

A system consists of two types of gas molecules A and B having same number density $2 \times 10^{25}/\text{m}^3$. The diameter of A and B are 10 \AA and 5 \AA respectively. They suffer collision at room temperature. The ratio of average distance covered by the molecule A to that of B between two successive collision is _____ $\times 10^{-2}$ (JEE MAIN 2021)

Particle A

$$n_1 = 2 \times 10^{25} / \text{m}^3$$

$$d_1 = 10 \text{ \AA}$$

Particle B

$$n_2 = 2 \times 10^{25} / \text{m}^3$$

$$d_2 = 5 \text{ \AA}$$

∴ Average distance covered (i.e. mean free path) $\lambda = \frac{1}{\sqrt{2} n n d^2}$
between two successive collisions

$$\begin{aligned} \therefore \frac{\lambda_1}{\lambda_2} &= \frac{n_2 d_2^2}{n_1 d_1^2} = \left(\frac{d_2}{d_1} \right)^2 \\ &= \left(\frac{5}{10} \right)^2 \end{aligned}$$

$$\boxed{\frac{\lambda_1}{\lambda_2} = 25 \times 10^{-2}}$$