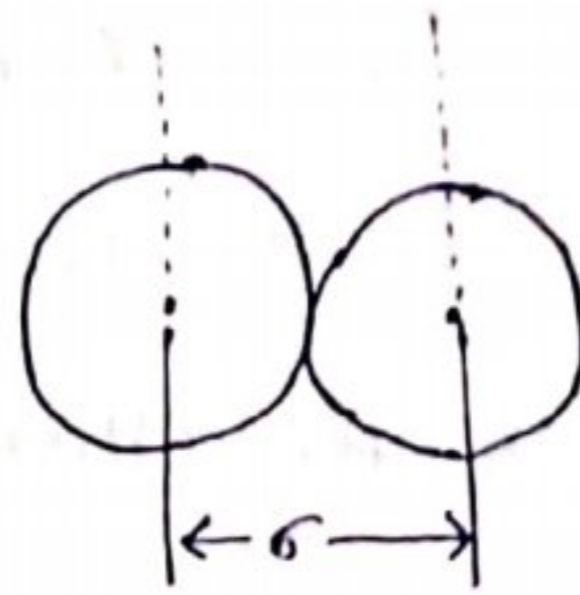


Collision Parameters :-

1). Collision diameter :-

When two non-reacting spherical molecules approach each other, they can't come closer together beyond a certain distance. The distance of closest approach between the centre of two molecules is known as collision diameter. It is denoted by ' σ '.



So, for the collision between two molecules, ' σ ' is the closest approach.

2). Collision frequency :-

The number of collisions experienced by an individual molecule with other gas molecule per second (per unit time) is called Collision frequency.

Let us consider the molecule is rigid non-reacting sphere with diameter ' σ ' & radius ' r '. The average velocity with which molecule moves is $\langle v_x \rangle$. This molecule collides with other molecules within a cylinder of radius $2r$.

$$\therefore \text{The Volume of the cylinder} = \pi \cdot (2r)^2 \cdot \langle v_x \rangle$$

$$= \pi \sigma^2 \langle v_x \rangle \quad \text{--- (1)}$$

If ' ρ ' is the no. of molecules per cm^3 then —

Average no. of collision per sec —

$$Z_1 = \pi \sigma^2 \langle U_x \rangle \rho \quad \text{--- (2)}$$

Where, Z_1 is the frequency with which a given molecule collides with the other.

Let, Z_{12} be the frequency of molecules of type-1 & type-2.

$$\therefore Z_{12} = \pi \sigma^2 \langle U_{x2} \rangle \rho \rho' \quad \text{--- (3)}$$

Where, ρ' is the density of molecule of type-2.

If the collisions are between two like molecules —

$$Z_{11} = \pi \sigma^2 \langle U_x \rangle \rho^2 \quad \text{--- (4)}$$

Since,

$$\langle U_x \rangle_{\text{rel}} = \sqrt{2} \langle U_x \rangle \quad \text{--- (5)}$$

for co-relating eq^s — (2), (4) & (5) correct ~~value~~ value of Z_1 & Z_{11} are given as —

$$Z_1 = \sqrt{2} \pi \sigma^2 \langle U_x \rangle \rho$$

$$\& Z_{11} = \sqrt{2} \pi \sigma^2 \langle U_x \rangle \rho^2$$

Since, each collision involves two molecule. So, Collision frequency —

$$Z_{11} = \frac{\sqrt{2} \pi \sigma^2 \langle U_x \rangle \rho^2}{2}$$

$$Z_{11} = \frac{1}{\sqrt{2}} \pi \sigma^2 \langle U_x \rangle \rho^2$$

$$\text{But } \langle U_x \rangle = \left(\frac{8RT}{\pi M} \right)^{1/2}$$

$$\therefore Z_{11} = \frac{1}{\sqrt{2}} \pi \sigma^2 \sqrt{\frac{8RT}{\pi M}} \cdot \rho^2$$

$$\therefore Z_{11} = 2\sigma^2 \rho^2 \sqrt{\frac{\pi RT}{M}}$$

This is called Collision frequency.

⑤ Collision Number :-

Acc to kinetic consideration of gaseous molecule, the no. of molecule with which a single molecule will collide per unit time is given by —

$$Z_1 = \sqrt{2} \pi \sigma^2 \langle U_x \rangle \rho$$

Where, $\langle U_x \rangle$ is the average velocity.

ρ is the number density i.e. the no. of molecules per unit volume of the gas.

Thus, the number of collisions suffered by a single molecule per unit time per unit volume of the gas is called Collision number.

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