B.Sc. I
Group-A

Kinetic gas equation in terms of Kinetic energy

Kinetic gas equation :

$$PV = \frac{1}{3} mNu^2$$

$$PV = \frac{2}{3} N \times \frac{1}{2} mu^2$$

$$PV = \frac{2}{3} N \times e$$

e = average kinetic energy of a single molecules

$$\therefore PV = \frac{2}{3} E \quad \text{---- (i)}$$

E = Total kinetic energy of all the N molecules.

Ideal gas equation

$$PV = nRT \quad \text{---- (ii)}$$

From eqn. (i) and (ii)

$$\frac{2}{3} E = nRT$$

For one mole of gas,
the kinetic energy of N molecules

$$\boxed{E = \frac{3RT}{2}}$$

The number of gas molecules in one mole of gas is N_0.

N_0 = Avogardo Number

$$e = \frac{E}{N_0}$$

$$e = \frac{3RT}{2N_0}$$

$$\boxed{e = \frac{3RT}{2N_0}}$$

This is average kinetic energy of a gas molecule.

MOST PROBABLE VELOCITY (α)

Most probable velocity of a gas at a particular temperature is the velocity possessed by the maximum fraction of the total number of molecules at that temperature.

$$\alpha = \sqrt{\frac{2RT}{M}}$$

R = gas constant
T = absolute temperature
M = molecular weight

(u)

ROOT MEAN SQUARE VELOCITY

The square root of the mean of squares of the velocities possessed by the different molecule of a gas at a particular temperature

If all the molecules of the gas are supposed to have different velocities say $v_1, v_2, v_3, v_4 --- v_n$ cm/sec,

then,

$$u = \sqrt{\frac{v_1^2 + v_2^2 + v_3^2 + v_4^2 + \cdots + v_n^2}{n}}$$

$$v = \sqrt{\frac{3RT}{M}}$$

R = Gas constant

T = absolute temperature

M = molecular weight

AVERAGE VELOCITY (v)

The arithmetic mean of the velocities possessed by the different molecules of a gas at a particular temperature.

If all the molecules of the gas have different velocities say $v_1, v_2, v_3 + \cdots + v_n$ cm/sec.

then

$$v = \frac{v_1 + v_2 + v_3 + \cdots + v_n}{n}$$

$$v = \sqrt{\frac{8RT}{\pi M}}$$

R = gas constant

T = absolute temperature

M = molecular weight