~~Express~~

Formula sheet

① Ideal gas: (high temp. and low pressure)

a) Boyle's law:

$$\boxed{P \propto \frac{1}{V}}$$ at constant temp.

b) charle's law:

$$\boxed{V \propto T}$$ at constant pressure

c) Avagadro's law:

At the same P & T, equal volume of all gases contain equal no. of molecules (N)..

$$\boxed{N_1 = N_2}$$

d) Ideal gas equation:-

$$PV = nRT$$

gas constant (R) = 8.314 J/molK

$$\text{Baltzmann constant}(K_B) = \frac{R}{N_A} = \frac{8.314}{6.03 \times 10^{23}}$$

$$\boxed{K_B = 1.3 \times 10^{-23}\ J/K}$$

② Maxwell distribution law:-

① distribution of Molecular velocity in perfect gas:-

If probability be $f(v)$ then

Normalization condition

$$\boxed{\int_{-\infty}^{+\infty} f(v)\, dv = 1}$$

→ Distribution in terms of magnitude:-

$$f(v)\,dv = \left(\frac{\beta}{\pi}\right)^{3/2} 4\pi e^{-\beta v^2} v^2 dv$$

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

a) Average velocity:- ($\bar{v}$)

$$\langle v \rangle = \int_0^{\infty} v\, f(v)\, dv$$

$$= \sqrt{\frac{8K_BT}{\pi m}}$$

b) Root mean square velocity: (v_{rms}):

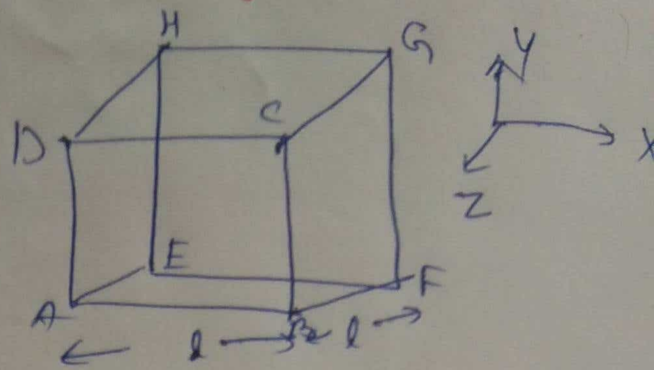
$$[\langle v^2 \rangle]^{1/2} = \sqrt{\frac{3K_BT}{m}}$$

c) Most probable Velocity

$$v_p = \frac{df}{dv} = 0$$

$$\Rightarrow v_p = \sqrt{\frac{2K_BT}{m}}$$

(3) Expression for the pressure of a gas:-



pressure $\boxed{P = \frac{1}{3}\frac{M}{V}\langle V^2\rangle} \Rightarrow P = \frac{1}{3}\rho V_{rms}^2$

As $\langle V^2\rangle = \frac{3P}{M/V}$ $\quad \boxed{\frac{M}{V} = \rho} \rightarrow$ density

$$V_{rms}^2 = \langle V^2\rangle = \frac{3P}{\rho}$$

$$V_{rms} = \sqrt{\frac{3P}{\rho}} = \sqrt{\frac{3RT}{M_{mole}}}$$

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

$$\boxed{k_BT = \frac{1}{3}mV_{rms}^2}$$

for N molecules:

total energy $\boxed{E = \frac{3}{2}Nk_BT}$ In 3-d case