Root Mean Square velocity or, (R.M.S) velocity

It is defined as the square root of the mean value of the squares of the velocities of all molecules at a particular temperature.

Let two molecules moving with velocities 3 and 4 cm per second respectively.

There average velocity is $\frac{3+4}{2} = \frac{7}{2} = 3.5$

But their R.M.S velocity is square root of $\sqrt{\frac{3^2+4^2}{2}} = \sqrt{\frac{9+16}{2}} = \sqrt{\frac{25}{2}} = \sqrt{12.5}$

$= 3.535$

If a container contains a gas having n molecules and at a particular moment the velocity of molecules are $c_1, c_2, c_3 \ldots\ldots c_n$ then —

$$\text{R.M.S velocity} = \sqrt{\frac{c_1^2 + c_2^2 + c_3^2 + \ldots\ldots + c_n^2}{n}}$$

and average velocity $= \frac{c_1 + c_2 + c_3 + \ldots\ldots + c_n}{n}$

from kinetic gas equn —

$$C^2 = \frac{3PV}{M} = \frac{3RT}{M}$$

$$\therefore C = \sqrt{\frac{3RT}{M}}$$

where M is molecular wt. of the gas.

Average velocity

It is defined by the mean of the velocities of all molecules at a particular temperature. It is represented by C.

$$C = \frac{C_1 + C_2 + C_3 + \cdots + C_n}{n}$$

$$\therefore C = \sqrt{\frac{8RT}{\pi M}} \quad \text{(i)}$$

Most probable velocity

The velocity possessed by the largest no. of molecules at a particular temperature is called most probable velocity. It is represented by C_m.

$$C_m = \sqrt{\frac{2RT}{M}} \quad \text{(ii)}$$

Relation between different velocities

* Average velocity = 0.9213 × R.M.S velocity
* Most probable velocity = 0.816 × R.M.S velocity.