Kinetic Theory of Gases

Boyle's Law :- $P \propto \frac{1}{V}$ (P = const.)

Charle's Law :- ~~$P \propto T$ (V = const.)~~

$V \propto T$ (P = const.)

Gay Lussac's law :-

$P \propto T$ (V = const.)

PRESSURE :-

$$P_{avg.} = \frac{1}{3} m_{total} \times \frac{v_{rms}^2}{V}$$

$$P = \frac{1}{3} \rho v_{rms}^2$$

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$V_{avg.} = \sqrt{\frac{8RT}{\pi M}}$$

~~$V_{rms} = \sqrt{\frac{2}{3}}$~~

Most Probable

$$V_{mp} = \sqrt{\frac{2RT}{M}}$$

Translational Kinetic Energy

$$K.E._{total} = \frac{1}{2} m_{total} V_{rms}^2$$

$$K.E. = \frac{3}{2} nRT$$

$$P = \frac{2}{3} \frac{K.E._T}{V}$$

$$K.E_{mean} = \frac{3}{2} kT$$

Avogadro's Law

For $P, V, T \Rightarrow$ Same

$$n = Fix$$

Ideal Gas Equation

$$PV = nRT$$

- $8.314\ J/mole\text{-}K$
- $2\ cal/mole\text{-}K$
- $0.08314\ atmL/mol\text{-}K$

Boltzman Constant

$$K = \frac{R}{N_A}$$

$$nR = NK$$

$$V_{rms} = \sqrt{\frac{3kT}{m}}$$

$$PV = nRT = NK_BT$$

$$K.E._{total} = \frac{3}{2}nRT = \frac{3}{2}NKT$$

Law of Equipartition of Energy

ESTIMATE

$$K.E._{total} = \frac{f}{2} nRT$$

where f is degree of freedom

$$K.E._{rotational} = \frac{(f-3)}{2} nRT$$

Mean Free Path (λ)

Relaxation Time

$$\tau \propto \frac{\sqrt{Temp.}}{Pressure}$$

$$\lambda = \frac{1}{\sqrt{2}\, N_A \, 4R^2}$$

No. of molecules / Volume