States of Matter

Date Planned : __ / __ / __	CBSE Pattern	Expected Duration : 90 Min
Actual Date of Attempt : __ / __ / __	Level-0	Exact Duration :_____

Very Short Answer Type (1 Mark)

1. The van der Waals constant 'b' for oxygen is 0.0318 L mol^{-1}. Calculate the diameter of the oxygen molecule.

2. A gas is filled into a bulb connected to an open limb manometer. The level of mercury in the open arm is 2.1 cm lower than that in the other arm of the manometer. The atmospheric pressure is 740 mm. What is the pressure of the gas?

3. Why in the case of hydrogen and helium, the compressibility factor is always greater than 1 and increases with increase of pressure?

4. What do you understand by 'triple point' of a substance?

5. What is Boyle temperature?

6. What is the effect of temperature on

(i) Surface tension and **(ii)** Viscosity?

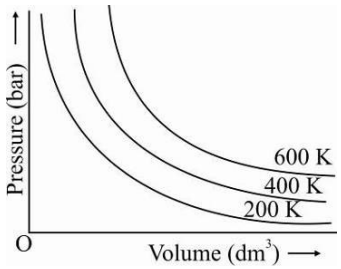
Short Answer Type-I (2 Marks)

7. An iron cylinder contains helium at a pressure of 250 kPa at 300K. The cylinder can withstand a pressure of 1×10^6 Pa. The room in which cylinder is placed catches fire. Predict whether the cylinder will blow up before it melts or not. (M.P. of the cylinder = 1800 K).

8. A large flask fitted with a stop-cock is evacuated and weighted; its mass is found to be 134.567 g. It is then filled to a pressure of 735 mm at 31°C with a gas of unknown molecular mass and then reweighed; its mass is 137.456g. The flask is then filled with water and weighed again; its mass is now 1067.9g. Assuming that the gas is ideal, calculate the molar mass of the gas.

9. Calculate the pressure exerted by 110 g of carbon dioxide in a vessel of 2 L capacity at 37°C. Given that the van der Waal's constants are a = 3.59 L^2 atm mol^{-2} and b = 0.0427 L mol^{-1}. Compare the value with the calculated value if the gas were considered as ideal.

10. The variation of pressure with volume of the gas at different temperatures can be graphically represented as shown in figure. On the basis of this graph answer the following questions.



(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 200 K to 400 K?

11. 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?

12. Explain the term 'laminar flow'. Is the velocity of molecules same in all the layers in laminar flow? Explain your answer.

13. Assuming the same pressure in each case, calculate the mass of hydrogen required to inflate a balloon to a certain volume at 100°C if 3.5 g He is required to inflate the balloon to half the volume at 25°C. (At masses H = 1, He = 4).

Short Answer Type-II (3 Marks)

14. An open flask containing air is heated from 300 K to 500 K. What percentage of air will be escaped to the atmosphere, if pressure is keeping constant?

15. 2.9 g of a gas at 95°C occupied the same volume as 0.184 g of hydrogen at 17°C at the same pressure. What is the molar mass of the gas?

16. 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 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?

17. Give reasons for the following:

(i) The size of weather balloon becomes larger and larger as it ascends into higher altitudes.

(ii) Tyres of automobiles are inflated to lesser pressure in summer than in winter.

18. 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' constant, '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

19. The relation between pressure exerted by an ideal gas (p_{ideal}) and observed pressure (p_{real}) is given by the equation,

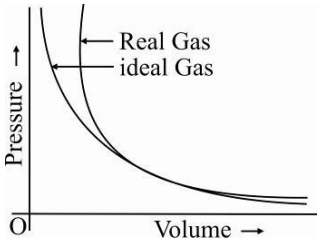
$$p_{ideal} = p_{real} + \frac{an^2}{V^2}$$

(i) If pressure is taken in Nm^{-2}, number of moles in mol and volume in m^3, calculate the unit of ' a '.

(ii) What will be the unit of ' a ' when pressure is in atmosphere and volume in dm^3 ?

Long Answer Type (5 Marks)

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

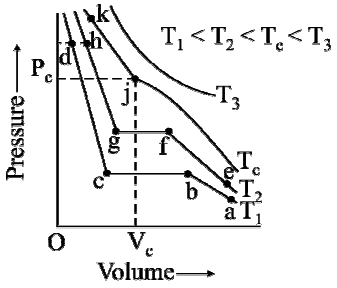


(i) Interpret the behaviour of real gas with respect to ideal gas at low pressure.

(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.

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



(i) In which state will CO_2 exist between the points a and b at temperature T_1 ?

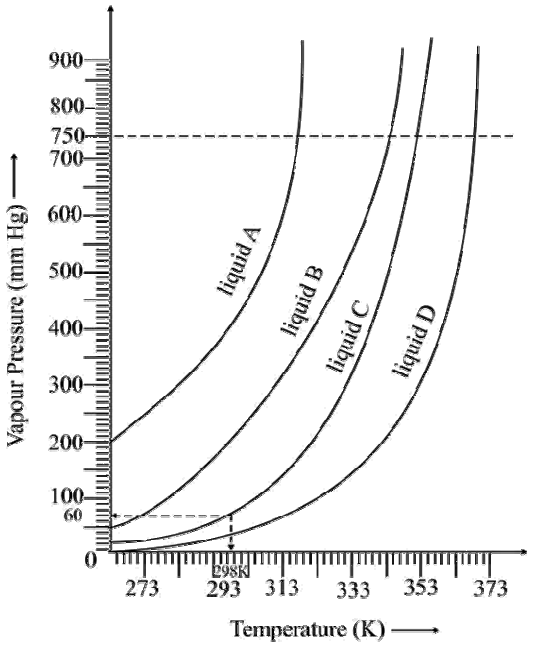
(ii) At what point will CO_2 start liquefying when temperature is T_1?

(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?

22. The variation of vapour pressure of different liquids with temperature is shown in figure



(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 ?

23. Two containers A and B have the same volume. Container A contains 5 moles of O_2 gas. Container B contains 3 moles of He and 2 moles of N_2. Both the containers are separately kept in vacuum at the same temperature. Both the containers have very small orifices of the same area through which the gases leak out. Compare the rate of effusion of O_2 with that of He gas mixture.

24. A balloon of diameter 20 meter weighs 100 Kg. Calculate its pay load, if it is filled with He at 1.0 atm and 27°C. Density of air is 1.2 $kg\,m^{-3}$. $\left[R = 0.082\,dm^3\,atm\,K^{-1}\,mol^{-1}\right]$

25. An open vessel at 27°C is heated until $3/5^{th}$ of the air in it has been expelled. Assuming that the volume of the vessel remains constant find

(a) the temperature at which vessel was heated?

(b) the air escaped out if vessel is heated to 900 K?

(c) temperature at which half of the air escapes out?