Maxwell's distribution law of velocity distribution ⇒

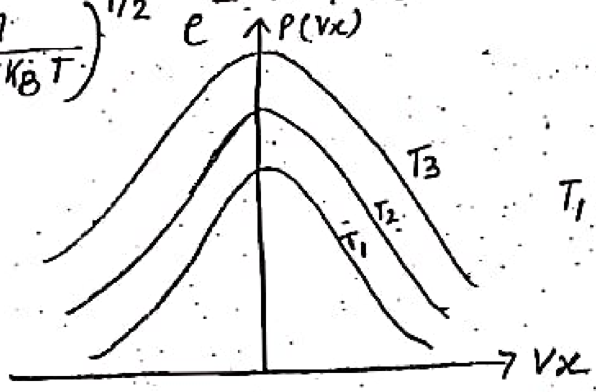
$$\underset{V_x \qquad\quad V_x + dV_x}{\overset{dN}{\longleftarrow\!\!+\!\!-\!\!-\!\!-\!\!+\!\!\longrightarrow}}$$

$$dP = \frac{dN(V_x)}{N} = \left(\frac{m}{2\pi K_B T}\right)^{1/2} e^{-mV_x^2/2K_BT}\, dV_x$$

$$dP(v) = \frac{dN(v)}{N} = \frac{dN(V_x)\, dN(V_y)\, dN(V_z)}{N}$$

$$= \left(\frac{m}{2\pi K_B T}\right)^{3/2} e^{-mv^2/2K_BT}\, \frac{dV_x dV_y dV_z}{dv}$$

$$\frac{dP}{dV_x} = \left(\frac{m}{2\pi K_B T}\right)^{1/2} e^{-mV_x^2/2K_BT}$$



$T_1 > T_2 > T_3$

i) $\frac{dP(V_x)}{dV_x}$ = max. at $V_x = 0$

ii) Probability distribution curve is symmetric
$P(-V_x) = P(V_x)$

Most Probable velocity

$\Rightarrow \frac{d}{dV_x}\left(\frac{dP}{dV_x}\right) = 0$ wrong

$V_x = 0$

or $\frac{d}{dV_x}[P(V_x)] = 0$ right

Max. value of

$$\cancel{\frac{dP(V_x)}{}\Big|_{max}} \text{ wrong } = \cancel{dP(V_x)\Big|_{V_x=0}} = \cancel{\left(\frac{m}{2\pi K_B T}\right)^{1/2}}$$

OR

$$P(V_x)\Big|_{max} = P(V_x)\Big|_{V_x=0} = \left(\frac{m}{2\pi K_B T}\right)^{1/2}$$

iv) **Average velocity:**

$$\langle V_x \rangle = \int_{-\infty}^{\infty} V_x \, P(V_x)\, dV_x$$

$$= 0$$

v) $\langle V_x^2 \rangle$

$$= \int_{-\infty}^{\infty} V_x^2 \, P(V_x)\, dV_x$$

$$= \frac{K_B T}{m}$$

vi)

$$\langle V^2 \rangle = \langle V_x^2 \rangle + \langle V_y^2 \rangle + \langle V_z^2 \rangle$$

$$= \frac{K_B T}{m} + \frac{K_B T}{m} + \frac{K_B T}{m}$$

$$V_{rms} = \sqrt{\frac{3K_B T}{m}}$$

vii) Velocity at which $P(V_x)$ falls $1/e$ time of max. value =

$$V_x = \sqrt{\frac{2K_B T}{m}}$$

viii) $\overline{v_x v_y} = \int\int_{-\infty}^{\infty} v_x v_y \, P(v_x v_y) \, dv_x \, dv_y$

$= 0$

ix) $\overline{v_x^2 v_y v_z} = 0$

x) $\overline{(\alpha + \beta v_x)^2} = \alpha^2 + \beta^2 \frac{K_B T}{m}$

xi) $\overline{(\alpha v_x - \beta v_y)^2} = (\alpha^2 + \beta^2) \frac{K_B T}{m}$

xii) $\overline{(\alpha v_x + \beta v_y - v_z)^2} = (\alpha^2 + \beta^2 + 1) \frac{K_B T}{m}$