 30.98°C and 73 atm respectively. Can CO_2 (g) be liquefied at 32°C and 80 atm pressure?
17. For real gases the relation between p, V and T is given by van der Waals equation:

$$\left(p+\frac{an^2}{V^2}\right)(V-nb) = nRT$$

    where 'a' and 'b' are van der Waals constants, 'nb' is approximately equal to the total volume of the molecules of a gas.
    'a' is the measure of magnitude of intermolecular attraction.
    (i) Arrange the following gases in the increasing order of 'b'. Give reason.
    O_2, CO_2, H_2, He
    (ii) Arrange the following gases in the decreasing order of magnitude of 'a'.
    Give reason.

CH_4, O_2, H_2

18. The relation between pressure exerted by an ideal gas (pideal) and observed pressure (preal) is given by the equation

    $P_{ideal} = P_{real} + (an^2/V^2)$

    If pressure is taken in Nm−2, number of moles in mol and volume in m^3, Calculate the unit of 'a'.

    What will be the unit of 'a' when pressure is in atmosphere and volume in dm^3?
19. Name two phenomena that can be explained on the basis of surface tension.
20. Viscosity of a liquid arises due to strong intermolecular forces existing between the molecules. Stronger the intermolecular forces, greater is the viscosity. Name the intermolecular forces existing in the following liquids and arrange them in the increasing order of their viscosities. Also give reason for the assigned order in one line.

    Water, hexane ($CH_3CH_2CH_2CH_2CH_2CH_3$), glycerine ($CH_2OH\ CH(OH)\ CH_2OH$)
21. Explain the effect of increasing the temperature of a liquid, on intermolecular forces operating between its particles, what will happen to the viscosity of a liquid if its temperature is increased?
22. The variation of pressure with volume of the gas at different temperatures can be graphically represented as shown in Fig. 5.3.

    On the basis of this graph answer the following questions.

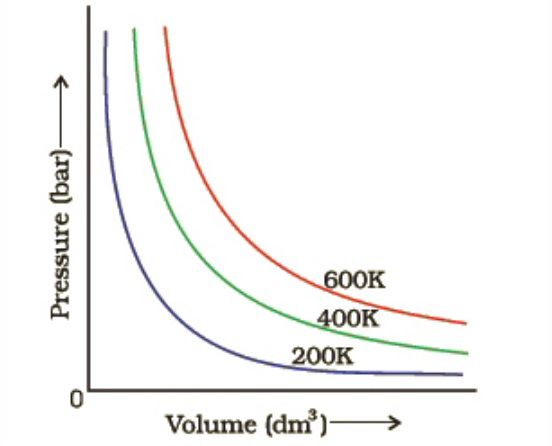

Fig. 5.3

- (i) How will the volume of a gas change if its pressure is increased at constant temperature?
- (ii) At a constant pressure, how will the volume of a gas change if the temperature is increased from 200K to 400K?

23. Pressure versus volume graph for a real gas and an ideal gas are shown in Fig. 5.4. Answer the following questions on the basis of this graph.

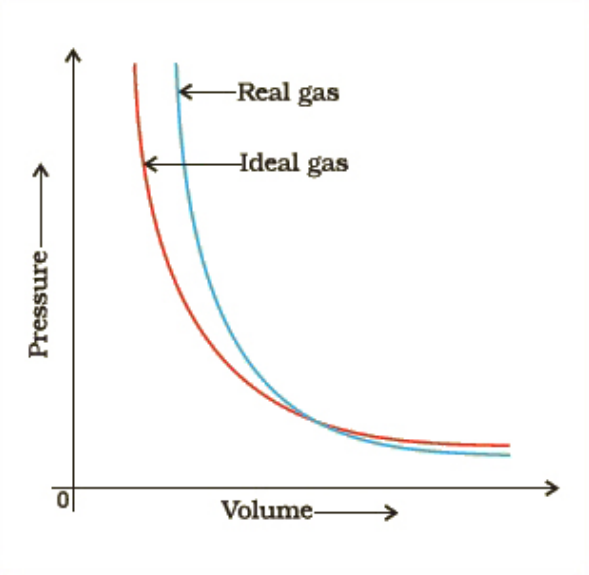

Fig. 5.4

- (i) Interpret the behaviour of real gas with respect to ideal gas at low pressure.
- (ii) Interpret the behaviour of real gas with respect to ideal gas at high pressure.
- (iii) Mark the pressure and volume by drawing a line at the point where real gas behaves as an ideal gas.

Long Answer Type Questions

1. Isotherms of carbon dioxide at various temperatures are represented in Fig. 5.5. Answer the following questions based on this figure.

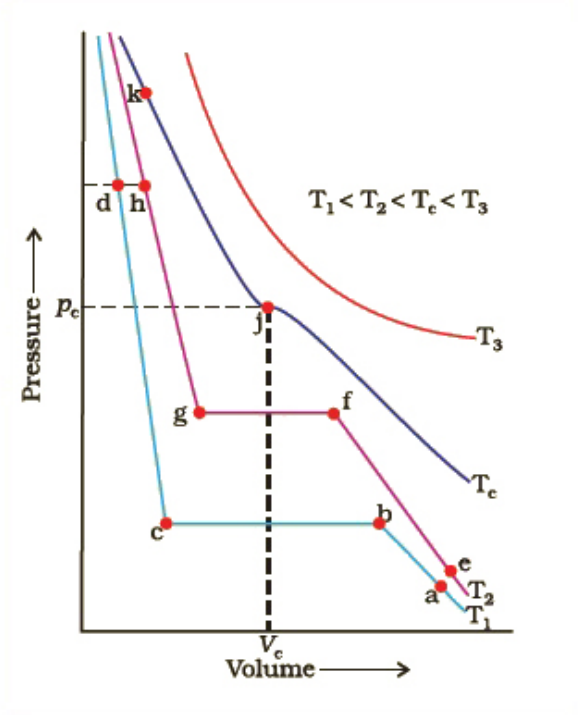

***Fig.** 5.5*

- (i) In which state will CO_2 exist between the points a and b at temperature T_1?
- (ii) At what point will CO_2 start liquefying when temperature is T_1?
- (iii) At what point will CO_2 be completely liquefied when temperature is T_2.
- (iv) Will condensation take place when the temperature is T_3.
- (v) What portion of the isotherm at T_1 represent liquid and gaseous CO_2 at equilibrium?

2. The variation of vapour pressure of different liquids with temperature is shown in Fig. 5.6.

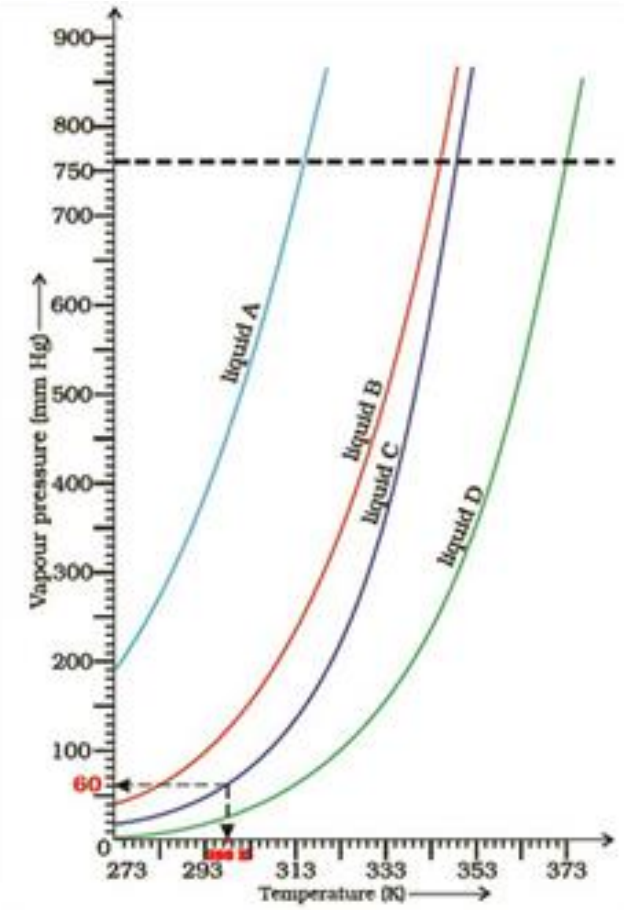

Fig. 5.6

- (i) Calculate graphically boiling points of liquids A and B.
- (ii) If we take liquid C in a closed vessel and heat it continuously. At what temperature will it boil?
- (iii) At high altitude, atmospheric pressure is low (say 60 mm Hg). At what temperature liquid D boils?
- (iv) Pressure cooker is used for cooking food at hill station. Explain in terms of vapour pressure why is it so?

3. Why does the boundary between liquid phase and gaseous phase disappear on heating a liquid upto critical temperature in a closed vessel? In this situation what will be the state of

the substance?

4. Why does sharp glass edge become smooth on heating it upto its melting point in a flame? Explain which property of liquids is responsible for this phenomenon.
5. Explain the term 'laminar flow'. Is the velocity of molecules same in all the layers in laminar flow? Explain your answer.
6. Isotherms of carbon dioxide gas are shown in Fig. 5.7. Mark a path for changing gas into liquid such that only one phase (i.e., either a gas or a liquid) exists at any time during the change. Explain how the temperature, volume and pressure should be changed to carry out the change.

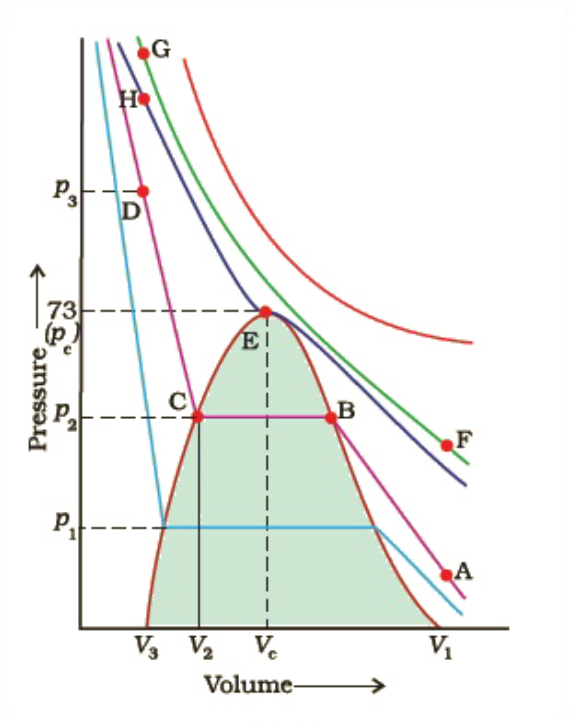

Fig. 5.7