Mean free path :-

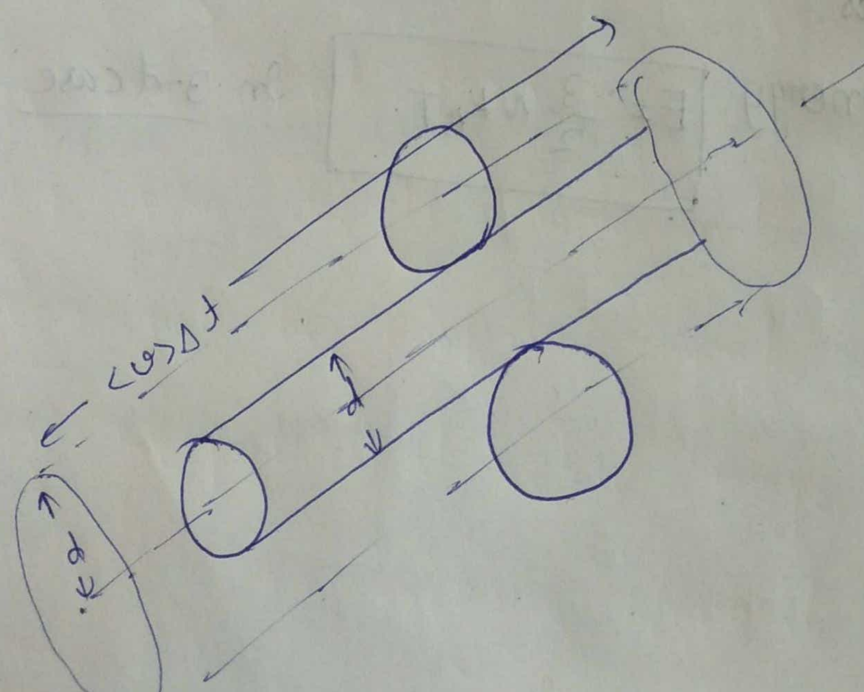
Molecules ~~of~~ in a gas have large speeds and they move and callide each other. As a result they can not move straight unhindered. their paths keep getting incessantly deflected.

Let us suppose, ~~we have~~ that we have ~~∞~~ malecules of a gas ~~in~~ of sphere of diameter d.

Let averge speed of a single particle be $\langle v \rangle$.

then in time Δt,

it covers $\pi d^2 \langle v \rangle \Delta t$ volume of cylinder.



If n is the no. of molecules per unit volume,

then no. of collisions in time Δt = $n\pi d^2 \langle v \rangle \Delta t$

So the rate of collisions is $n\pi d^2 \langle v \rangle$.

$\therefore$ Time b/w two successive collisions

$$\boxed{\tau = \frac{1}{n\pi \langle v \rangle d^2}}$$

$\therefore$ ~~distance~~

mean free path :- The average distance b/w to successive collisions, called the mean free path.

$$\therefore \lambda = \langle v \rangle \tau$$

$$\boxed{\lambda = \frac{1}{n\pi d^2}}$$ but this is not correct. (here we assume rest of molecules in rest state

$\rightarrow \because$ all molecules are moving.

$\therefore$ exact mean free path (experiment)

mean free path $$\boxed{\lambda = \frac{1}{\sqrt{2}\pi n d^2}}$$

Vander Waals gas:—

As we ~~so~~ know, there exists no ideal gas. All gases are real and follows vander Waals equation.

For a real gas containg 'n' moles, the equation is written as,

$$\boxed{\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT}$$

where a & b are constant parameters and its values depend upon different gases.

→ Vander, Waals ~~go~~ assumed that, gaseous particles :—

i) Are hard spheres.

ii) Have definite volume and hence can not be compressed beyond a limit

iii) Two particles at close range interact and have an exclusive spherical volume around them.

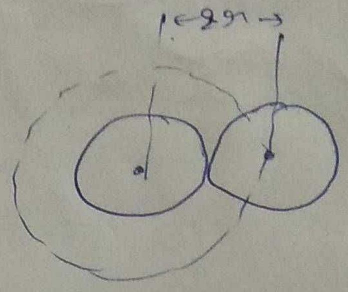
Volume correction:-

$V_R = V_i - b$

Volume of real gas

correction factor

Volume of ideal gas



$b = 4 \times \frac{4}{3}\pi r^3 =$

for particles, Volume correction $= nb$

$= 4n \times \frac{4}{3}\pi r^3$.

$$\therefore \boxed{V_r = V_i - nb}$$

pressure correction:-

the reduction in pressure $\propto$ square of particle density in the bulk $\propto$.

(due to surface particle)

i.e. $\propto \frac{n^2}{V^2} = a\frac{n^2}{V^2}$

$\therefore$ Pressure of real gas $= P_r + a\frac{n^2}{V^2}$

Vander Waals gas equation:-

$$\therefore \boxed{\left(P + a\frac{n^2}{V^2}\right)(V - nb) = nRT}$$

~~no~~ for one particle

$n=1$