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LIVE •

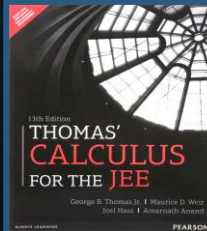
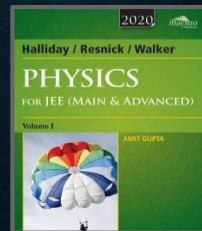
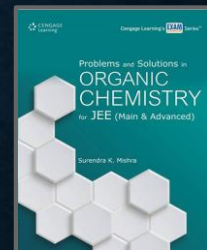
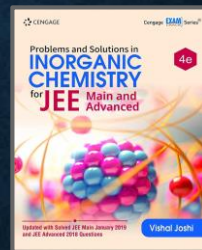
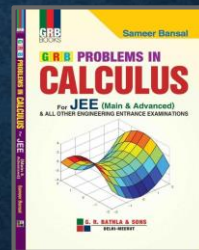
HINDI **PHYSICS**

Course of 12th syllabus Physics for JEE Aspirants 2022: Part - I

Lesson 1 • Apr 2, 2021 12:30 PM

D C Pandey

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Prashant Jain
Mathematics



Amarnath Anand
Mathematics



Nishant Vora
Mathematics



Piyush Maheshwari
Chemistry



Vijay Tripathi
Chemistry



Sakshi Ganotra
Chemistry



Namo Kaul
Physics



Mohit Bhargav
Physics



Ajit Lulla
Physics



Nurture Batch

for IIT JEE Main and Advanced 2024

Code: SAKSHI

Batch highlights:

- Curated by India's Top Educators
- Coverage of Class 11 JEE syllabus
- Enhance conceptual understanding of JEE Main & JEE Advanced subjects
- Systematically designed courses
- Strengthen JEE problem-solving ability



Prashant Jain

Mathematics Maestro



Nishant Vora

Mathematics Maestro



Ajit Lulla

Physics Maestro



Abhilash Sharma

Physics Maestro



Sakshi Vora

Chemistry Maestro



Megha Khandelwal

Chemistry Maestro



Evolve Batch

for Class 12th JEE Main and Advanced 2023

Code: SAKSHI

USPs of the Batch

- Top Educators from Unacademy Atoms
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- Quick revision, tips & tricks



Nishant Vora
Mathematic Maestro



Ajit Lulla
Physics Maestro



Sakshi Ganotra
Organic & Inorganic
Chemistry Maestro



Megha Khandelwal
Chemistry Maestros



Prashant Jain
Mathematics Maestro



Abhilash Sharma
Physics Maestro



Achiever Batch 2.0

for IIT JEE Main and Advanced 2023 Droppers

Code: SAKSHI

Batch highlights:

- Learn from India's Top Educators
- Coverage of Class 11 & 12 syllabus of JEE
- Deep dive at a conceptual level for JEE Main and JEE Advanced
- Systematic course flow of subjects and related topics
- Strengthening the problem-solving ability of JEE level problems

For more details, contact **8585858585**



Nishant Vora
Mathematics Maestros



Prashant Jain
Mathematics Maestros



Ajit Lulla
Physics Maestros



Abhilash Sharma
Physics Maestros



Sakshi Vora
Chemistry Maestros



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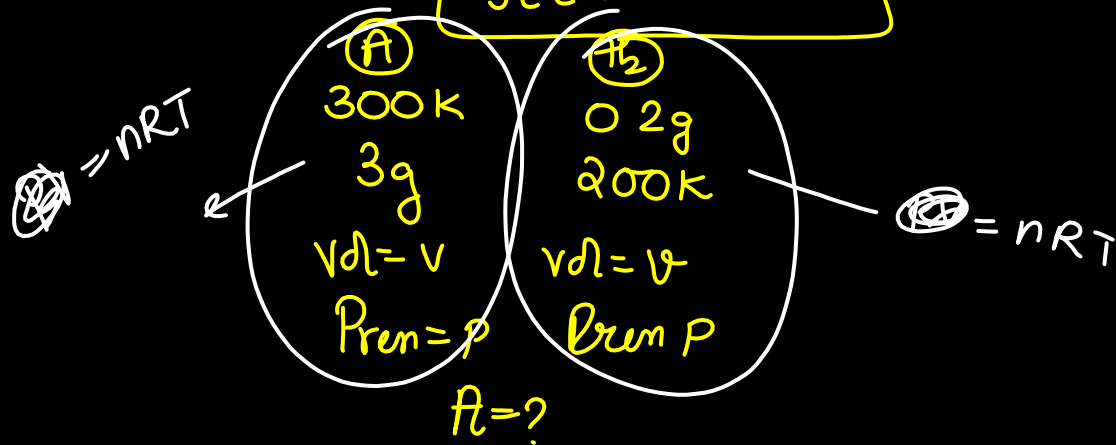
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1. At 300 K, a sample of 3.0 g of gas A occupies the same volume as 0.2 g of hydrogen at 200 K at the same pressure. The molar mass of gas A is _ g mol⁻¹ (nearest integer) Assume that the behaviour of gases as ideal. (Given : The molar mass of hydrogen (H₂) gas is 2.0 g mol⁻¹)

JEE Main PYQ



$$\textcircled{A} \quad \textcircled{B}$$

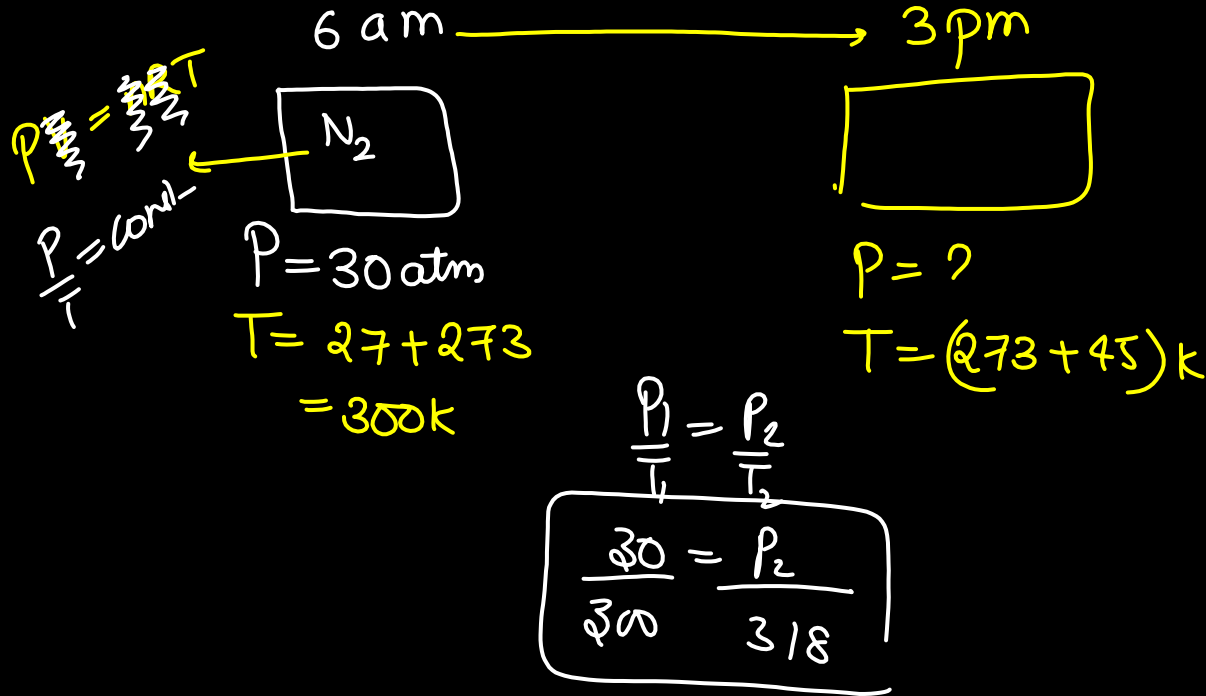
$$nRT = nRT$$

$$\frac{3}{mm} \times 300 = \frac{0.2}{2} \times 200$$

$$mm = 45 \text{ g/mol}$$

2. A rigid nitrogen tank stored inside a laboratory has a pressure of 30 atm at 06:00 am when the temperature is 27°C . At 03:00 pm, when the temperature is 45°C , the pressure in the tank will be _ atm. [nearest integer]

JEE Main PYQ



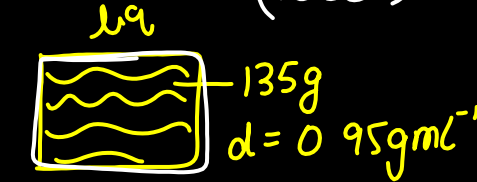
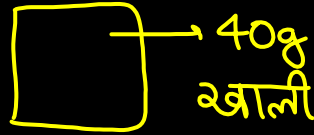
3.

An evacuated glass vessel weighs 40.0 g when empty, 135.0 g when filled with a liquid of density 0.95 g mL^{-1} and 40.5 g when filled with an ideal gas at 0.82 atm at 250 K . The molar mass of the gas in g mol^{-1} is :

(Given : $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$)

- A. 35
B. 50
C. 75
~~D. 125~~

JEE-PYQ



$$m_{\text{liq}} = (135 - 40) \text{ g} \\ = 95 \text{ g}$$

$$d = \frac{m}{V}$$

$$V = \frac{m}{d} = \frac{95 \text{ g}}{0.95 \text{ g mL}^{-1}} \\ = 100 \text{ mL}$$

$$PV = nRT$$

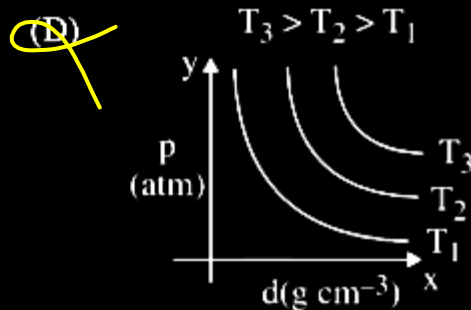
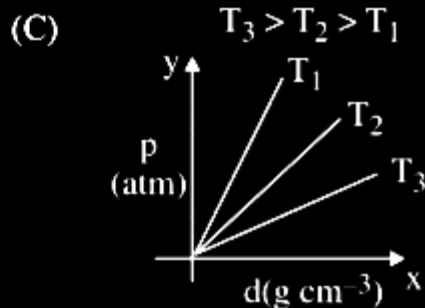
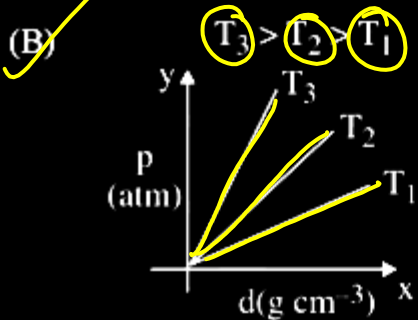
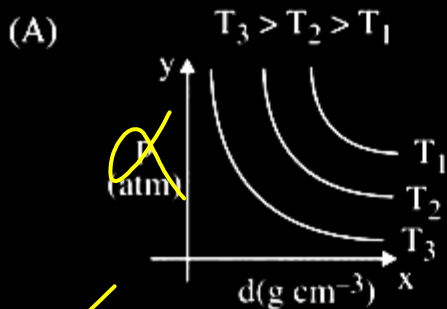
$$\left(\frac{100}{1000}\right) (0.82 \text{ atm}) = \frac{0.5 \times 0.082 (250)}{MM}$$

$$MM = 125$$

A square box representing a glass vessel filled with gas, indicated by dots. To the right of the box is the label "40.5g". Below the box are the labels " $P = 0.82 \text{ atm}$ ", " $T = 250 \text{ K}$ ", and " $MM = ?$ ".

4.

Which amongst the given plots is the correct plot for pressure (p) vs density (d) for an ideal gas ?



$$d = \frac{PM}{RT}$$

$$\frac{PM}{RT} = d$$

$$P = \frac{RT}{m} d$$

$$y = mx$$

slope = $m = \frac{RT}{m}$

5. 100 g of an ideal gas is kept in a cylinder of 416 L volume at 27°C under 1.5 bar pressure. The molar mass of the gas is g mol⁻¹.
(Nearest integer) (Given : $R = 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$)

JEE PYS

2022

Ideal

$$PV = nRT$$

100g

$m = ?$

416 l

$T = 300\text{K}$

$P = 1.5 \text{ bar}$

$$1.5 \text{ bar} \times 416 \text{ l} = \left(\frac{100 \text{ g}}{m \text{ g mol}^{-1}} \right) \times 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1} \times 300 \text{ K}$$

6. The pressure of a moist gas at 27°C is 4 atm. The volume of the container is doubled at the same temperature. The new pressure of the moist gas is 2.2×10^{-1} atm. (Nearest integer)
(Given : The vapour pressure of water at 27°C is 0.4 atm)

JEE Main 2022

Diagram illustrating the process of doubling the volume of a moist gas at constant temperature.

Initial State (Left Box):

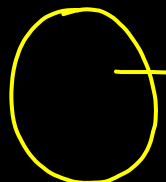
- Temperature: 300K
- Pressure: $T.P = 4\text{ atm}$
- Partial pressure of water vapor: $P_{H_2O} = 0.4\text{ atm}$
- Partial pressure of dry gas: $P_g + P_{H_2O} = 4$
- Partial pressure of dry gas: $P_g = 4 - 0.4 = 3.6\text{ atm}$
- Equation: $PV = nRT$
- Equation: $PV = P'V'$
- Equation: $3.6 \times V = x \cdot 2V$
- Equation: $x = 1.8\text{ atm}$

Final State (Right Box):

- Volume: $Vol = 2V$
- Temperature: $T = 300\text{K}$
- Partial pressure of dry gas: $x = 1.8\text{ atm}$
- Partial pressure of water vapor: 0.4 atm
- Total pressure: 2.2 atm

Result: moist gas \rightarrow new pressure 2.2 atm

7. A sealed flask with a capacity of 2 dm^3 contains 11 g of propane gas. The flask is so weak that it will burst if the pressure becomes 2 MPa . The minimum temperature at which the flask will burst is $^\circ\text{C}$. [nearest integer] (Given : $R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$. Atomic masses of C and H are 12u and 1u respectively.) (Assume that propane behaves as an ideal gas.)

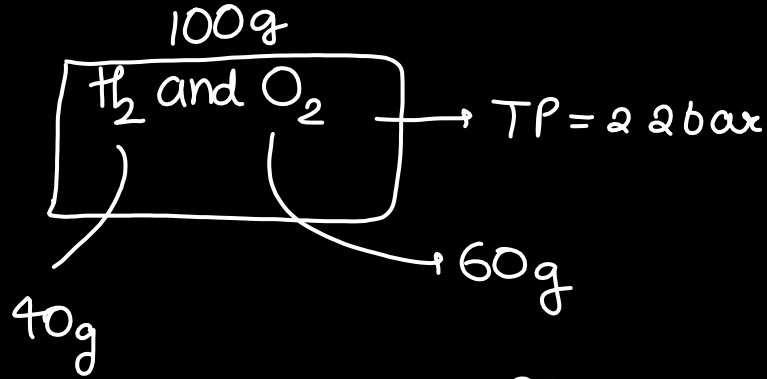

 $2 \text{ dm}^3 = V$
 11 g
 $\text{C}_3\text{H}_8 (\text{g})$

$P = 2 \times 10^6 \text{ Pa}$
 $T = ?$

$PV = nRT$

$2 \times 10^6 \text{ Nm}^{-2} \times 2 \frac{\text{dm}^3}{\text{m}^3} = \frac{11}{\text{mm}_{\text{C}_3\text{H}_8}} \times 8.3 \text{ JK}^{-1} \text{ mol}^{-1} \times T$

8. A mixture of hydrogen and oxygen contains 40% hydrogen by mass when the pressure is 2.2 bar. The partial pressure of hydrogen is bar. (Nearest integer)



$$40\% \rightarrow \frac{40}{100} \times 100$$

$$PP_{H_2} = T.P \times X_{H_2}$$

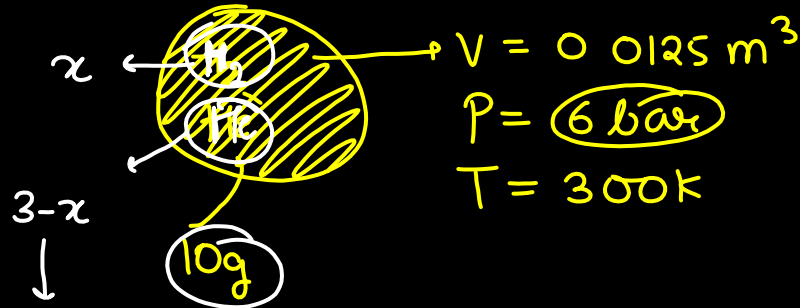
$$= (2.2 \text{ bar}) \left(\frac{n_{H_2}}{n_{H_2} + n_{O_2}} \right)$$

$$(2.2 \text{ bar}) \left(\frac{\frac{40}{2}}{\frac{40}{2} + \frac{60}{32}} \right)$$

9.

A 10 g mixture of hydrogen and helium is contained in a vessel of capacity 0.0125 m^3 at 6 bar and 27°C . The mass of helium in the mixture is _g. (nearest integer)

Given : $R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$ (Atomic masses of H and He are 1u and 4u, respectively)



2molex $10\text{g} = x(2) + (3-x)(4)$



$$10 = 2x + 12 - 4x$$

$$-2 = -2x$$

$$x = 1 \text{ mole}$$

$$PV = nRT$$

$$6 \text{ bar} \cdot 0.0125 \text{ m}^3 = n \times 8.3 \text{ JK}^{-1} \text{ mol}^{-1} \times 300 \text{ K}$$

$$1 \text{ m}^3 = 1000 \text{ l}$$

$$n_{\text{total}} = 3$$

10.

Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Activated charcoal adsorbs SO_2 more efficiently than CH_4 .

Reason A : Gases with lower critical temperatures are readily adsorbed by activated charcoal.

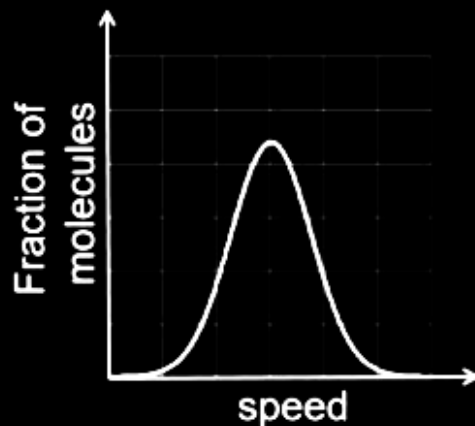
In the light of the above statements, choose the correct answer from the options given below

- A. Both A and R are correct and R is the correct explanation of A.
- B. Both A and R are correct but R is NOT the correct explanation of A.
- C. A is correct but R is not correct.
- D. A is not correct but R is correct.

11. for a real gas at 25°C temperature and high pressure (99 bar) the value of compressibility factor is 2, so the value of vander waal's constant 'b' should be $_ \times 10^{-2} \text{ L mol}^{-1}$ (nearest integer) (given $R = 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$)

12.

If the distribution of molecular speeds of a gas is as per the figure shown below, then the ratio of the most probable, the average, and the root mean square speeds, respectively, is



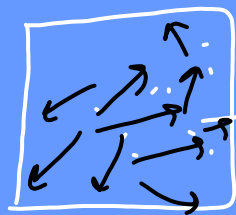
(A) 1 : 1 : 1

(B) 1 : 1 : 1.224

(C) 1 : 1.128 : 1.224

(D) 1 : 1.128 : 1

Gaseous State



any gas O_2 , Ne , Air , He , CO_2 , CH_4 etc
(कितनी)

① amount of gas $(n) = \frac{Gm}{mm}$

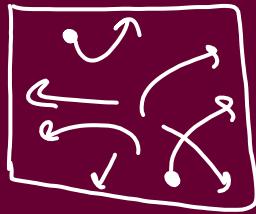
② Temperature of the gas

$^{\circ}C \xrightarrow{273.15} (K)$

③ volume occupied by gas

$$V_{\text{gas}} = V_{\text{container}}$$

④ Pressure of the gas (P)



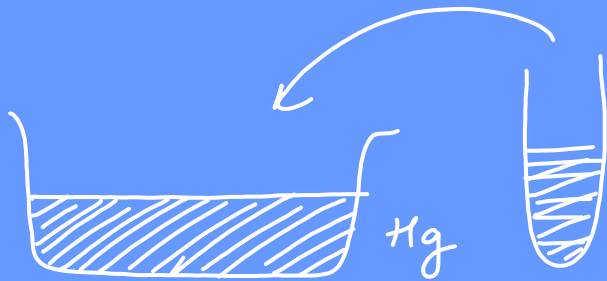
every particles exerts same pressure
uniform pressure

⑤ atmospheric pressure (atm)

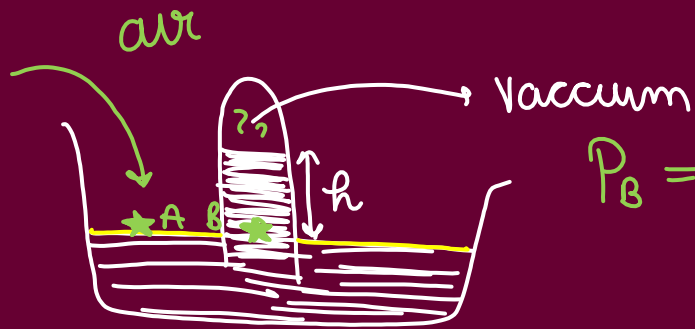


$$\begin{aligned}\text{Std pressure} &= 1 \text{ atm} \\ &= 101325 \text{ Nm}^{-2}\end{aligned}$$

⑥ Barometer



$$P_A = P_{atm}$$

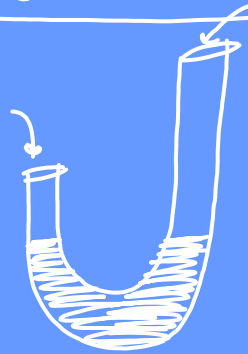


$$P_B = h \rho g$$

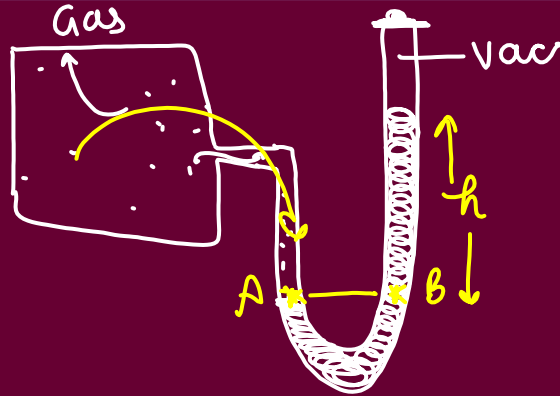
$$\begin{aligned} P_A &= P_B \\ \hline P_{atm} &= h \rho g \end{aligned}$$

$$h = 76 \text{ cm Hg}$$

① Manometer.



closed end manometer



$$P_A = P_{\text{gas}}$$

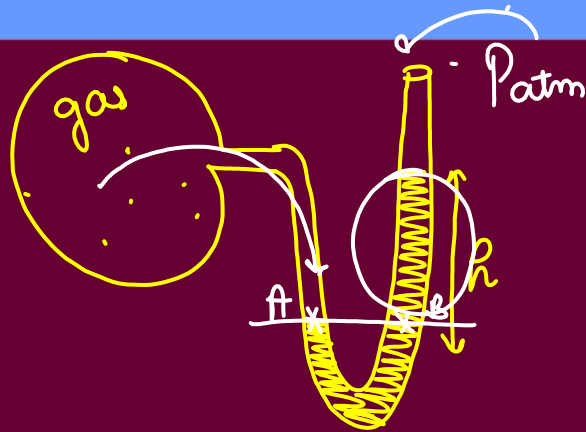
$$P_B = h\rho g + 0$$

$$P_A = P_B$$

$$P_{\text{gas}} = h\rho g$$

⑧ open end manometer

$$P_{\text{gas}} = ?$$



$$P_{\text{gas}} = ?$$

$$P_A = P_{\text{gas}}$$

$$P_B = h\rho g + P_{\text{atm}}$$

$$P_A = P_B$$

$$h\rho g + P_{\text{atm}} = P_{\text{gas}}$$

Ideal Gas

Gas laws

① Boyle's law:

$n, T \rightarrow \text{constant}$

$$P \propto \frac{1}{V}$$

$$P \uparrow \quad V \downarrow$$

$$P \downarrow \quad V \uparrow$$

$$PV = \text{constant}$$

$$P_1 V_1 = P_2 V_2 \quad \& \quad \text{---}$$

स्थिर तरीका

Ideal gas $PV = \text{constant}$

~~Boyle~~ Boyle ~~Boil~~ ~~T~~ ~~T~~

$$VP = k$$

$$P = \frac{k}{V} \Rightarrow P \propto \frac{1}{V}$$

②. Charles's law
 $n \& p \rightarrow \text{constant}$

$$\boxed{V \propto T} \rightarrow \text{Kelvin}$$

$$\frac{V}{T} = \text{constant}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} = \frac{V_3}{T_3} \dots$$

रूट्टा तरीका

$$\cancel{V} = \cancel{V} T \quad (\text{c.p.})$$

Charles's $V \propto T$

② Gay-Lussac's law.
 $V, n \rightarrow \text{const}$

$$P \propto T \text{ (Kelvin)}$$

$$\frac{P}{T} = k = \text{const}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \text{ \& so on}$$

$$\frac{P}{T}$$

$$P \propto T$$

$$P \propto T$$

④. Avogadro's law
 $P, T \rightarrow \text{const}$

$$V \propto n$$

$$\frac{V_1}{n_1} = \frac{V_2}{n_2} \text{ \& so on.}$$

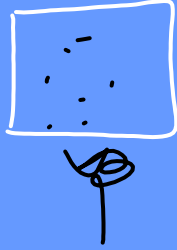
रजत

$$V = n \frac{RT}{P}$$

$$V \propto n$$

Gay-Lussac's.

HW

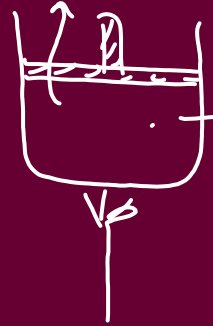


$$\begin{aligned} V &= \text{const} \\ P &\propto T \\ T &\uparrow \\ P &\uparrow \end{aligned}$$

Avogadro.

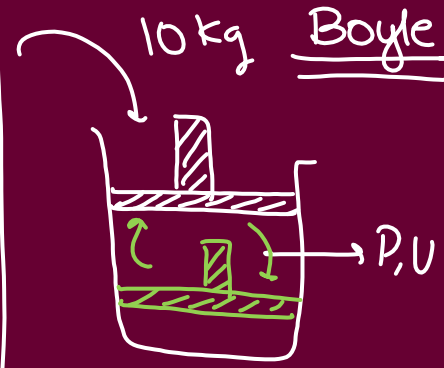
HW

Charles's law



V, T, P

$$\begin{aligned} P &\propto \text{const} \\ V &\propto T \\ T &\uparrow \\ V &\uparrow \end{aligned}$$



Boyle

$$\begin{aligned} n, T &\rightarrow \text{const} \\ P &\propto \frac{1}{V} \\ P &\uparrow \quad V \downarrow \\ P &\downarrow \quad V \uparrow \end{aligned}$$

Boyle's
 $V \propto \frac{1}{P}$

Charles
 $V \propto T$

Avogadro's
 $V \propto n$

$V \propto \frac{nT}{P}$

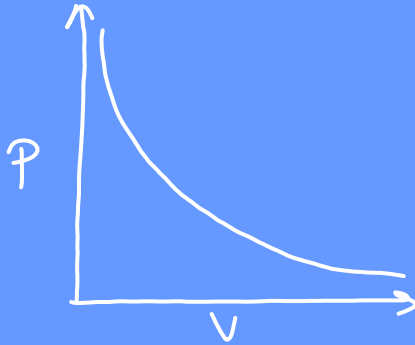
$V = \frac{R n T}{P}$

$PV = nRT$ ✓

$\{ \textcircled{R} \text{ Universal Gas constant} \}$
 $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
 $0.0821 \text{ l atm K}^{-1} \text{ mol}^{-1}$
 $2 \text{ cal K}^{-1} \text{ mol}^{-1}$

Graph Questions

①



@ const Temp, n

$$PV = \text{constant}$$

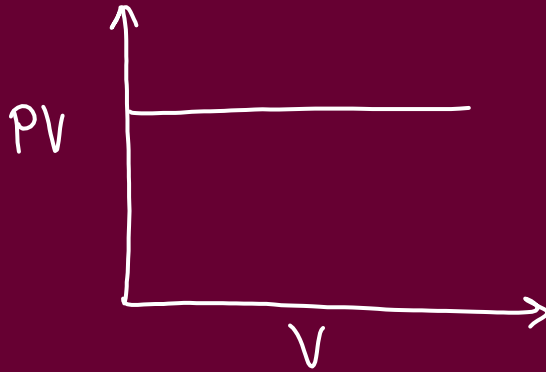
$$PV = k$$

$$P \uparrow \quad V \downarrow$$

$$P \downarrow \quad V \uparrow$$

Boyle's law

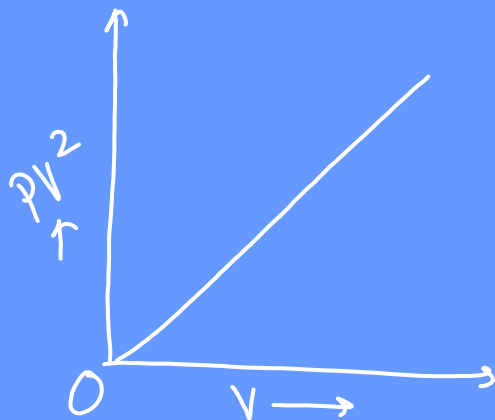
②



Boyle's law

$$PV = k$$

③



Boyle's law

$$PV = \text{constant}$$

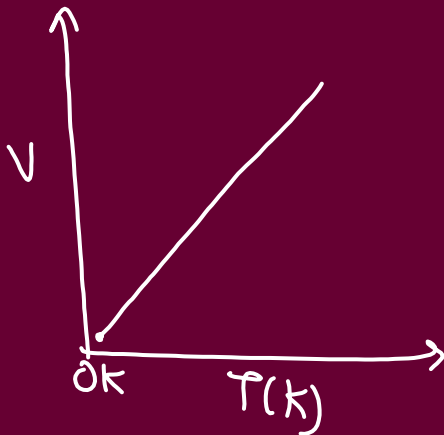
$$PV = k$$

\times by V on both sides

$$PV^2 = kV$$

$$y = mx$$

④



Charles's law \longrightarrow

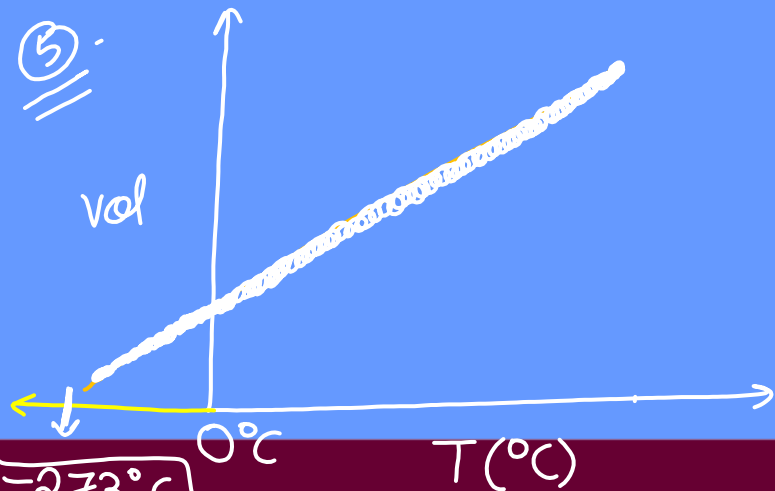
$$V = kT$$

$$V \propto T$$

⑤.

vol

$$V_{\text{gas}} = 0$$

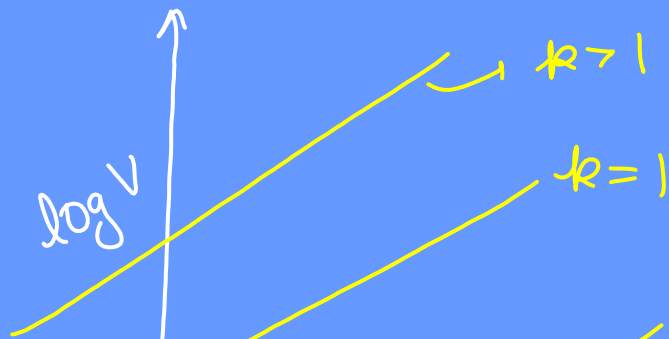


-273°C
↓
OK

absolute zero
absolute Temp

Gas cease to exist

⑥.



Charles' Law

~~$V = kT$~~

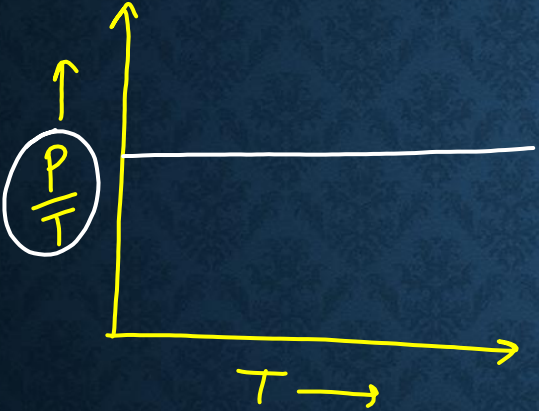
$V \propto T$

$V = kT$

$V = kT$
 $\log V = \log k + \log T$

$y = c + mx$

⑦



Gay-Lussac's law

$$P \propto T$$

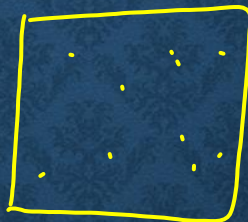
$$\frac{P}{T} = k$$

$$\frac{P}{T} = k \times 1$$

Equation of State

State A

State B



$$PV = nRT$$

$$P_1 V_1 = n_1 R T_1$$

$$\frac{P_1 V_1}{n_1 T_1} = R$$

{ Pressure P_1 ,
no of moles n_1 ,
Volume $= V_1$,
Temp $= T_1$

{ P_2
 n_2
 V_2
 T_2

$$P_2 V_2 = n_2 R T_2$$

$$R = \frac{P_2 V_2}{n_2 T_2}$$

$$R = R$$

$$\star \left(\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2} \right)$$

Ques. Pressure of an ideal gas contained in a closed rigid vessel is increased by 20%, when it is heated

By 60 K Cal the final temp

$$\frac{360K}{T+60}$$



$$P_1 = \frac{P}{T}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\frac{P}{T} = \frac{P + 20\%P}{T+60}$$

$$\frac{P}{T} = \frac{P + \frac{20}{100}P}{T+60}$$

$$\frac{P}{T} = \frac{1P + 0.2P}{T+60}$$

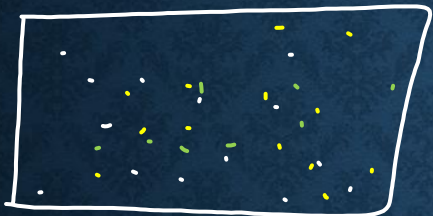
$$\frac{P}{T} = \frac{1.2P}{T+60}$$

$$T+60 = 1.2T$$

$$60 = 1.2T - T$$

$$\textcircled{360} = \frac{60 \times 100}{2} = 0.2T = T$$

Dalton's law of partial pressure



$$P_{\text{Total}} = P_A + P_B + P_C$$

Partial pressure of A P_A
Partial pressure of B P_B
Partial pressure of C P_C

$$\text{Partial pressure}_{\text{any gas}} = \text{Total pressure} \times \chi_{\text{gas}}$$

JEEPYQ

* Equal mass of CH_4 & O_2 are mixed
in a container at 25°C

The fraction of total pressure
exerted by oxygen

O_2	CH_4
$x\text{g}$	$x\text{g}$

298K

$$\frac{1}{3} = \frac{x}{3x}$$

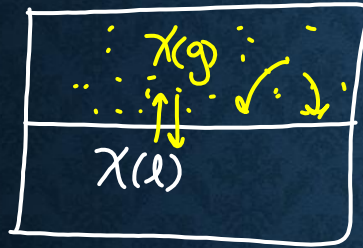
$$PP_{\text{O}_2} = TP \times x_{\text{O}_2}$$

$$\frac{PP_{\text{O}_2}}{TP} = x_{\text{O}_2} = \frac{n_{\text{O}_2}}{n_{\text{O}_2} + n_{\text{CH}_4}}$$

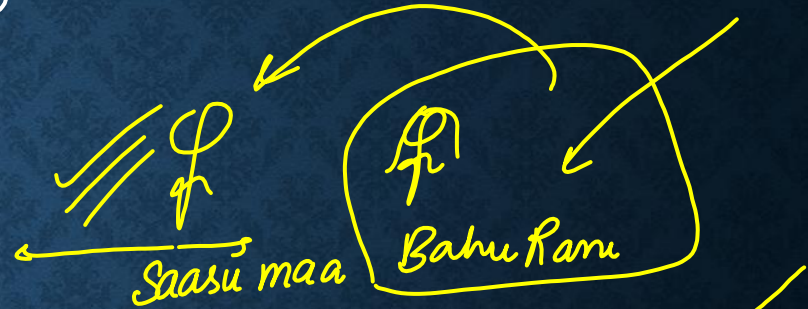
$$\left(\frac{\frac{x}{32}}{\frac{x+2x}{32}} \right)$$

$$\left(\frac{\frac{x}{32}}{\frac{x}{32} + \frac{x}{16}} \right)$$

Vapour Pressure



$T = 25^\circ\text{C}$



@ const Temp. the pressure exerted by the vapour on the surface of liquid (when liq & vap are in eq with each other)

$$VP_{H_2O} = \text{aqueous tension}$$

moist gas



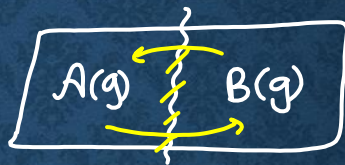
$$T.P = P_{gas} + VP_{H_2O}$$

ap tension

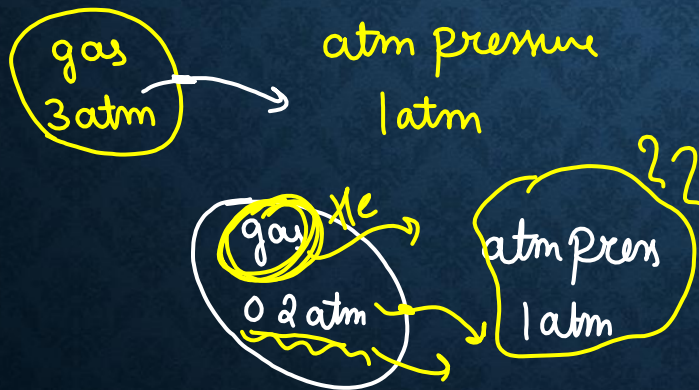
Effusion



Diffusion



Intermixing

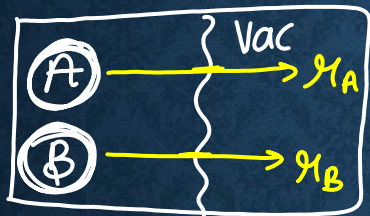


Rate of effusion / Diffusion

$$\left\{ \begin{array}{l} * \frac{\text{no of moles of the gas effusion}}{\text{time taken}} \\ * \frac{\text{vol effusion}}{t} \\ * \frac{\text{dis travelled by the gas}}{t} \\ * \frac{\text{dec in Pres}}{t} \end{array} \right\}$$

Graham's law

$T, P \rightarrow$ same



$$\frac{r_A}{r_B} = \sqrt{\frac{d_B}{d_A}} \quad \text{---} \textcircled{1} \quad \star$$

$$r \propto \frac{1}{\sqrt{d_{\text{gas}}}}$$

$$r \propto \frac{1}{\sqrt{m m_{\text{gas}}}}$$

$$\frac{r_A}{r_B} = \sqrt{\frac{m_B}{m_A}} \quad \star$$

density of gas

Ideal $PV = nRT$

$$PV = \frac{w}{M} RT$$

$$PM = \left(\frac{w}{V} \right) RT$$

$\nearrow d$

$$PM = d RT$$

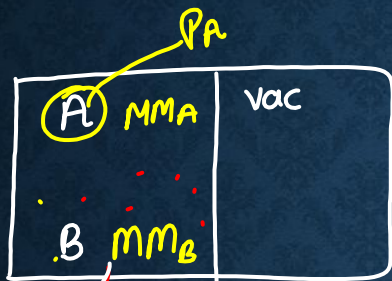
$$\boxed{d = \frac{PM}{RT}}$$

$\curvearrowright @P, R, T \rightarrow \text{const}$

$d \propto M$



see also



★ $\mu_{\text{gas}} \propto \frac{P_{\text{gas}}}{\sqrt{m m_{\text{gas}}}}$ ★

$$\frac{\mu_A}{\mu_B} = \frac{P_A}{P_B} \sqrt{\frac{m_B}{m_A}}$$

↑ inside the container

$$\frac{\mu_A}{\mu_B} = \frac{n_A}{n_B} \sqrt{\frac{M_B}{M_A}}$$

Ques The ratio of rate of diffusion of He & methane under identical P. & T condition is

$$\frac{r_{He}}{r_{CH_4}} = \sqrt{\frac{m_{CH_4}}{m_{He}}} = \sqrt{\frac{16}{4}} = \sqrt{4} = 2.1$$

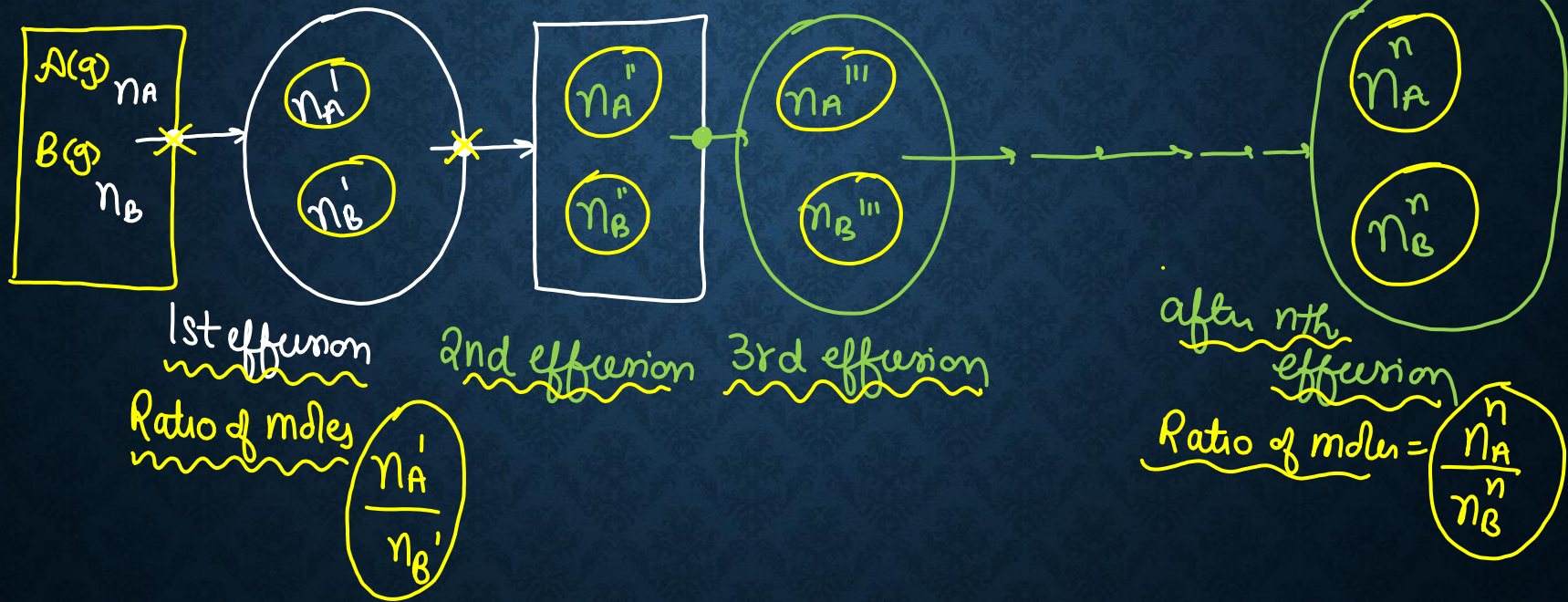
$$r_A = \frac{n_A}{t} \rightarrow$$

$$r_B = \frac{n_B}{t} \rightarrow$$

Same time interval

$$\frac{r_A}{r_B} = \left(\frac{n_A}{n_B} \right) \rightarrow \text{effused}$$

Successive effusion



$\mu_{\text{gas}} \propto \frac{n_{\text{inside the container}}}{\sqrt{m m_{\text{gas}}}}$

$$\left(\frac{n_A}{n_B} \right)_{\text{effused}} = \left(\frac{n_A}{n_B} \right)_{\text{inside the container}} \sqrt{\frac{m_B}{m_A}}$$

after 1st step

$$\frac{n_A'}{n_B'} = \frac{n_A}{n_B} \sqrt{\frac{m_B}{m_A}}$$

\vdots
 \downarrow

$$\frac{n_A''}{n_B''} = \left(\frac{n_A'}{n_B'} \right) \sqrt{\frac{m_B}{m_A}}$$

after nth step

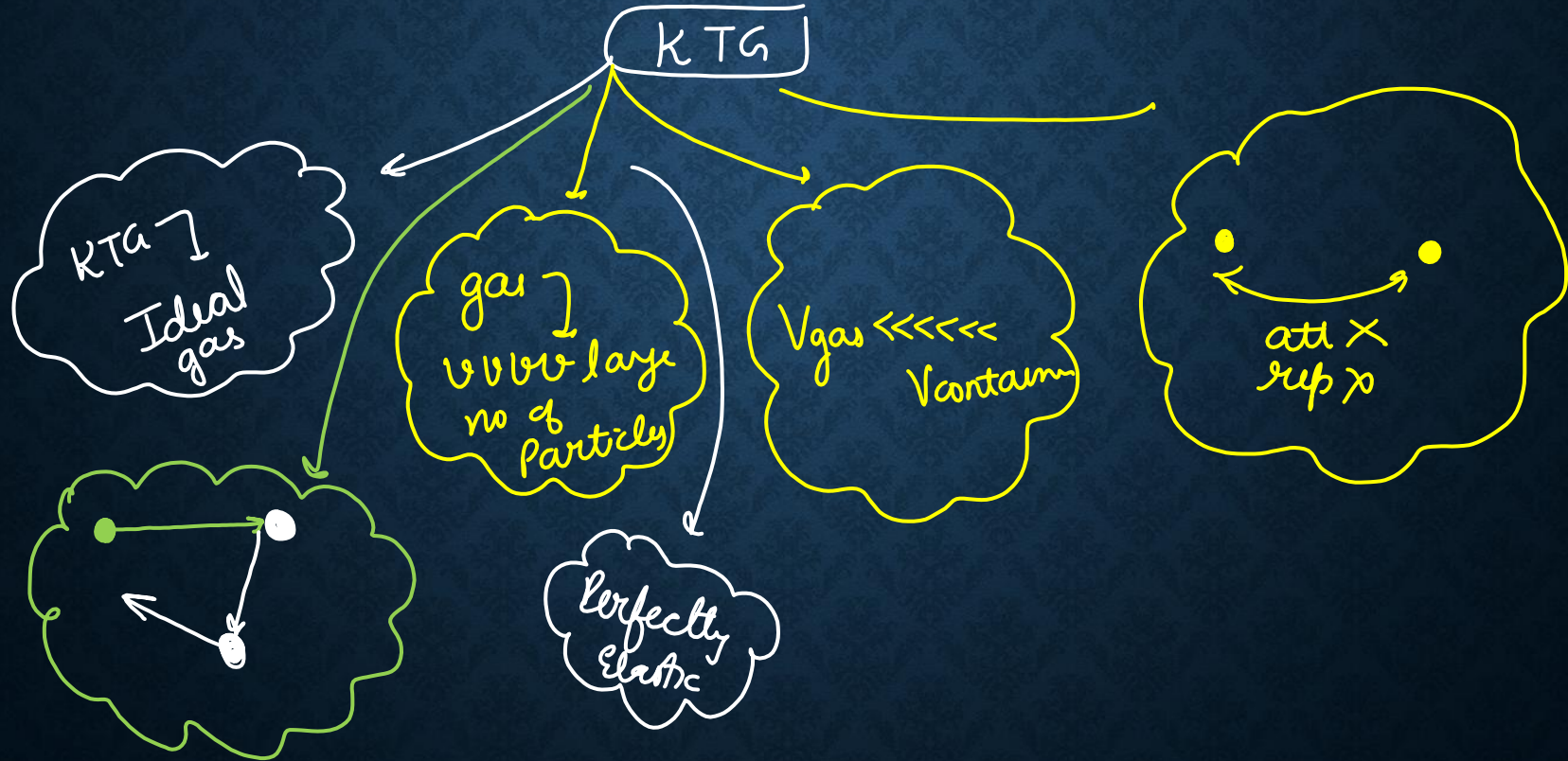
$$\frac{n_A^n}{n_B^n} = \left(\frac{n_A}{n_B} \right) \left(\sqrt{\frac{m_B}{m_A}} \right)^n$$

no of steps of effusion

फिर से moles effuse करें
after nth step

initial moles
in the
container

Kinetic Theory of gases



average KE per molecule

depends upon

Temp only



Hence Proved

KTA



1 particle ✓


mass = m ✓

contains volume = V ✓

Speed of particle = u ✓

$$P = \frac{1}{3} \frac{m u^2}{V}$$

$$P = \frac{1}{3} \frac{m}{V} \left[u_1^2 + u_2^2 + u_3^2 + \dots + u_N^2 \right] \checkmark$$


$$P = \frac{1}{3} \frac{m}{V} \left[N U_{rms}^2 \right] \checkmark$$

Hence Proved

1 mole gas

$$N = N_A$$

$$P = \frac{1}{3} \frac{(\overset{\curvearrowright}{m})}{V} \left[\overset{\curvearrowright}{N_A} \underline{u^2}_{rms} \right]$$

m = mass of 1 particle

$m N_A \rightarrow$ molar mass

$$P = \frac{1}{3} \frac{M}{V} [u^2_{rms}]$$



KE of a particle

$$KE = \frac{1}{2} m u^2 \quad \checkmark$$

$$KE = \frac{1}{2} m [u_1^2 + u_2^2 + u_3^2 + \dots + u_N^2] \quad \checkmark$$

$$= \frac{1}{2} m [N \cdot U_{rms}^2] \quad \checkmark$$

$$KE \quad \text{1 mole particles}$$

$$= \frac{1}{2} m N_A U_{rms}^2$$



$$\boxed{\frac{1}{2} M U_{rms}^2}$$



$$KE = \frac{1}{2} m v^2$$



leader

$$\frac{KTA}{KE \& P} \rightarrow ?$$

$$P = \frac{1}{3} \left(\frac{M}{V} \right) U_{rms}^2 \quad \text{--- ①}$$

$$KE = \frac{1}{2} M U_{rms}^2 \quad \text{--- ②}$$

$$2KE = M U_{rms}^2$$

$$P = \frac{2KE}{3V}$$

$$\frac{3PV}{2} = KE \quad n=1$$
$$KE = \frac{3}{2} nRT$$

KTG

$$(KE)_{1\text{mole}} = \frac{3}{2} PV$$
$$= \frac{3}{2} RT$$

$$(KE)_{n\text{mole}} = \frac{3}{2} nRT$$

$$KE \propto n$$
$$\propto T$$

quads

average KE per molecule of the gas $\propto T$

$$(KE)_{avg} = \frac{\text{total KE}}{\text{total no of molecules}}$$

$$= \frac{\frac{3}{2} \cancel{R} T}{\cancel{N} \cdot N_A}$$

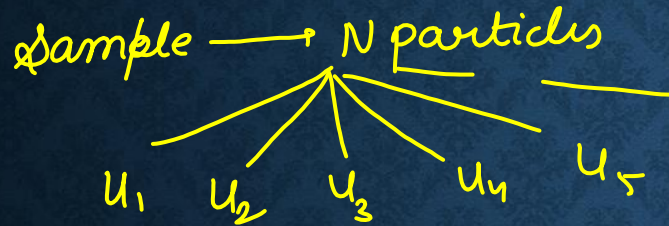
$$= \frac{3}{2} \left(\frac{R}{N_A} \right) T$$

$$= \frac{3}{2} k_b T$$

$$\frac{R}{N_A} = k_b = \text{Boltzmann's const}$$

$$\frac{8314 \text{ J K}^{-1} \text{ mol}^{-1}}{6022 \times 10^{23} \text{ mol}^{-1}} = \textcircled{\text{J K}^{-1}}$$

Different speeds of Particles



$$U_{avg} = \frac{U_1 + U_2 + U_3 + U_4 + \dots + U_N}{N}$$

Root mean square speed / U_{rms}

$$U_{rms} = \sqrt{\frac{U_1^2 + U_2^2 + U_3^2 + \dots + U_N^2}{N}}$$

Square on Both sides

$$U_{rms}^2 = \frac{U_1^2 + U_2^2 + U_3^2 + \dots + U_N^2}{N}$$

$$U_{rms}^2 \cdot N = U_1^2 + U_2^2 + \dots + U_N^2$$

U most probable

↓
the speed corresponding to
max no of particles



$$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$$
$$T = \text{K}$$

(M) → molar mass

~~g/mol~~

Kg/mole

U_{mp}



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

#SV shortcut

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

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

ju main
2013 -

u_{rms} u_{avg} u_{mp}

$$\sqrt{\frac{3RT}{m}}$$

$$\sqrt{\frac{8RT}{\pi M}}$$

$$\sqrt{\frac{2RT}{m}}$$



$$u_{rms} > u_{avg} > u_{mp}$$

$$\sqrt{3} \cdot \sqrt{\frac{8}{\pi}} \cdot \sqrt{2}$$

$$1.732 \cdot \sqrt{\frac{8}{\pi}} \cdot 1.414$$

Real Gases

① no gas — ideal

② $PV = nRT$ (ideal)

$PV \neq nRT$ (real/
non-ideal)

①

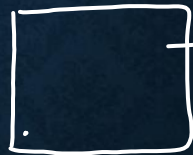
V_{gas} not neg
compared to
the vol of
container

②

att ✓
repulsive ✓

Volume correction

V_{gas} = vol available
for the free
movement of
the gas



v = vol of
container

$$V_{\text{gas}} = V$$

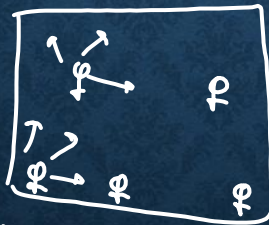
$$(V_{\text{gas}})_{\text{Real}} \neq V$$

$$(V_{\text{gas}})_{\text{Real}} = V - \textcircled{V'}$$

volume
correct



$$V_{\text{gas Real}} = V - \textcircled{V'}$$



$$V_{\text{gas}} = V$$

$V' = \text{volume correction}$
 $= \text{effective vol. of gas particles}$

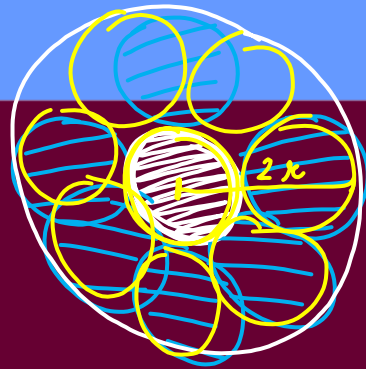
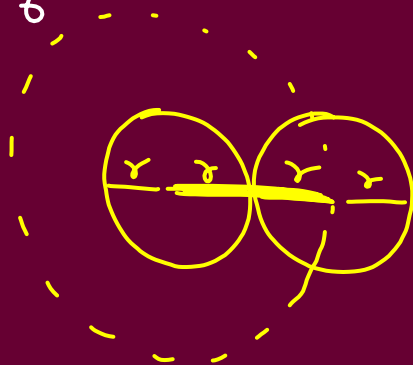
b = effective volume of 1 mole particles

n moles particles \rightarrow effective vol = nb

$$V_{\text{gas}} = V - nb$$

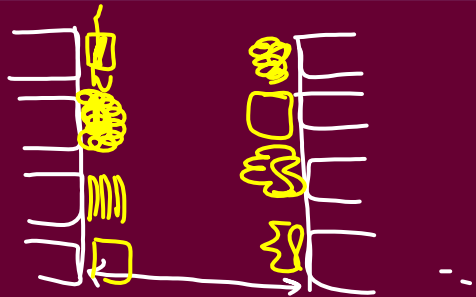
vol. for free movement of
gas

vol of container



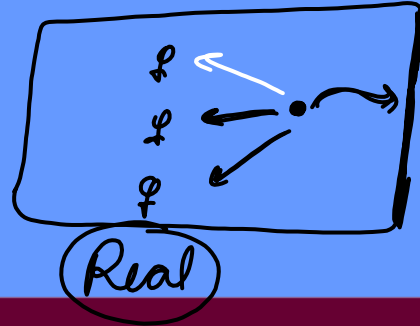
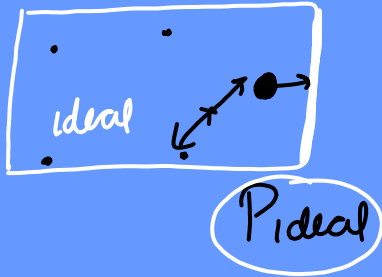
$$\begin{aligned}\text{effective volume occupied by 2 particles} &= \frac{4\pi}{3} (2r)^3 \\ &= 8 \times \frac{4\pi r^3}{3}\end{aligned}$$

$$\begin{aligned}1 \text{ particle} &= \frac{8 \times \frac{4\pi r^3}{3}}{2} \\ &= 4 \times \frac{4\pi r^3}{3}\end{aligned}$$



$$V_f = 4 \frac{4\pi r^3}{3} N_0$$

Pressure correction P'



$$P_{\text{gas}} = P_{\text{ideal}} - P'$$

Press of real gas

$$P' = \frac{an^2}{V^2}$$

~~$PV = nRT$~~
 ~~$P = \left(P - \frac{an^2}{V^2}\right) \left(\frac{n}{V}\right)$~~

for n moles of a gas

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

Vanderwaal eq

for 1 mole

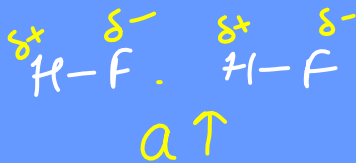
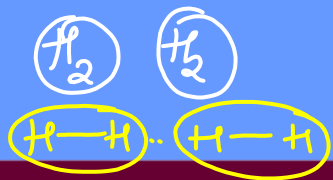
$$\left(P + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

$$n=1 \rightarrow V = \frac{V}{n} = V_m = molar vol$$

a, b \rightarrow Vanderwaal gas constants
fixed value for every gas

(a) \rightarrow measure of α_n intramolecular att forces

att \uparrow
a \uparrow



size \uparrow mass $\uparrow \Rightarrow$ im forces of att \uparrow a \uparrow
 $a_{\text{H}_2} < a_{\text{CO}_2}$

$\mathcal{L} \rightarrow$



























































































































































































































































































































































































































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- Strengthen JEE problem-solving ability



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Mathematics Maestro



Nishant Vora

Mathematics Maestro



Ajit Lulla

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Megha Khandelwal

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For more details, contact **8585858585**



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Mathematics Maestros



Prashant Jain
Mathematics Maestros



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