

Quiz-3 CH1201

Name: Priyanshu Mahato

Roll NO.: 21MS002

Q. No. of binary collisions per unit time per cc is given by:-

$$Z_{AA} = \frac{1}{\sqrt{2}} \pi \sigma^2 \bar{c} n^2$$

where, \bar{c} = avg. speed

n = no. of molecules per unit volume
(here, c.c.)

Now, $PV = n'RT$

$$\Rightarrow n' = \frac{1 \text{ atm} \times 1 \text{ L}}{0.0821 \text{ atm L K}^{-1} \times 298 \text{ K}} \approx 0.04$$

$$\Rightarrow n = \frac{n' \times N_A}{V}$$

$$= \frac{0.04 \times 6.022 \times 10^{23}}{1 \text{ L}}$$

$$= 2.46 \times 10^{22} \text{ L}^{-1} = 2.46 \times 10^{19} \text{ cm}^{-3}$$

$$\bar{c} = \sqrt{\frac{8RT}{\pi M}} = \sqrt{\frac{8 \times 8.314 \times 298}{3.14 \times 28 \times 10^{-3}}} = 474.80 \text{ ms}^{-1}$$

$$= 47480.39 \text{ cm s}^{-1}$$

$$\sigma = 2\sigma = d = 3.74 \times 10^{-10} \text{ m} = 3.74 \times 10^{-8} \text{ cm}.$$

$$\therefore, Z_{AA} = \frac{1}{\sqrt{2}} \times \pi \times (3.74 \times 10^{-8})^2 \times 47480.39 \times (2.46 \times 10^{19})^2$$

$$= 8.98 \times 10^{28} \text{ cm}^{-3} \text{ s}^{-1}$$

$$\approx \underline{\underline{9 \times 10^{28} \text{ cm}^{-3} \text{ s}^{-1}}}$$