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Date – 26/10/2024

MJC – SEM-III

Unit-I

Topic:- The mean or average speed of a gas molecule.

Let there be N_i molecules each having speed v_i, then mean or average speed ($\bar{v}$) is defined as:-

$$\bar{v} = \frac{\sum_i N_i v_i}{\sum_i N_i}$$

But $\sum_i N_i = N$, then total No of molecules

$$\bar{v} = \frac{1}{N} \sum N_i v_i$$

As the speed of molecules is approximately continuous, we may replace summation sign by integration; i.e.

$$\bar{v} = \frac{1}{N} \int_0^\infty v\, N(v)\, dv$$

$$= \frac{1}{N} \int_0^\infty v \cdot 4\pi N \left(\frac{M}{2\pi RT}\right)^{3/2} \cdot v^2 \cdot e^{\frac{-2mv^2}{2RT}} dv$$

$$= \int_0^\infty 4\pi \left(\frac{M}{2\pi RT}\right)^{3/2} v^3 e^{\frac{-mv^2}{2RT}} dv$$

$$= 4\pi \left(\frac{M}{2\pi RT}\right)^{3/2} \int_0^\infty v^3 e^{\frac{-mv^2}{2RT}} dv.$$

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$$= 4\pi\left(\frac{m}{2\pi KT}\right)^{3/2}\left[\frac{2(KT)^2}{m^2}\right]$$

$$\overline{v} = \sqrt{\frac{8KT}{m\pi}} = 1.59\sqrt{\frac{KT}{m}}$$

This equation gives the mean or average speed of a gas molecules.

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Hw

Q Write an equation for the average speed of a gas molecules.