Question 9

3.7 g of a gas at 25°C occupied the same volume as 0.184g of hydrogen at 17°C and at the same pressure. What is the molecular weight of the gas? ***(1979)***

Given, $\text{moles} = \dfrac{\text{mass}}{\text{mol.wt}}$

mass of gas = 3.7g, mass of hydrogen = 0.184g

$T_1 = 298\text{K}$, $T_2 = 17°\text{C} = 273 + 17 = 290\text{K}$

$$\text{Moles of } H_2 = n_1 = \frac{\text{Mass}}{\text{M. wt.}} = \frac{0.184}{2} = 0.092$$

$$\text{Moles of gas} = n_2 = \frac{\text{Mass}}{\text{M. wt.}} = \frac{3.7}{\text{M}}$$

For hydrogen $P_1V_1 = n_1RT_1$ .....(i)

For gas $P_1V_1 = n_2RT_2$ .....(ii)

($\because$ Pressure and volume of gas are same)

$\therefore$ From equation (i) and equation (ii)

$$\frac{P_1V_1}{P_1V_1} = \frac{n_1RT_1}{n_2RT_2} \text{ or } 1 = \frac{0.092 \times 298}{n_2 \times 290}$$

$$\text{or } n_2 = \frac{0.092 \times 298}{290} \text{ or } \frac{3.7}{\text{M}} = \frac{0.092 \times 298}{290}$$

$$\text{or } \frac{3.7}{\text{M}} = 0.0945 \therefore \text{M} = \frac{3.7}{0.0945} = \mathbf{39.15}$$