Question 14

At 27°C, hydrogen is leaked through a tiny hole into a vessel for 20 minutes. Another unknown gas at the same temperature and pressure as that of H_2 is leaked through the same hole for 20 minutes. After the effusion of the gases the mixture exerts a pressure of 6 atmosphere. The hydrogen content of the mixture is 0.7 mole. If the volume of the container is 3 litres, what is the molecular weight of the unknown gas?   *(1992 - 3 Marks)*

Using gas equation; $PV = nRT$
Total no. of moles of gases in the mixture (n)

$$= \frac{PV}{RT} = \frac{6 \times 3}{0.0821 \times 300} = 0.7308 \text{ mol.}$$

Thus no. of moles of unknown gas $= 0.7308 - 0.7$
$$= 0.0308 \text{ mol.}$$

Now we know that

$$\frac{r_1}{r_2} = \frac{\text{moles of hydrogen gas}}{\text{moles of unknown gas}} = \frac{0.7}{0.0308}$$

Also we know that $\dfrac{r_1}{r_2} = \sqrt{\dfrac{M_2}{M_1}}$

$$\therefore \quad M_2 = \left(\frac{r_1}{r_2}\right)^2 M_1 \quad \text{or} \quad M_2 = \left(\frac{0.7}{0.0308}\right)^2 \times 2 = \mathbf{1033}$$