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Unit-1 (Kinetic Theory of Gases)

Ideal Gas:- An ideal gas is a theoretical gas composed of a set of randomly-moving, non-interacting point particles.

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Now we discuss about the Maxwell-Boltzmann molecular speed distribution law for an ideal gas:-

The Maxwell-Boltzmann equation for distribution of energy among the molecules of an ideal gas is

$$n(E)\,dE = \frac{2\pi N}{(\pi KT)^{3/2}} E^{\frac{1}{2}} e^{-E/KT}\, dE \quad \text{—— (i)}$$

$\because$ the molecules have no internal degrees of freedom, all the energy of the gas molecules is completely kinetic in nature. Thus.

$$E = \frac{1}{2} m v^2,$$

$$\therefore \quad dE = m v\, dv$$

Substituting these values of E and dE in equation (i), the number of molecules $n(v)\,dv$ whose speed lie between v and $(v+dv)$ is given by.

[PTO]

$$n(v)dv = \frac{2\pi N}{(\pi KT)^{3/2}} \cdot \left(\frac{1}{2}mv^2\right)^{\frac{1}{2}} e^{-mv^2/2KT} mv\,dv$$

$$= \frac{2\pi N}{(\pi KT)^{3/2}} \cdot 2\left(\frac{m}{2}\right)^{3/2} v^2 e^{-mv^2/2KT} dv$$

$$\boxed{n(v)dv = 4\pi N \left(\frac{m}{2\pi KT}\right)^{3/2} v^2 e^{-mv^2/KT} dv} \quad (11)$$

The above equation is known as the Maxwell - Boltzmann law of distribution of speeds.