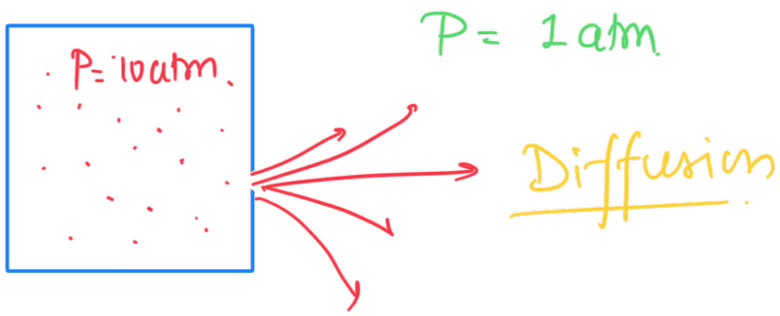
Graham's law of diffusion and effusion.

- **Diffusion**: Spreading of a gas from a higher pressure region to the lower pressure region, is called diffusion.

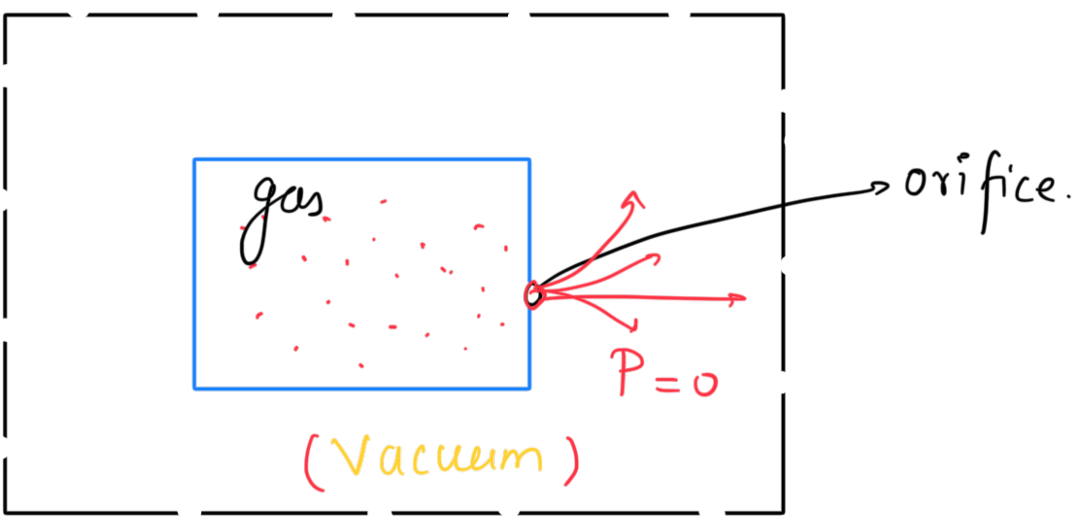
$$1\,atm = 101325\ \frac{N}{m^2}$$

$$= 1,01,325\ \frac{Newton}{m^2}$$

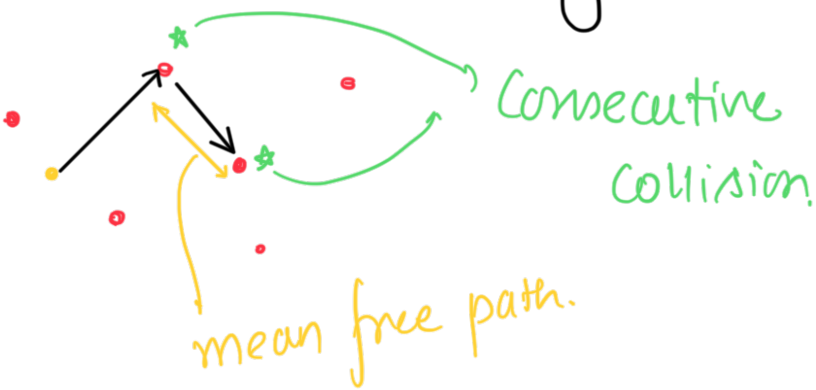


Effusion

Effusion: Spreading of a gas from a high pressure region to vacuum, through an orifice, is called effusion.



The diameter of orifice is equal to the mean free path of the gas.



✪ Rate of diffusion and effusion :

(i) with respect to velocity $= \dfrac{dv}{dt} = \dfrac{\Delta v}{\Delta t} = \dfrac{v}{t}$.

(ii) with respect to no of moles $= \dfrac{dn}{dt} = \dfrac{\Delta n}{\Delta t} = \dfrac{n}{t}$

(iii) with respect to distance through orifice $= \dfrac{dx}{dt} = \dfrac{\Delta x}{\Delta t} = \dfrac{x}{t}$

Case Ist : when pressure of container is constt.

$$\boxed{\text{Rate} \propto \frac{1}{\sqrt{M}} \propto \frac{1}{\sqrt{d}} \propto \frac{1}{\sqrt{V.d}}}$$

$\because M =$ Molar mass of gas.

$\because$ Vapour density $= \dfrac{\text{Molar mass}}{2}$

★ Find the ratio of rate of difussion and effusion for two gases.

Suppose, A and B are two gases.

$$\frac{r_A}{r_B} = \frac{\frac{\cancel{K}}{\sqrt{M_A}}}{\frac{\cancel{K}}{\sqrt{M_B}}}$$

$\because r \propto \frac{1}{\sqrt{M}}$

$r = \frac{K}{\sqrt{M}}$.

$$\boxed{\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}}}$$

$$\boxed{\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{d_B}{d_A}} = \sqrt{\frac{V \cdot d_B}{V \cdot d_A}}}$$

Ans: Find the ratio of rate of difussion of He and CO_2.

$$\frac{r_{He}}{} = \sqrt{\frac{M_{CO_2}}{}} = \sqrt{\frac{44}{}} = \sqrt{\frac{11}{}}$$

$$\frac{r}{r_{CO_2}} = \sqrt{\frac{M}{M_{He}}} = \sqrt{\frac{}{4}} = \ldots$$

Que: Find the ratio of rates of diff. of H_2 and N_2.

given: $d_{H_2} = 1\ g/cm^3$, $d_{N_2} = 2\ g/cm^3$.

$$\frac{r_{H_2}}{r_{N_2}} = \sqrt{\frac{M_{N_2}}{M_{H_2}}} = \sqrt{\frac{28}{2}} = \sqrt{14}.$$

$$\frac{r_{H_2}}{r_{N_2}} = \sqrt{\frac{d_{N_2}}{d_{H_2}}} = \sqrt{\frac{2}{1}} = \sqrt{2}$$

Que: Find the ratio of rate of diff of H_2 and Ne.

V.d of Ne with respect to He

$$\frac{r_{H_2}}{r_{Ne}} = \sqrt{\frac{M_{Ne}}{M_{H_2}}} = \sqrt{\frac{20}{2}} = \cancel{\sqrt{10}}.$$

$$\text{Vapour density of Ne} = \frac{M_{Ne}}{M_{He}} = \frac{20}{4}$$

$$= 5.$$

$$\text{V.d. of } H_2 = \frac{2}{2} = 1$$

$$\frac{r_{H_2}}{r_{Ne}} = \sqrt{\frac{V.d_{Ne}}{V.d_{H_2}}} = \sqrt{\frac{5}{1}} = \sqrt{5}.$$

$$\boxed{\text{Vapour density} = \frac{\text{Molar mass of given subs}}{\text{Molar mass of respective subs}}}$$

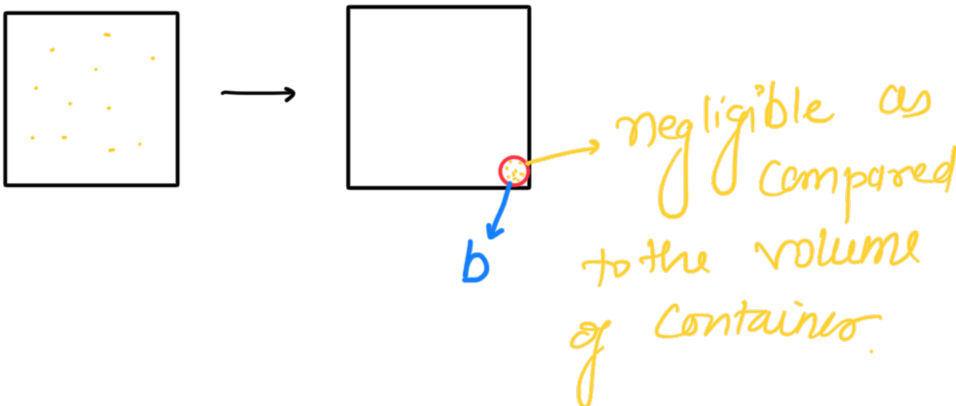
⊛ Kinetic theory of gases : (Ideal gas)

(i) The particles of ideal gas are tiny i.e. they have negligible size.

(ii) They do not attract/repel each other.

(iii) The perfectly elastic collision occurs b/w the particles of ideal gas. Hence, No amount of energy releases by the collision.

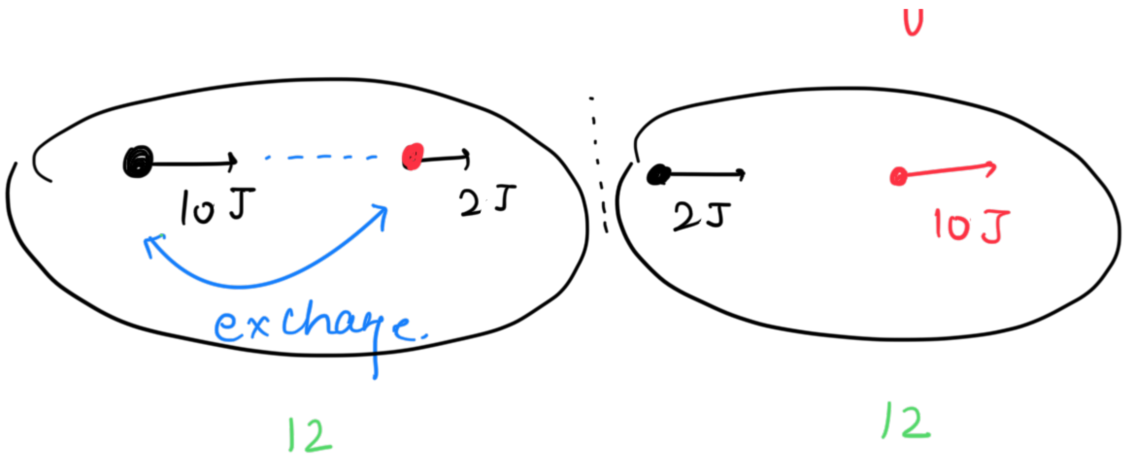
(iv) The volume of particles is negligible, as compared to volume of the gas or volume of the Container.

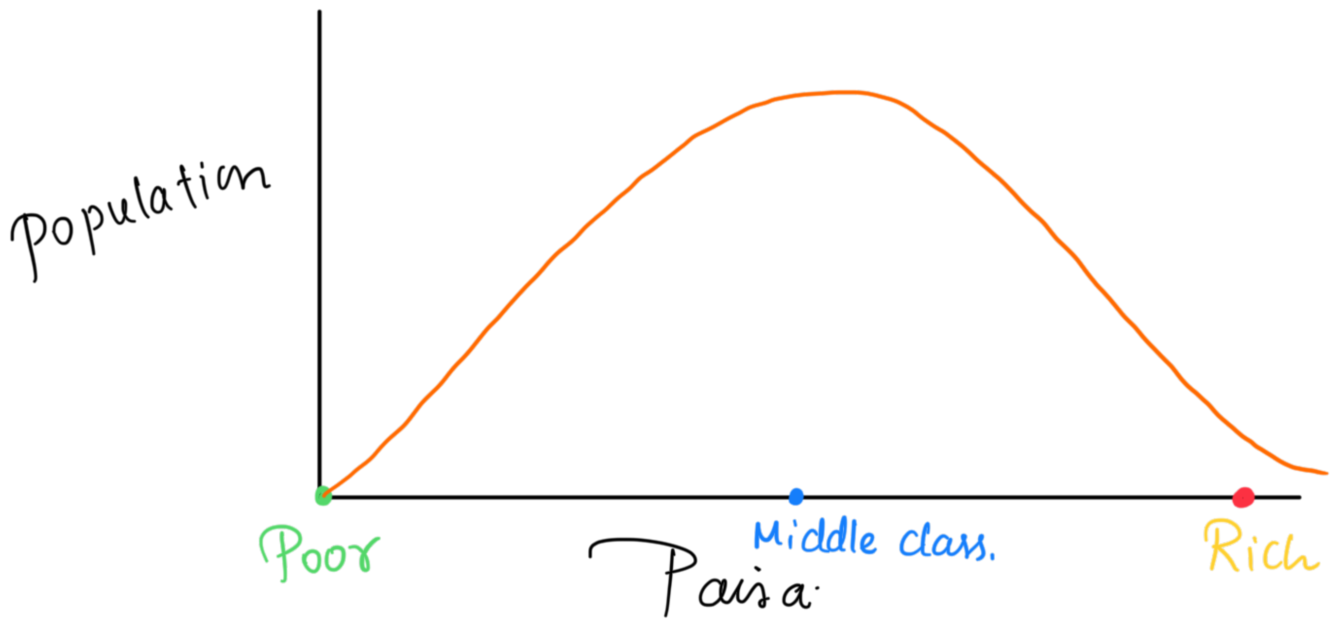


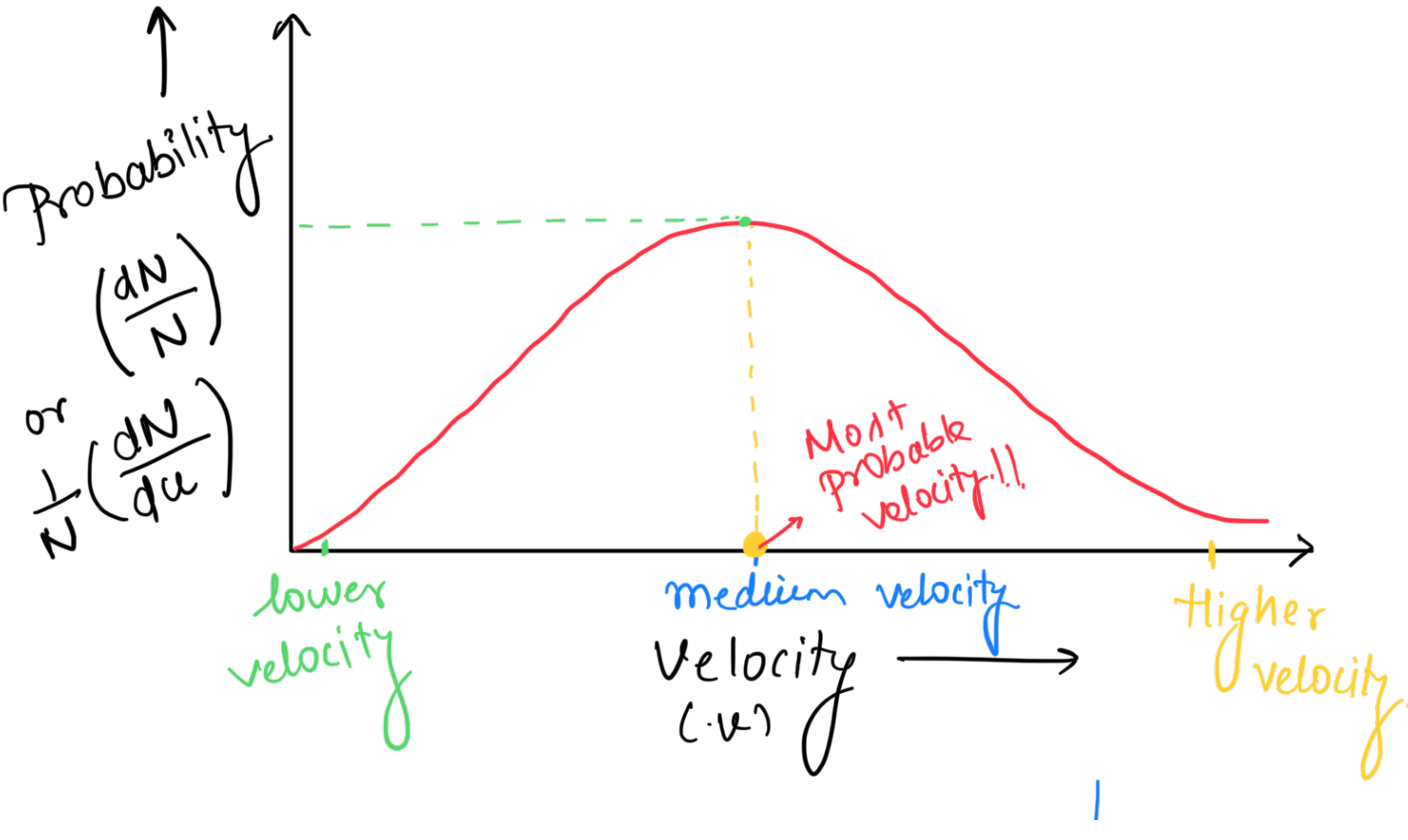
(v) Average Kinetic energy of a gas depends Upon the temperature of the gas only, Nothing else!!

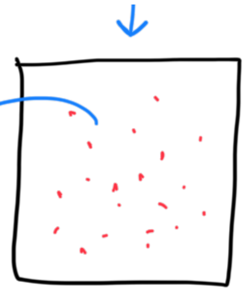
✪ Maxwell- Boltzmann's distribution law:

Classical Physics ← Bridge → Quantum Physics


U
10 J
2 J
exchange.
2 J
10 J
12
12


Population
Poor
Middle class.
Rich
Paisa


Probability
$\left(\frac{dN}{N}\right)$
or $\frac{1}{N}\left(\frac{dN}{du}\right)$
Most probable velocity!!!
lower velocity
medium velocity
Higher velocity
Velocity (v)
1



most probable velocity. $\leftarrow v$

NOTE: Gaussian function:

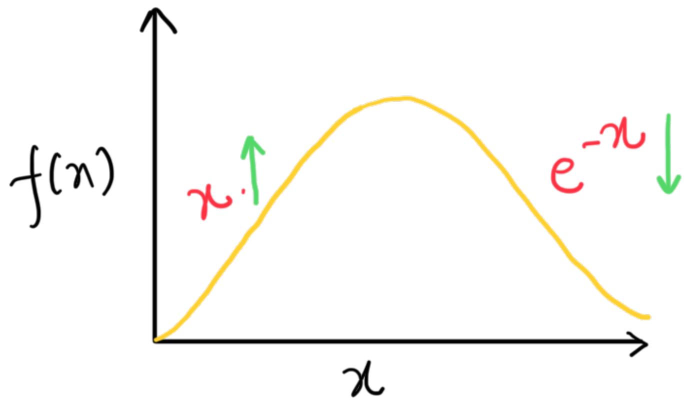
$$\boxed{f(x) = x \cdot e^{-x}}$$

decrease the value.

dominate in higher value.

Increase the value

dominate in lower values



It is the graph of $f(x) = x \cdot e^{-x}$.
(a gaussian fn)

Maxwell boltzmann equation

$$\boxed{\frac{1}{N}\left(\frac{dN}{du}\right) = 4\pi\left(\frac{M}{2\pi RT}\right)^{3/2} \cdot e^{-\left(\frac{Mu^2}{2RT}\right)} \cdot u^2}$$