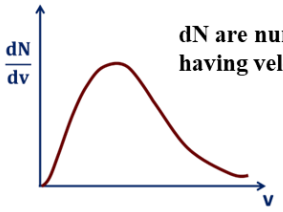
MIND MAP

Kinetic Theory of Gases

Maxwell Distribution Function



dN are number of molecules having velocity from v to v+dv.

Average Speed

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

↓ average speed

$$V_{avg} = \frac{(|v_1| + |v_2| + \cdots)}{N}$$

Average velocity $= 0$

Root Mean Square Speed

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

↓ Root mean square speed; ↓ Molecular mass

$$V_{rms} = \sqrt{\frac{v_1^2 + v_2^2 + \ldots\ldots + v_N^2}{N}}$$

Most Probable Speed

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

↓ most probable speed

Law of Equipartition of Energy

Each degree of freedom contributes $\frac{1}{2}kT$ of energy per molecule.

k is Boltzmann constant

T = Temperature of gas

$k = 1.38 \times 10^{-23}$ J/K

$k = \frac{R}{N_A}$ (R: Universal Gas Constant; N_A: Avogadro number)

Boltzmann constant

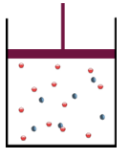
Internal energy of 'n' moles of gas $U = \frac{f}{2}nRT$

Translational kinetic energy of 'n' moles $= \frac{3}{2}nRT = \frac{3}{2}PV$

Dalton's Law of Partial Pressure

The total pressure of the mixture of ideal gases is the sum of the partial pressures.

$P = P_1 + P_2 + \ldots\ldots$



Ideal Gas Equation

$V \propto \frac{1}{P}$ (Boyle's law) $\quad V \propto T$ (Charles's law) $\quad V \propto n$ (Avogadro's law)

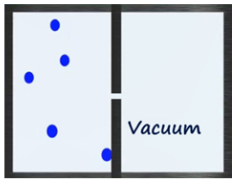
$$PV = nRT$$

R is universal gas constant $= 8.314 = \frac{25}{3}\frac{J}{Mol - K}$

Graham's Law of Diffusion

Rate of diffusion $\propto \frac{1}{\sqrt{\text{Molecular Mass}}}$

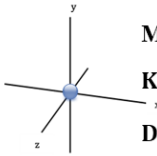
$$\frac{r_1}{r_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$$



Degree of Freedom (f)

It refers to the minimum numbers of independent means by which a molecule can possess energy.

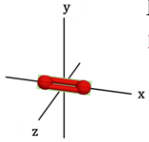
Atomicity of gas	f
Monoatomic	3
Diatomic and other linear molecules	5
Non-linear	6



Monoatomic Gas

$KE = \frac{1}{2}mv_x^2 + \frac{1}{2}mv_y^2 + \frac{1}{2}mv_z^2$

DOF (f) = 3



Diatomic Gas

DOF = 3 (Translational) + 2 (Rotational) = 5

Triatomic Gas

Linear (eg. CO_2) O = C = O

DOF = 3 (Translational) + 2 (Rotational) = 5

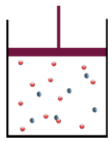
Non-linear (eg. SO_2)

DOF = 3 (Translational) + 3 (Rotational) = 6

Equivalent DOF (feq)

$n_1 f_1 RT + n_2 f_2 RT = (n_1 + n_2) f_{eq} RT$

$$f_{eq} = \frac{n_1 f_1 + n_2 f_2}{n_1 + n_2}$$



Mean Free Path

The average distance between two successive collisions is called mean free path.

$$\text{mean free path 'l'} = \frac{1}{\sqrt{2}n\pi d^2}$$

n: no of mol/vol; d: diameter of molecule