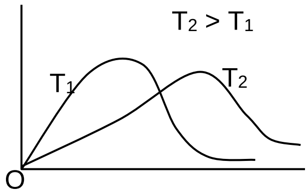
Molecular velocities:

- Due to frequent collisions among themselves and with the walls of the container, the velocities of gas molecules can not remain constant.
- The velocity of a gas molecule will remain same only in very short period i.e. 10^{-9} seconds.
- Though the velocities change so frequently, the ratio of certain number of molecules with certain velocity to the total number of molecules remains constant.
- The plot of fraction of molecule V_s velocity gives the following graph.



Conclusions from the above graph

- No single molecule will possess zero velocity
- Very few molecules have either very low velocities or high velocities
- With increase in temperature, the number of molecules possessing higher velocities is increased and the number of molecules possessing low velocities and the number of molecules possessing most probable velocity is decreased.
- As the velocities of the molecules increase, the fraction of the molecules possessing a particular velocity also increases up to maximum value and then decreases.
- Boltzman equation: It is useful to know the number of molecules having particular energy in a given sample of gas at a given temperature.

  $n_i = n.e^{-E_i / KT}$

  n = total number of molecules

  T = temperature

  k = Boltzuman constant

  n_i = number of molecules with particular energy E_i

Types of Molecular velocities:

1. Most Probable velocity (C_P)

- It is the velocity possessed by the maximum number of molecules present in the gas at any temperature

  $C_p = \sqrt{\frac{2RT}{M}} = \sqrt{\frac{2PV}{m}} = \sqrt{\frac{2P}{d}}$

  M = mass of given gas

  $C_p = 0.8166 \times$ RMS velocity

- The average of the velocities of all the molecules in the gas at any temperature is known as average velocity.

  It is represented by $\bar{C}$

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

  $\bar{C} = \sqrt{\frac{8RT}{M}} = \sqrt{\frac{8PV}{\pi M}} = \sqrt{\frac{8P}{\pi d}}$

  m = mass of given gas

  $\bar{C}$= 0.9213 × R.M.S Velocity
- The square root of the mean of the squares of the velocities of all the molecules present in the gas at any temperature is known as the RMS velocity. It is represented by C

  C = $\sqrt{\frac{C_1^2+C_2^2+C_3^2+.......C_n^2}{n}}$

  C= $\sqrt{\frac{3RT}{M}}$= $\sqrt{\frac{3PV}{m}} = \sqrt{\frac{3P}{d}}$

  C = 1.58 $\sqrt{\frac{T}{M}} x10^4 cm/sec$
- For a gas at two different temperature the ratio of its RMS velocities is given by

  $\frac{C_1}{C_2} = \sqrt{\frac{T_1}{T_2}}$
- For two different gases having same RMS velocity $\frac{T_1}{M_1} = \frac{T_2}{M_2}$

ii) For two different gases at the same temperature,

  $\frac{C_1}{C_2} = \sqrt{\frac{M_2}{M_1}}$

- For gas at any temperature.

  $C_p < \bar{C} < C$
- At any temperature, in a given sample of gas.

  $n_{c_p} > n_{\bar{C}} > n_c$
- Ratio between molecular velocities

  1) $C_p: \bar{C}: C = \sqrt{2}: \sqrt{\frac{8}{\pi}}: \sqrt{3}$

  2) $C_p: \bar{C}: C = \sqrt{2}: \sqrt{2.55}: \sqrt{3}$

  3) $C_p: \bar{C}: C = 0.8166: 0.9213: 1$

  4) $C_p: \bar{C}: C = 1: 1.128: 1.224$