YAKEEN 2.0 NEET 2024

- Subject – Physical Chemistry
- Chapter – States of Matter

Lecture No.- 1

BY: Amit Mahajan Sir

Today's Targets

1. Revision Of Last Class
2. Temperature
3. Volume
4. Pressure, Barometer, Manometer
5. Home Work Discussion & Home Work

Rules to attend class

if u want to succeed in 2024 NEET exam.

1. Always sit in a peaceful environment with headphone and be ready with your copy and pen.
2. Never ever attend a class from in between or don't join a live class in the middle of the chapter.
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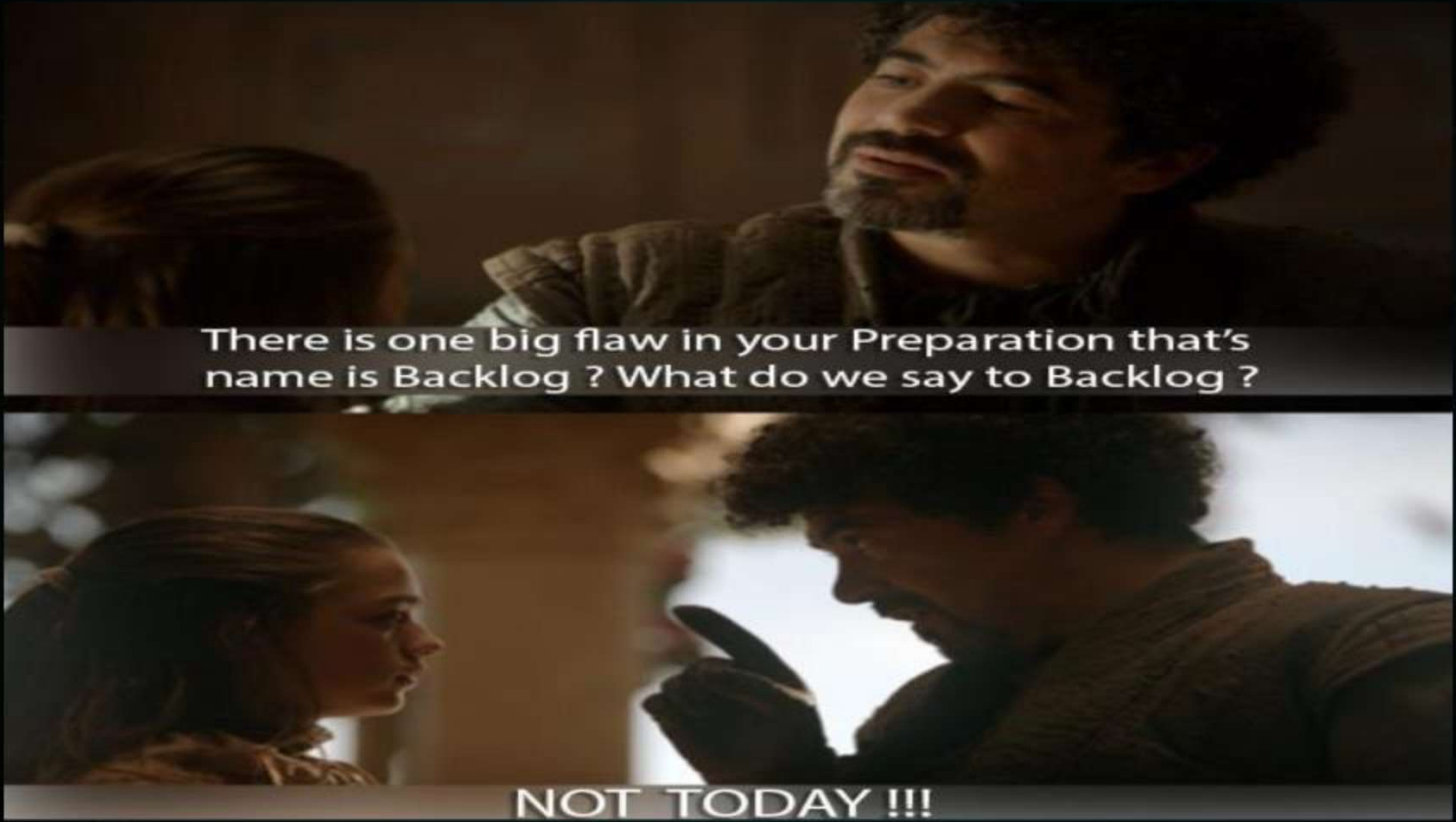
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name is Backlog ? What do we say to Backlog ?
NOT TODAY !!!

Revision Of Last Class

(1) Abnormal Molar mass $\neq$ Normal Molar mass.

(2) Van't hoff factor (i) $= \dfrac{\text{Normal Molar mass}}{\text{Abnormal Molar mass}} = \dfrac{\text{Abnormal C.P.}}{\text{Normal C.P.}}$

(3) $i = 1 \Rightarrow$ non-electrolyte, non-volatile solute $\rightarrow$ Sugar, urea. Glucose Fructose

$i > 1 \Rightarrow$ solute electrolyte for ex:- Na^+Cl^-, K_2SO_4

$i < 1 \Rightarrow$ Solute Carboxylic acid in non-Polar solvent (Benzene, Hexane, CCl_4 etc) or Phenol

$i > 1$ (dissociation)

(4) $i = 1 - \alpha + n\alpha$.

α = degree of dissociation

n = no. of particles formed after dissociation of 1 particle

% age dissociation $= \alpha \times 100$

(5) $i < 1$ (association)

$i = 1 - \alpha + \frac{\alpha}{n}$

α = degree of association.

% age association $= \alpha \times 100$

n = no. of particles combine together to form 1 particle

(6) Colligative Prop. (C.P.) $\propto$ iC

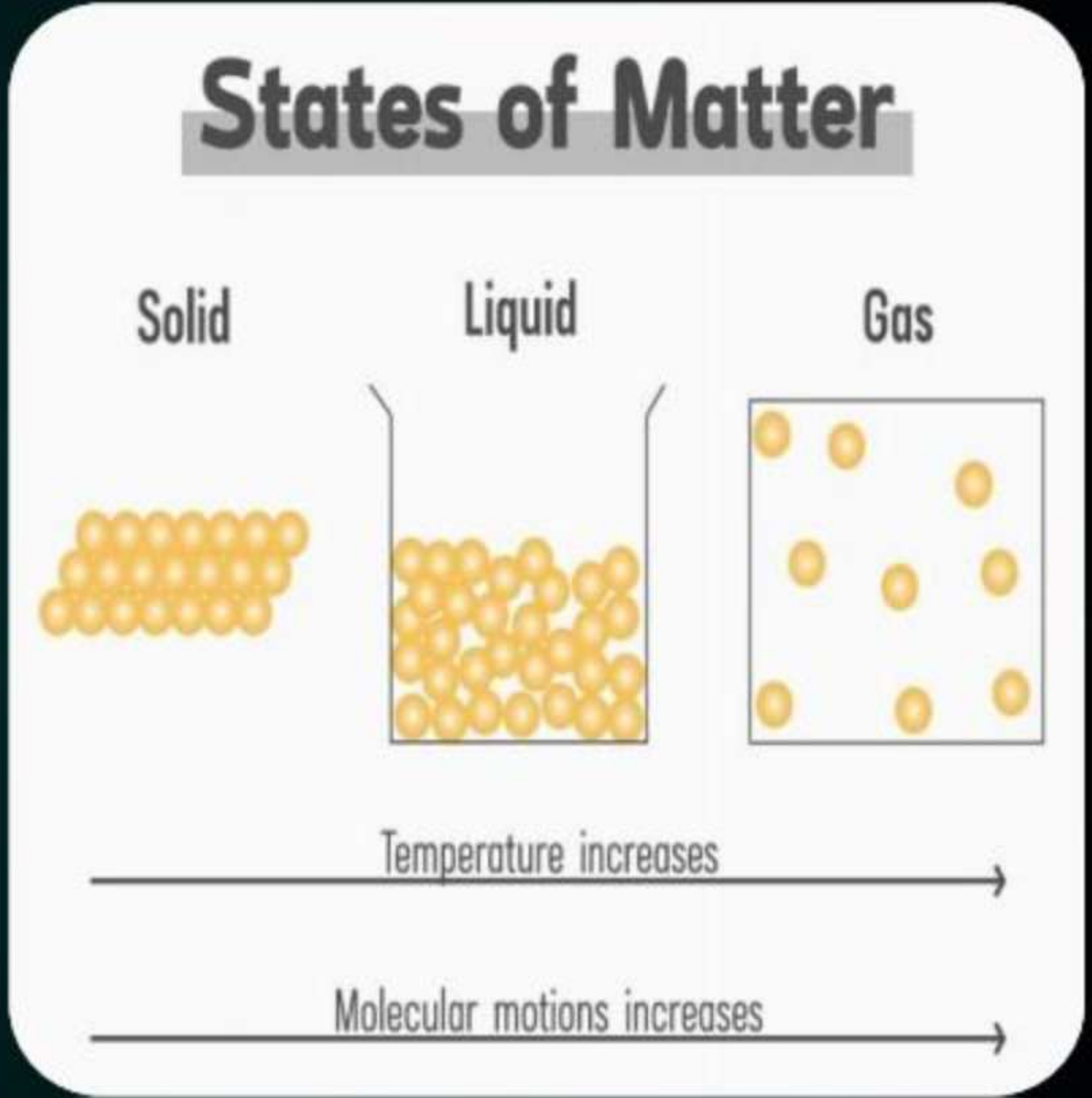
if C = same

$C.P. \propto i$

B.pt of solution $\propto i$

f.pt of solution $\propto \frac{1}{i}$

Gaseous State



Temperature

#MIT

(1) Degree of Hotness or Coldness

(2) Different scales are used to measure temperature

$$°F = \frac{9}{5}°C + 32$$

$$K = °C + 273$$

Q. Convert $40°F$ into $°C$.

Ans
$$°F = \frac{9}{5}°C + 32$$
$$\downarrow$$
$$40 = \frac{9}{5}°C + 32$$

$$\frac{9}{5}°C = 40 - 32 = 8$$

$$°C = \frac{8 \times 5}{9} = \frac{40}{9}$$

Q. Convert $27°C$ into Kelvin (K)

$$K = °C + 273$$

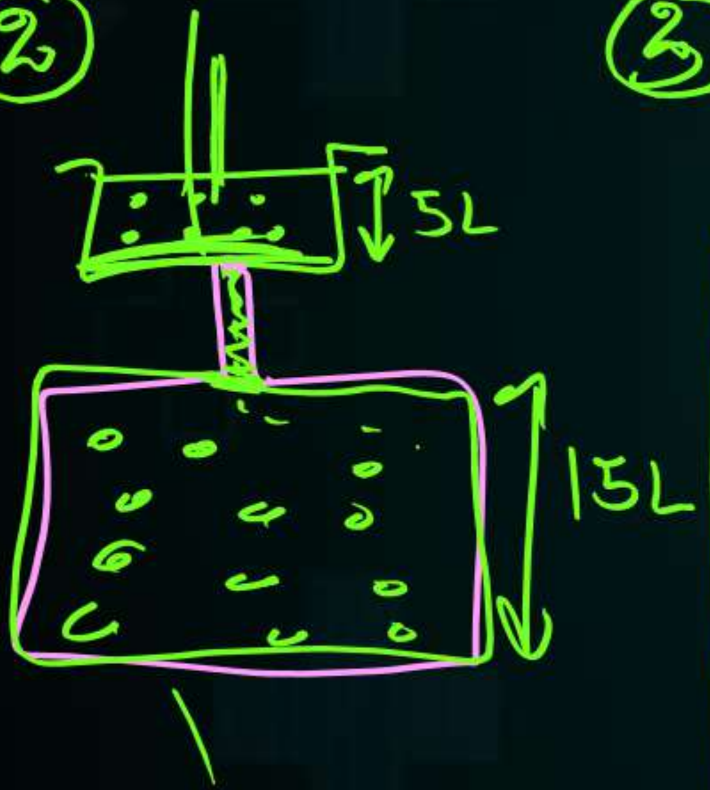
$$K = 27 + 273 = 300\,K$$

Volume

MFT

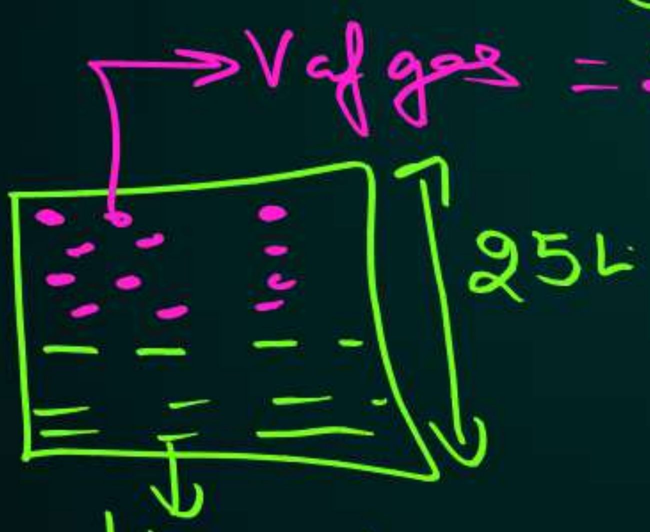
(1) Volume of gas = Volume of Container

(2)

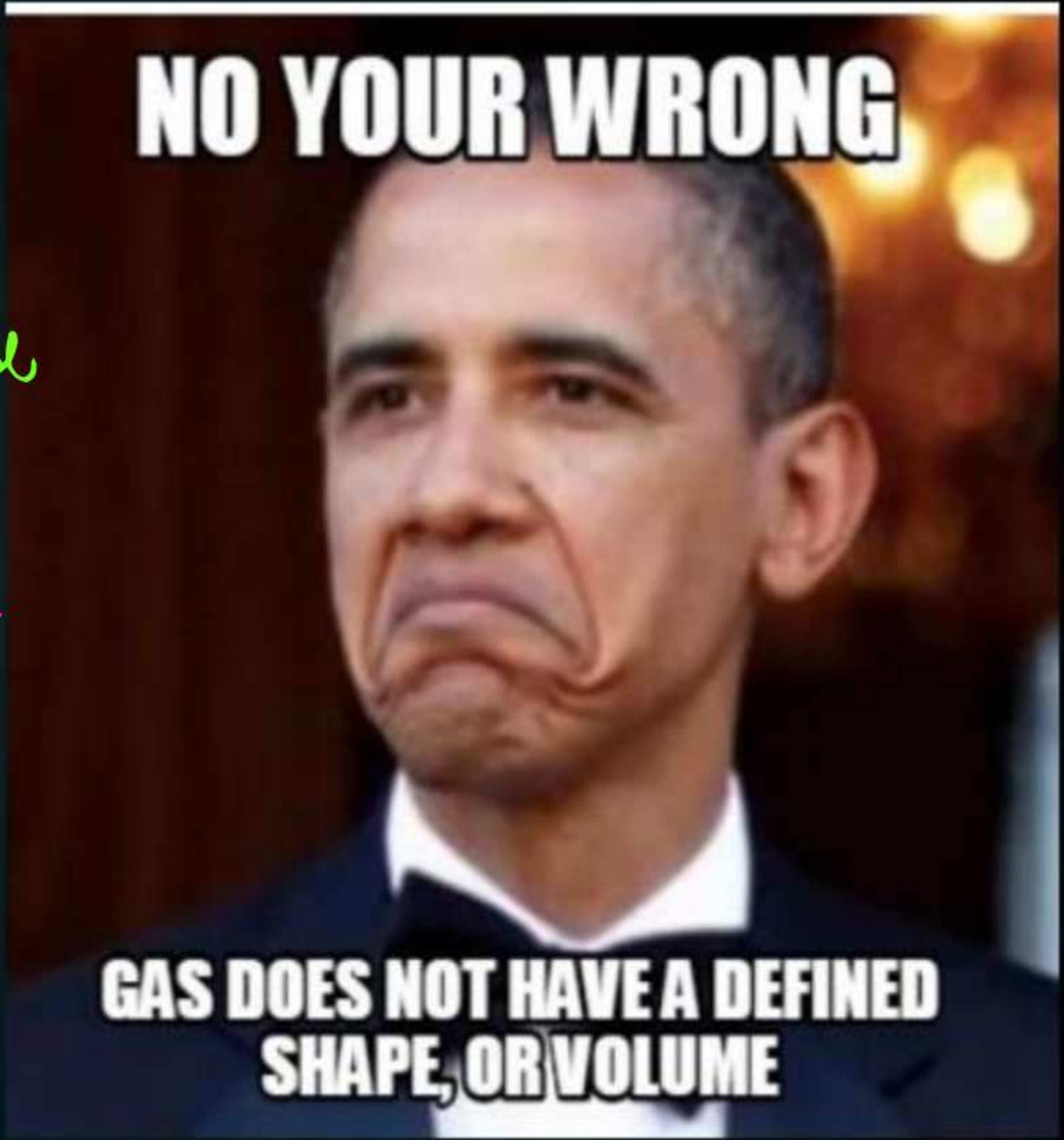


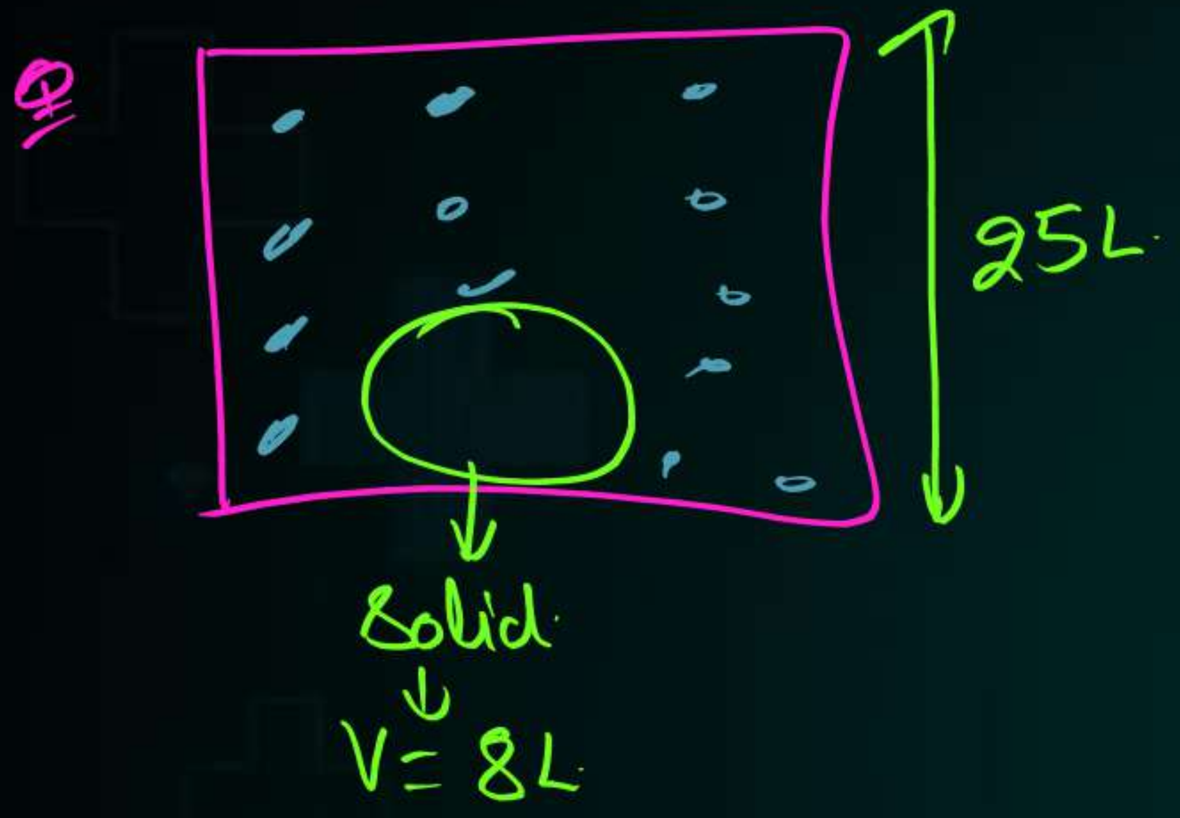
(3) Vol. of gas = Vol. Occupied by gas in Container.

V of gas = 25 − 10 = 15L



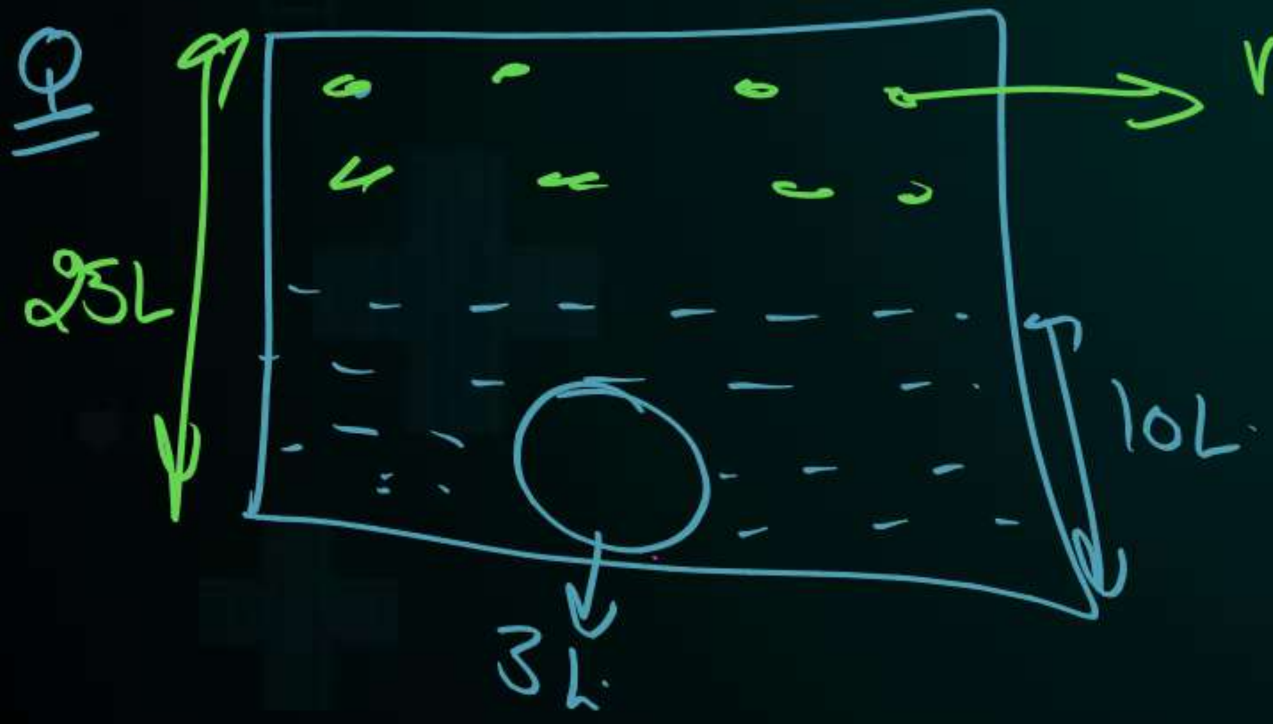
Liquid = 10L.





V of gas = 25 − 8 = 17 L

O_2
↓
O_2 molecule
↓
shape → sphere

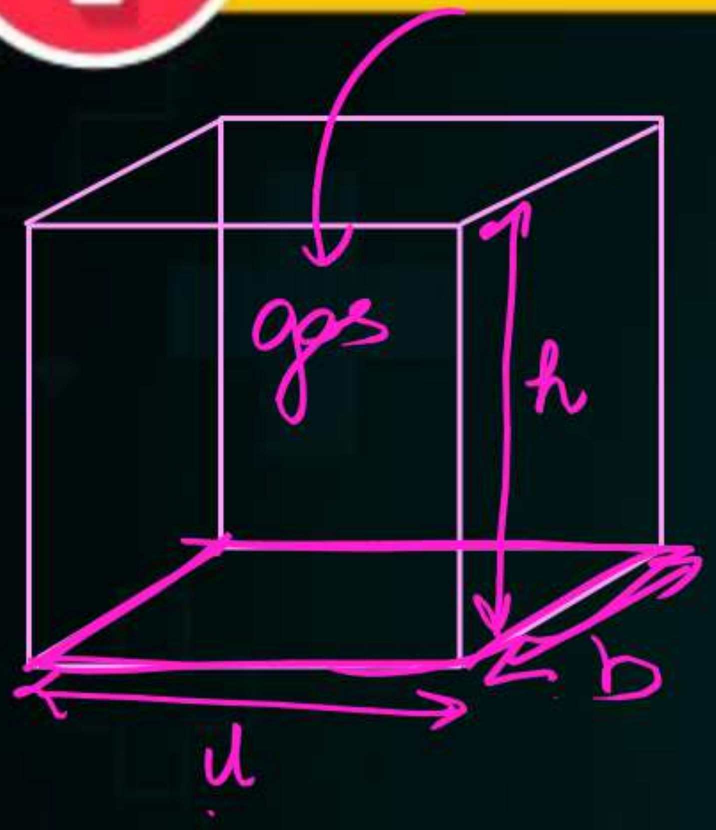


V of gas = 25 − 10 = 15 L

1 mole of any gas at N.T.P./S.T.P.

1 mole of gas at S.T.P./N.T.P. — 22.4 L

S.I. Unit of Volume



Volume of Cuboid $= l \times b \times h$

$\downarrow \quad \downarrow \quad \downarrow$

$m \quad m \quad m$

$1m^3 = 10^{\cancel{6}} cm^3 = \cancel{10}^{3} dm^3$

$10^3 cm^3 = 1 dm^3$

$1 dm^3 = 1000 cm^3$

$1 dm^3 = 1L$

$1m = 10 dm$

$1m \times 1m \times 1m = 10dm \times 10dm \times 10dm$

$1m^3 = 10^3 dm^3$

① S.I. unit of Volume $= m^3$

② $1m = 10 dm = 100cm = 1000mm$

dm → decimetre

③ $1m^3 = 10^3 dm^3 = 10^6 cm^3 = 10^9 mm^3$

④ $1L = 1000ml$

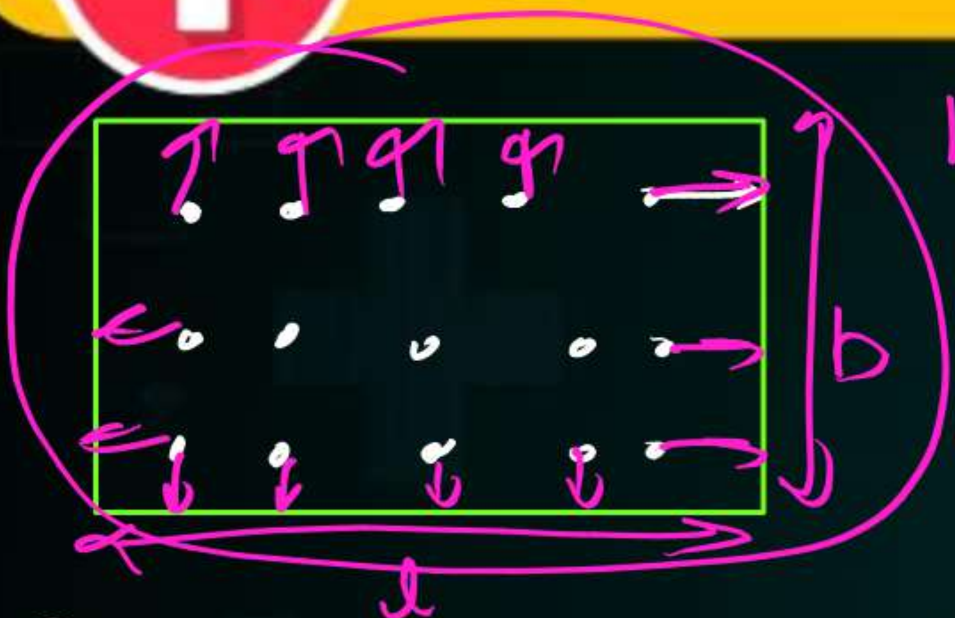
$1L = 1000cm^3$

$1L = 1000$ c.c.

$1ml = 1cm^3 = 1$ c.c.

⑤ $1dm^3 = 1$ L

Pressure

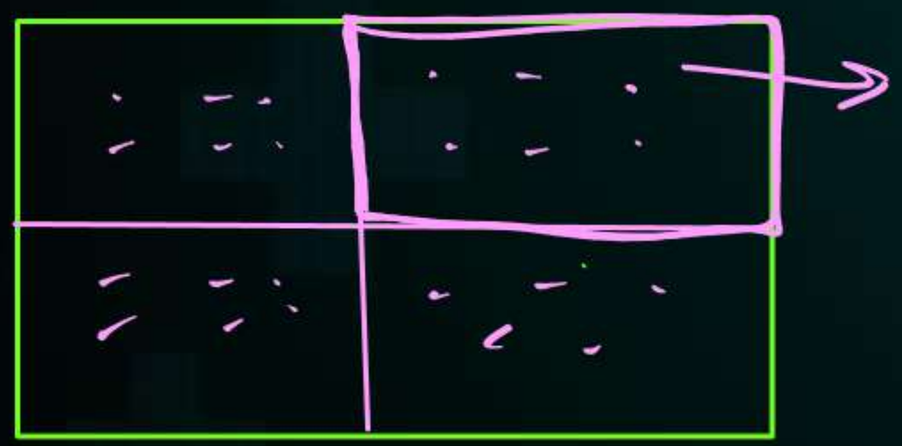


Let $F = 20\,N$

$A = 4\,m^2$

$$P = \frac{F}{A} = \frac{20}{4} = 5\,N/m^2$$

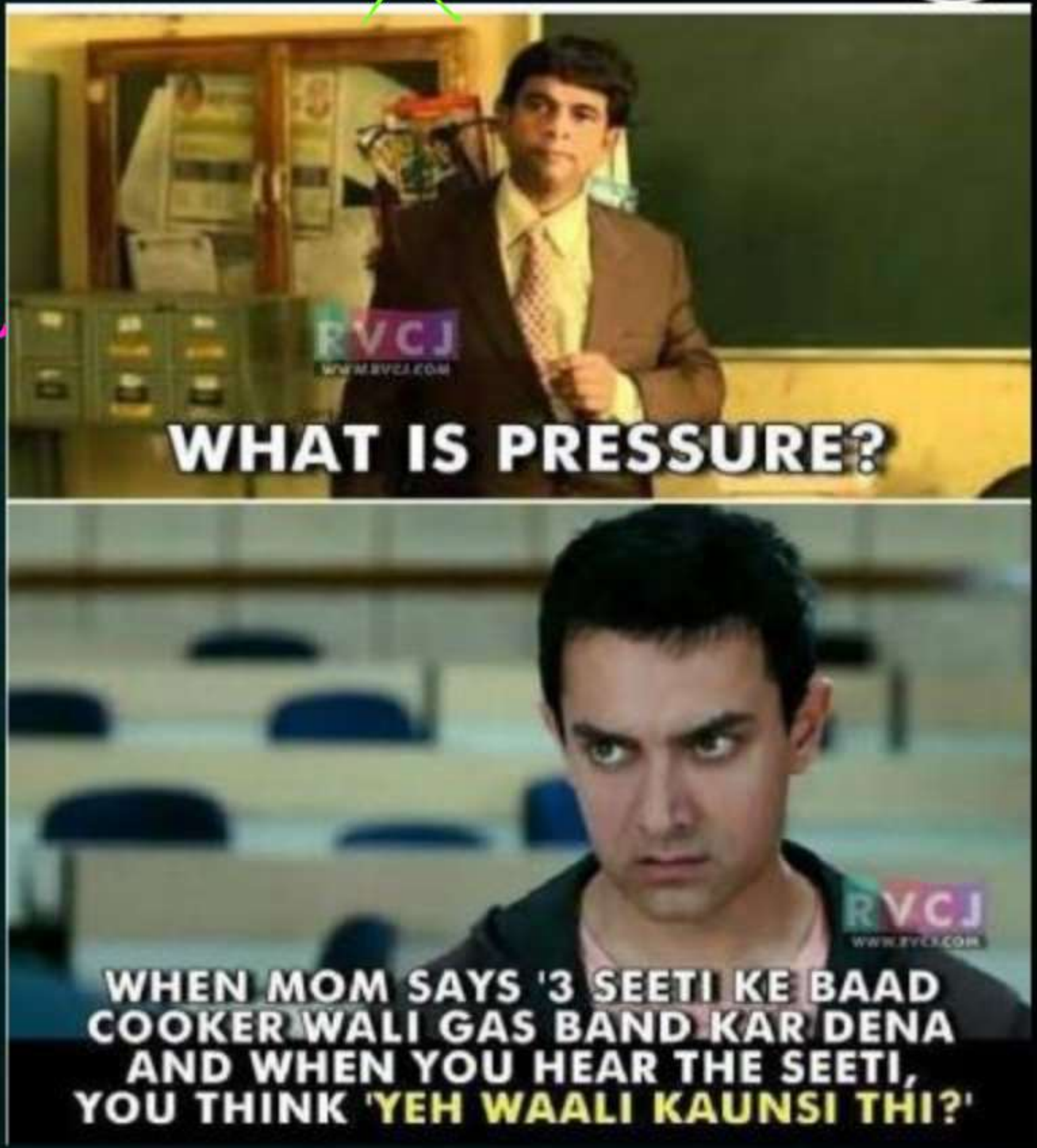
(1) Force exerted per unit area by gas molecules on walls of Container.



$F = 5\,N$

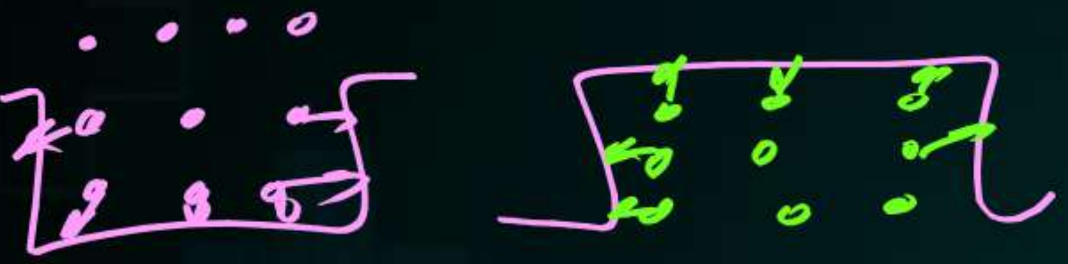
$A = 1\,m^2$

$$P = \frac{F}{A} = \frac{5}{1} = 5\,N/m^2$$



MIT

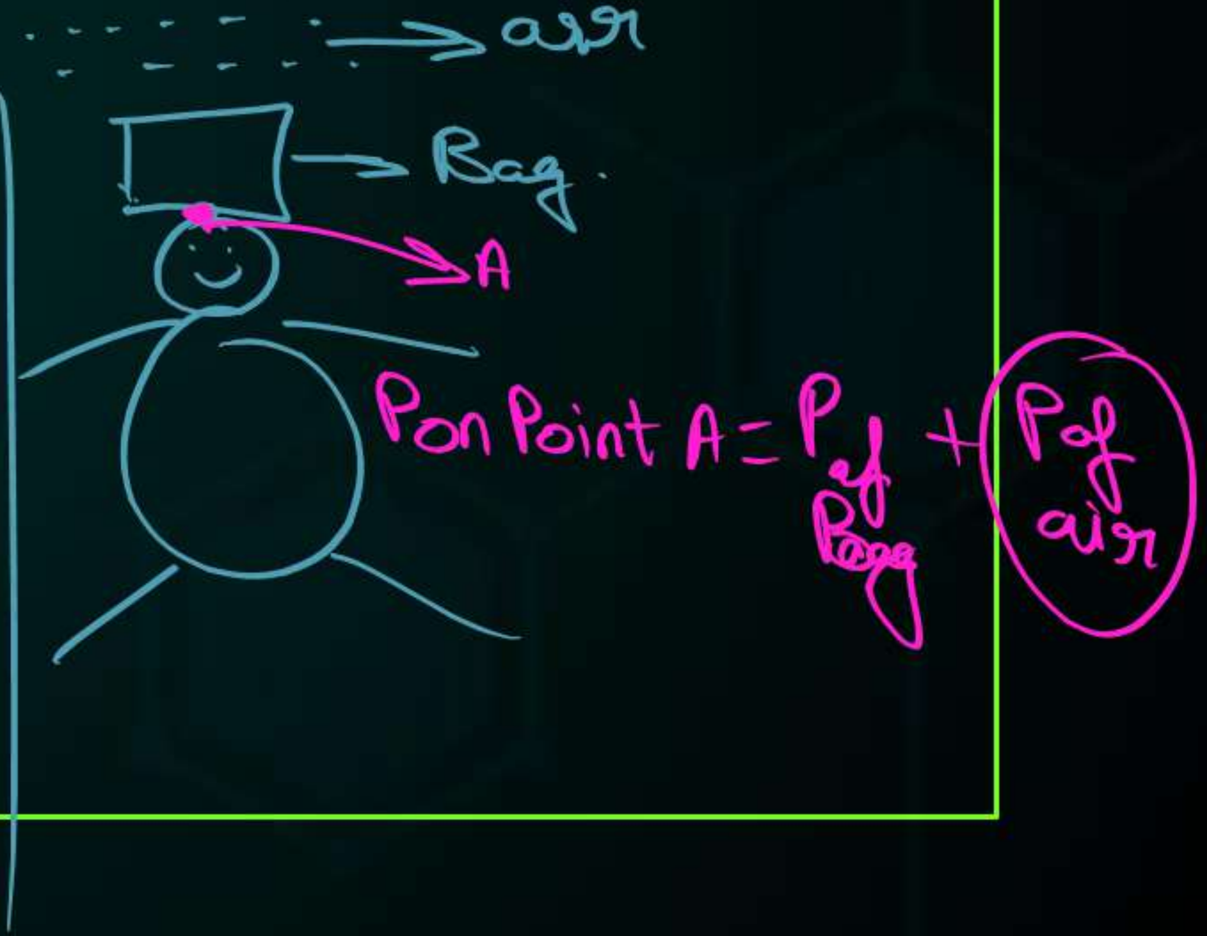
① Container main gas pressure exert karti hai jis side se Container open ho



② Pressure exerted by atmospheric gases on our body is Called atmospheric pressure.

1 atm

③ ek point ke upar jitne substance hai woh sare uspar pressure lagate hai



Unit of Pressure

MIT

① S.I. unit of Pressure = $\frac{N}{m^2}$ or Pascal (Pa)

② Atmospheric Pressure = 1 atm (at sea level)

$1\,atm = 1.01325 \times 10^5\,Pa \approx 10^5\,Pa$

$1\,atm = 1.01325\,bar$

$1\,bar = 0.987\,atm$

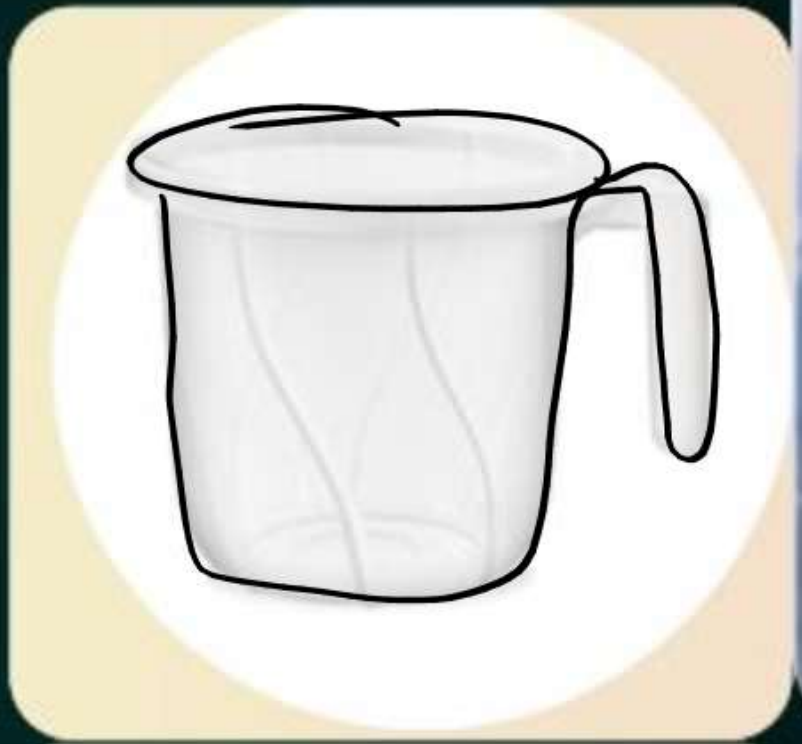
$1\,atm = 760\,mm\ of\ Hg = 76\,cm\ of\ Hg = 0.76\,m\ of\ Hg$

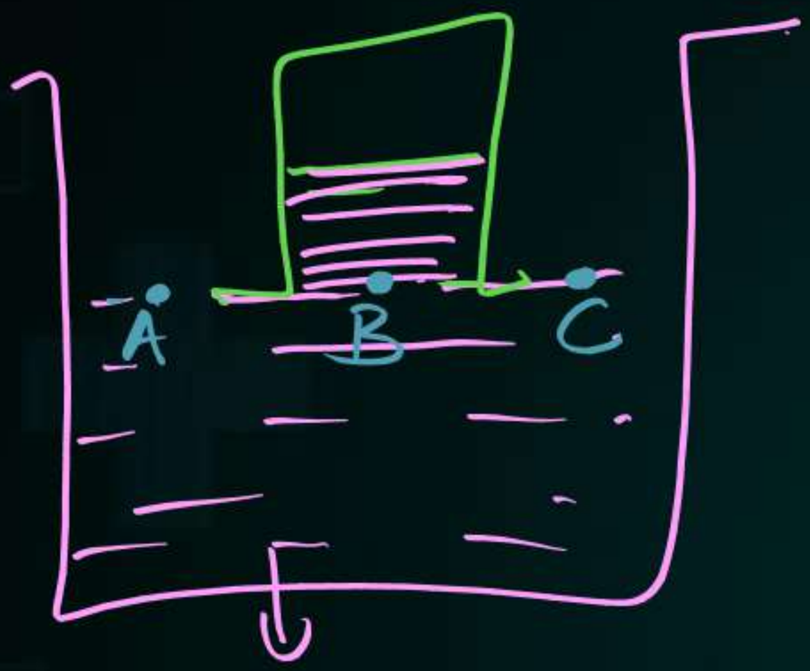
$1\,torr = 1\,mm\ of\ Hg$

Barometer

(1) Atmospheric pressure is measured by barometer.

Faulty Barometer





#MIT

Pressure is same at same horizontal level in Continuous medium

$$P_A = P_B = P_C$$

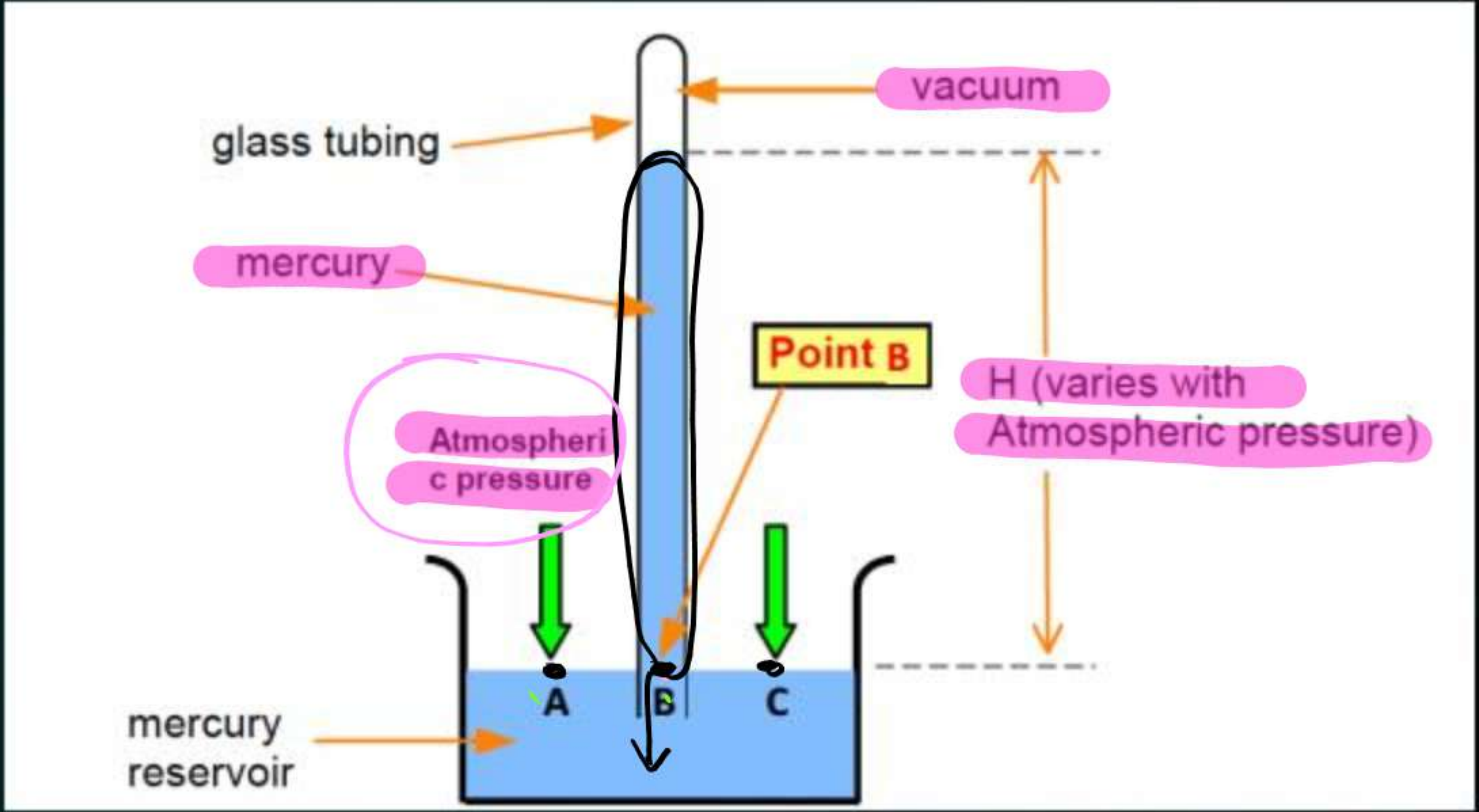
Barometer

① $P_A = P_B = P_C$

$P_A = 1$ atmospheric Pressure

$P_A = P_C = \underline{1\,atm}$

$P_B = P_{due\,to\,Hg} = \frac{F}{A} = \frac{mg}{A}$



$P_{due\,to\,Hg} = \frac{V \times \rho g}{A} = \frac{\cancel{A} h \rho g}{\cancel{A}}$

$m = V \times d\,(\rho)$

mass, Volume, density

MIT

$P_{\text{due to Hg}} = h \rho g = 1\,atm = 76\,cm \text{ of } Hg = 10.3\,m \text{ of } H_2O$

h = Height of Mercury (Hg) Column) in cm

d or ρ = density of mercury in $g/cm^3 = 13.6\ g/cm^3$

g = acceleration due to gravity.

$P_A = P_B = P_C = 76\,cm \text{ of } Hg = 1\,atm$

Q How to find height of any liquid in terms of atmospheric pressure

Ans $P = h \rho g$

$h_{Hg} \rho_{Hg} \cancel{g} = h_{liq.} d_{liq.} \cancel{g}$

MIT

$$\boxed{h_{Hg} \rho_{Hg} = h_{liq.} d_{liq.}}$$

$h_{Hg} = 76 \text{ cm of Hg.}$

$\rho_{Hg} = 13.6 \text{ g/cm}^3$

Q Find height of water which will exert 1atm P.

Ans ρ of $H_2O = 1 \text{ g/cm}^3$

h of $H_2O = ?$

$h_{Hg} \rho_{Hg} = h_{H_2O} \rho_{H_2O}$

$\text{cm } 76 \times 13.6 = h_{H_2O} \times 1$

$h_{H_2O} = \frac{76 \times 13.6}{100} = 10.3 \text{ m of } H_2O$

Barometer

faulty

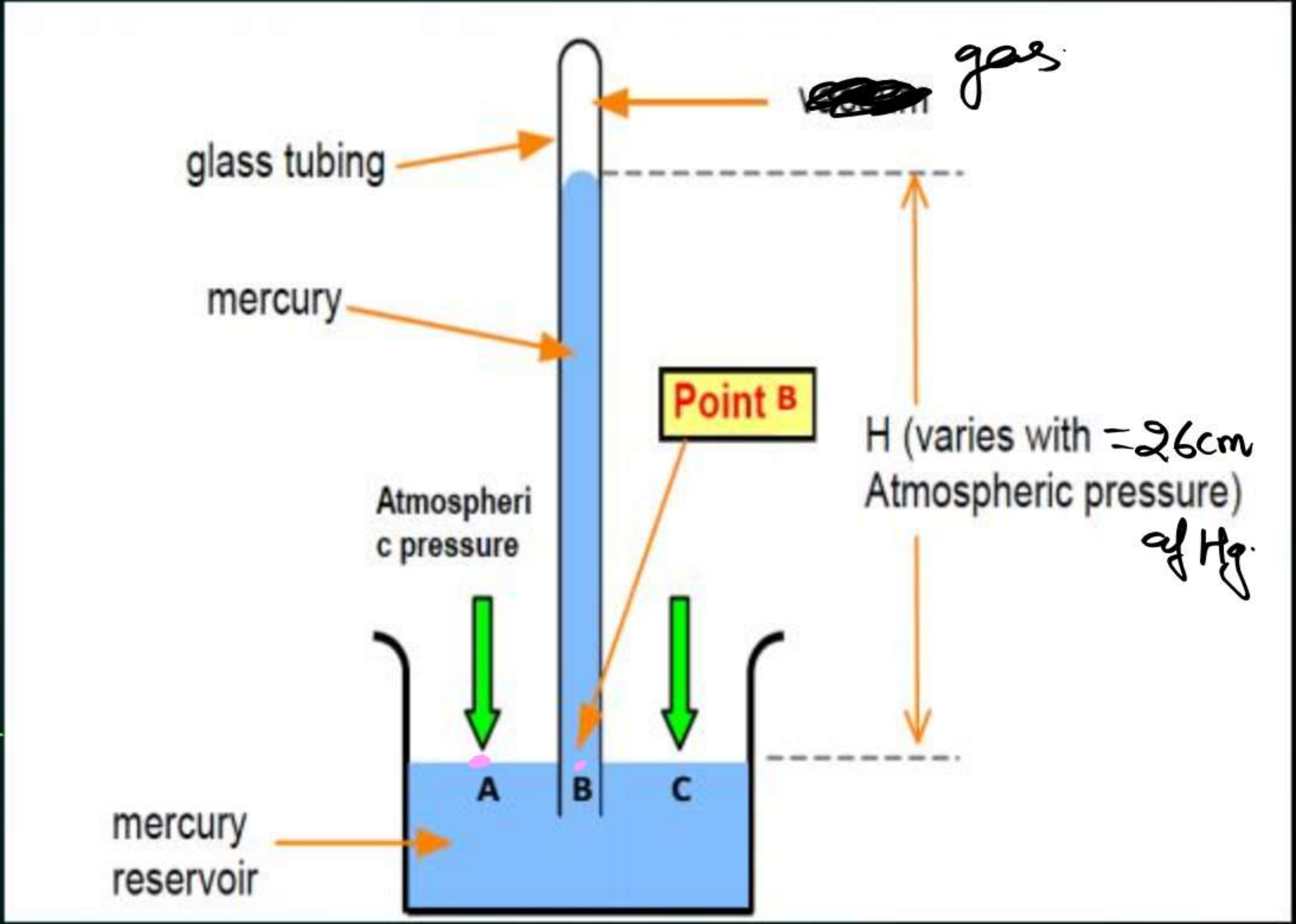
Q find P of gas

$P_A = P_B$

$1\,atm = P_{due\ to\ Hg} + P_{gas}$

$76 = 26 + P_{gas}$

$P_{gas} = 76 - 26 = 50\,cm\ of\ Hg$



How to increase Your Focus ?

- Use Pen Technique - Discussed in chapter 1 Lecture 2
- Use Ear Plugs while Studying - Discussed in chapter 1 Lecture 3

How to increase Your Efficiency ?

- Use Pomodoro technique - Discussed in chapter 1 Lecture 5
- Join a Library – Discussed in Chapter 2 Lecture 6

How to stop Overthinking ?

- Use Appointment method - Discussed in chapter 1 Lecture 10

How to get Confidence in Physical Chemistry

- Make formula sheets & write each formula in rough copy 10 times after remembering it & practice a variety of questions after revising & doing each question discussed in your copy by yourself - Discussed in Chapter 1 Lecture 12

Thank You

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Lecture No.- 2

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3. Charle Law
4. Home Work

Gas laws (Part-01)

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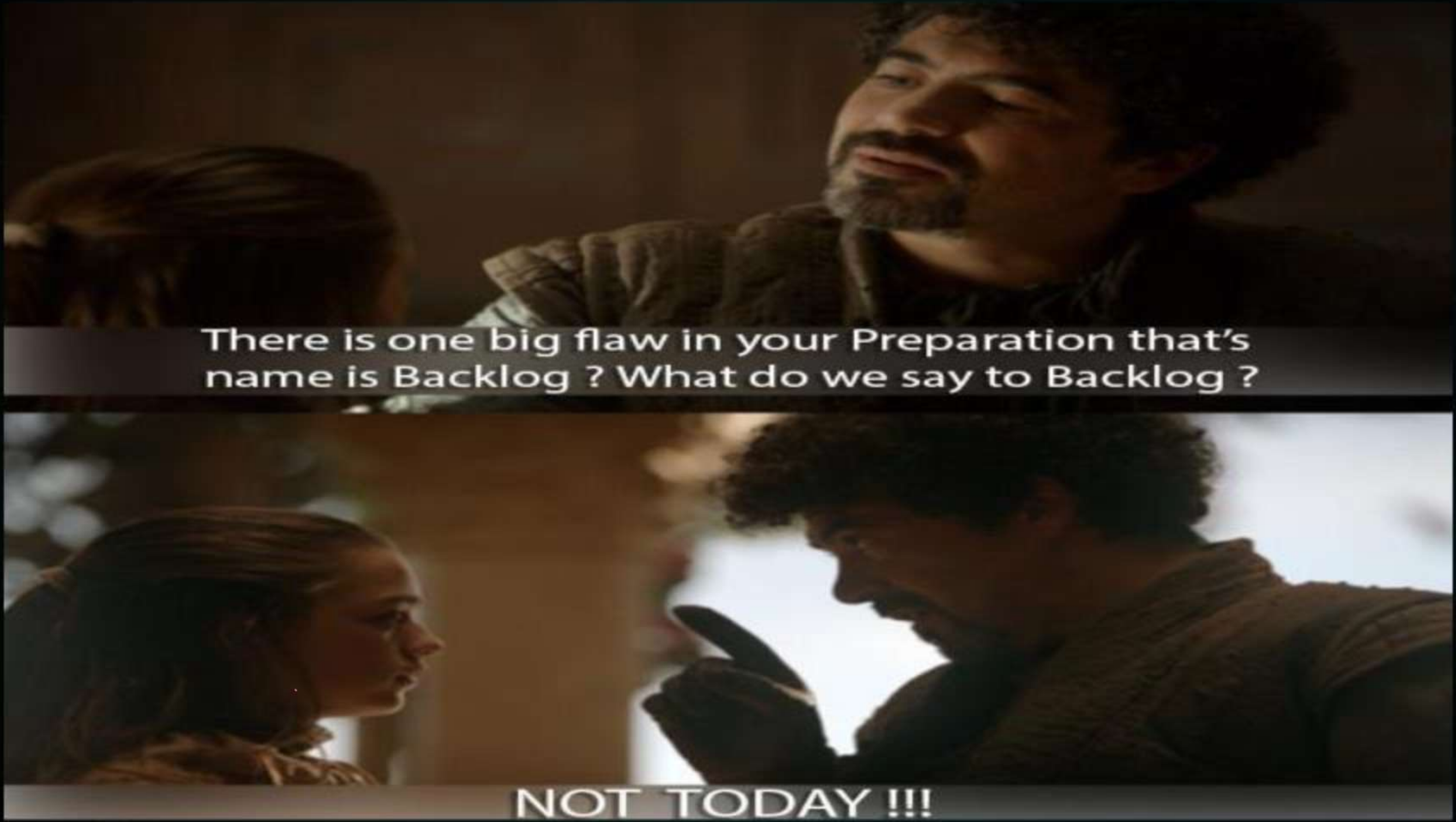
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Revision Of Last Class

T → $°F = \frac{9}{5}°C + 32$
→ $°C$
→ $K = °C + 273$

V → S.I. unit is m^3

$1m = 10dm = 100cm = 1000mm$

$1m^3 = 10^3 dm^3 = 10^6 cm^3 = 10^9 mm^3$

$1L = 1dm^3$ | $1ml = 1cm^3 = 1c.c.$

$1L = 1000ml$

Pressure $P = \frac{F}{A}$

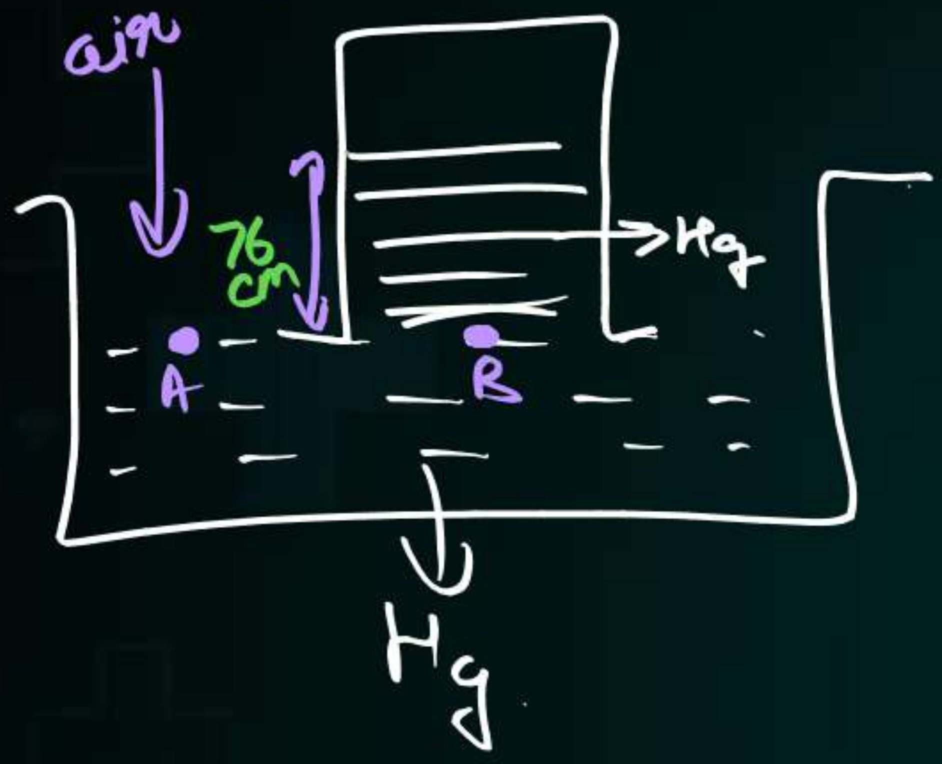
S.I unit $P =$ Pa or N/m^2.

$1 atm \approx 10^5 Pa$

$1 atm = 1.01325$ bar

$1 bar = 0.987 atm$

atmospheric pressure measure → Barometer



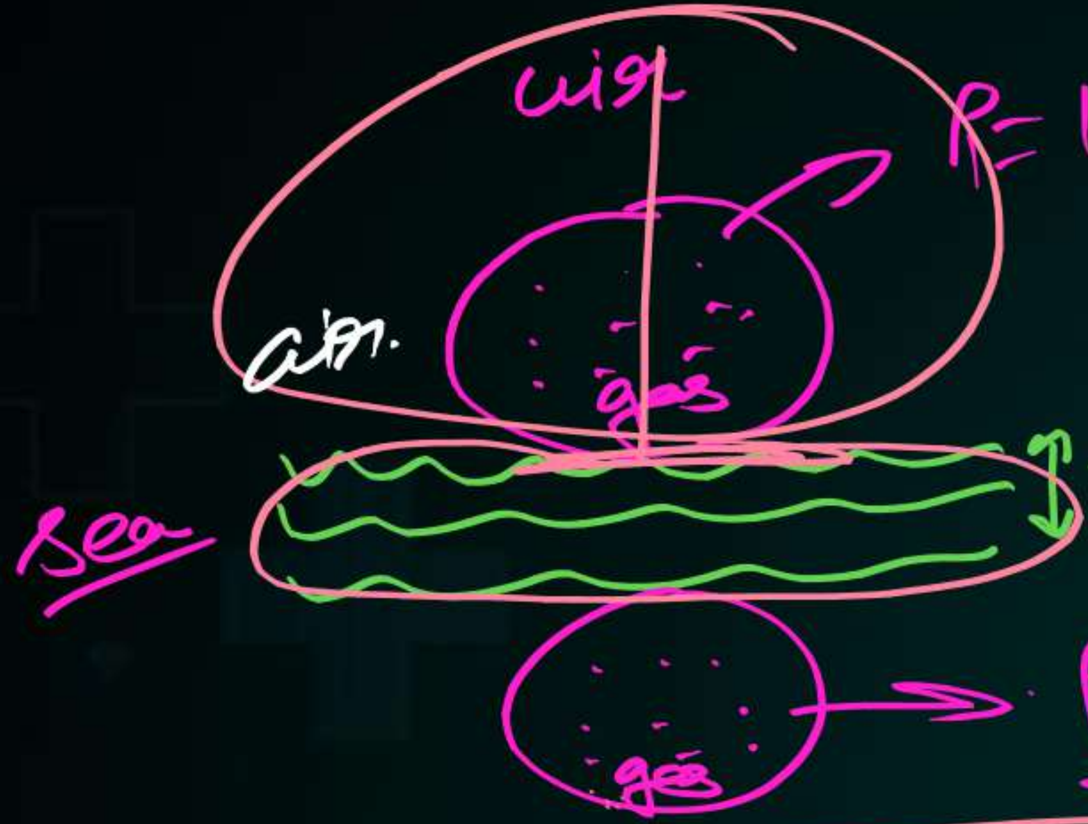
$P_A = 1\,atm = 760\,mm$ of $Hg = 76\,cm$ of Hg

$P_A = P_B = 76\,cm$ of Hg

$1\,atm = 76\,cm$ of $Hg = 10.3\,m$ of H_2O

$P = h\rho g$

$P = 1\,atm = 76\,cm \text{ of } Hg = 10.3\,m \text{ of } H_2O$



$3\,m \text{ of } H_2O$

$P_g = \cancel{1\,atm + 3\,m \text{ of } H_2O}$

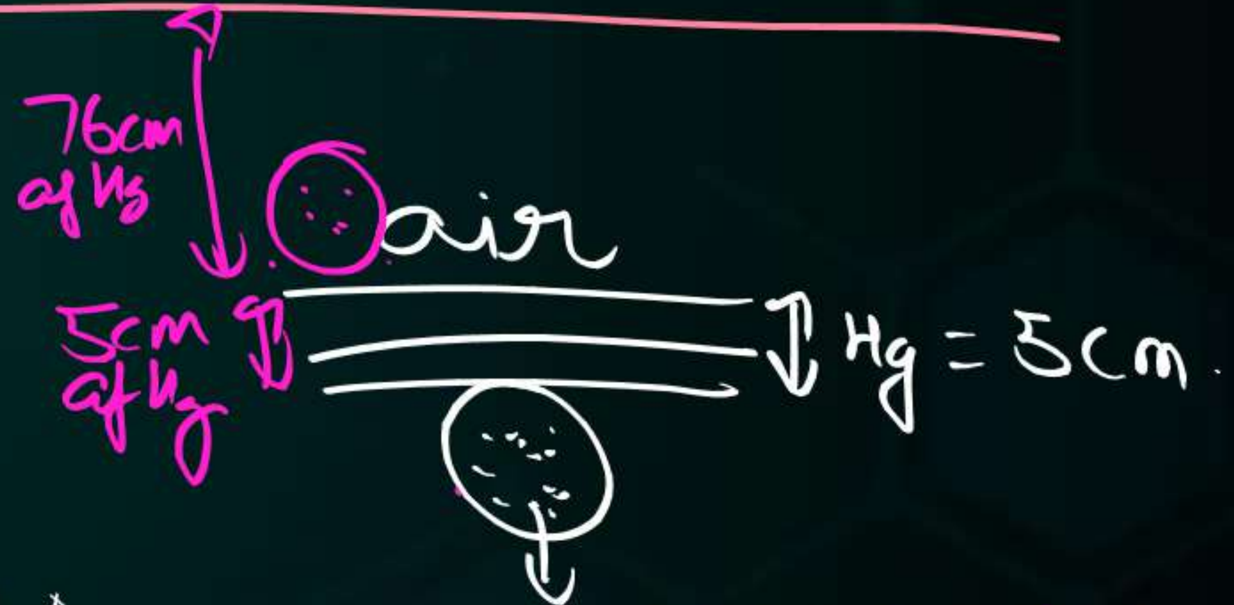
$= 76\,cm \text{ of } Hg + 3\,m \text{ of } H_2O$

$P_g = 3 + 10.3 = 13.3\,m \text{ of } H_2O$

$P = 10.3\,m \text{ of } H_2O$

$100\,m \text{ of } H_2O$

$P_g = 10.3 + 100 = 110.3\,m \text{ of } H_2O$



$P = 76 + 5 = 81\,cm \text{ of } Hg$

Question

Q. Why Hg is chosen as Barometric Liquid?

Ans ① Hg is non-Volatile.

② it has high density ∴ height is less.

∴ measurement is easy

$$P = (h \rho)_{Hg}\, \cancel{g} = (h \rho)_{H_2O}\, \cancel{g}$$

For Hg: h small, ρ Big.

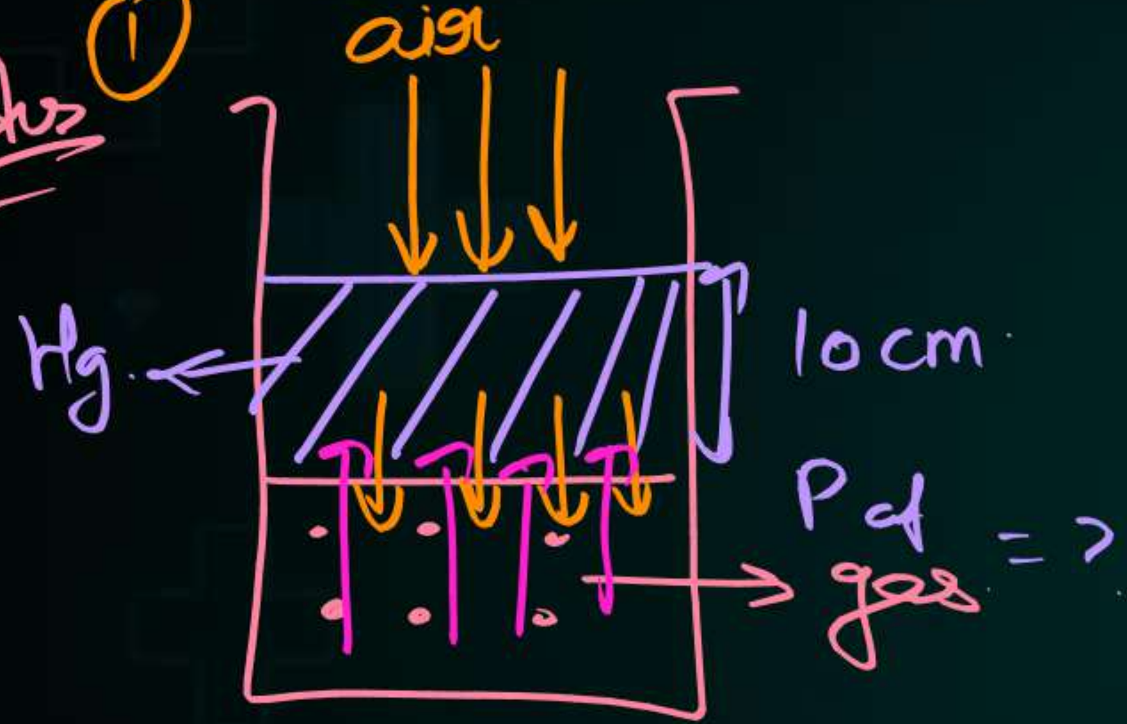
For H_2O: h Big, ρ small, $1\,g/ml$.

Total Pocket money = 1000 Rs.

Question

Find P of gas present in the container?

Ans (1)



$P_{\text{of gas}} = P_{\text{air}} + P_{\text{due to Hg}}$

$= 76\text{ cm of Hg} + 10\text{ cm of Hg}$

$= 86\text{ cm of Hg}$

Q

10cm & density = 3.4 g/cm^3

$\rho_{Hg} = 13.6\ g/cm^3$

$$P = (h\rho)_{Hg} = (h\rho)_{liquid}$$

$$h_{Hg} \times 13.6 = 10 \times 3.4$$

$$h_{Hg} = \frac{10 \times 3.4}{13.6} = 2.5\ \text{cm of Hg}$$

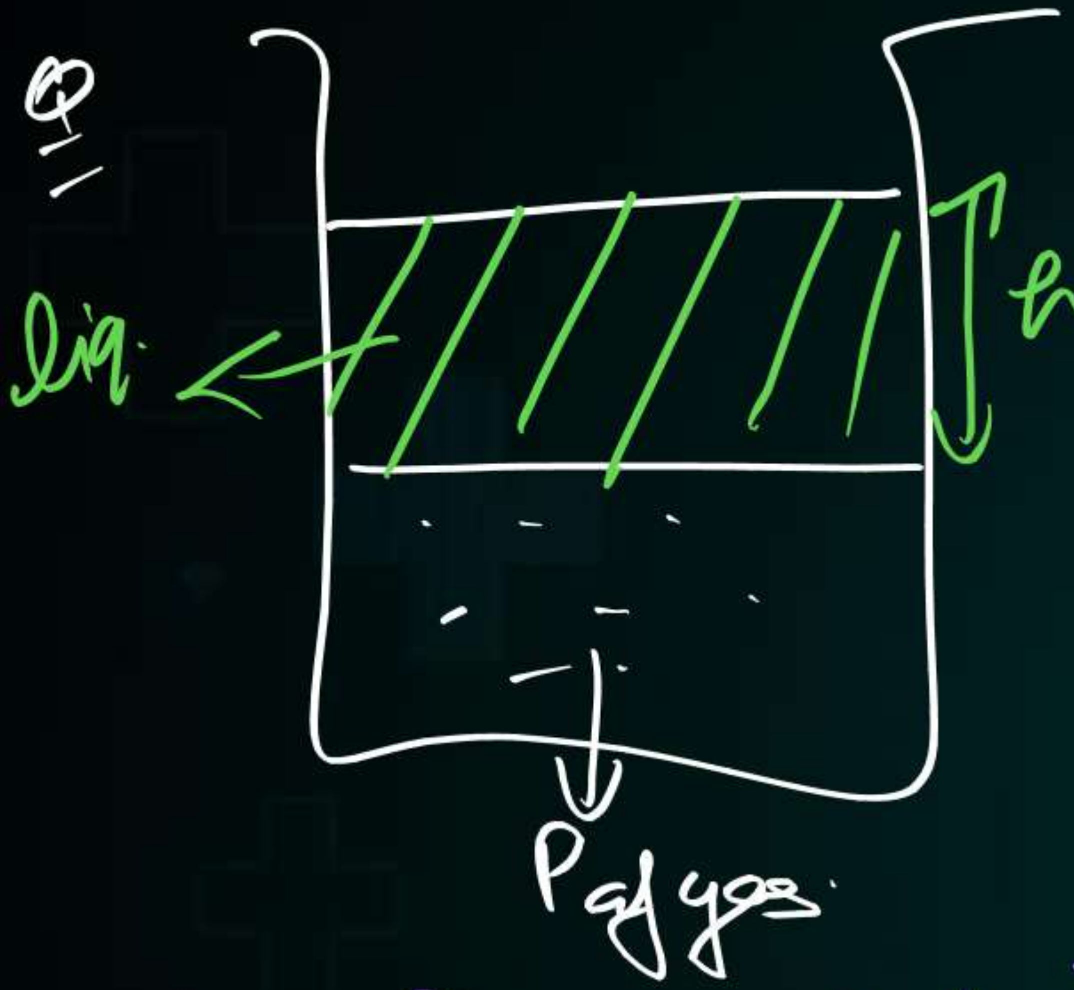
$$P_{gas} = P_{air} + P_{liquid}$$

$P_{liquid} \downarrow P_{\text{due to Hg}}$

$$= 76\ \text{cm of Hg} + P_{\text{due to Hg}}$$

$$= 76 + 2.5 = 78.5\ \text{cm of Hg}$$

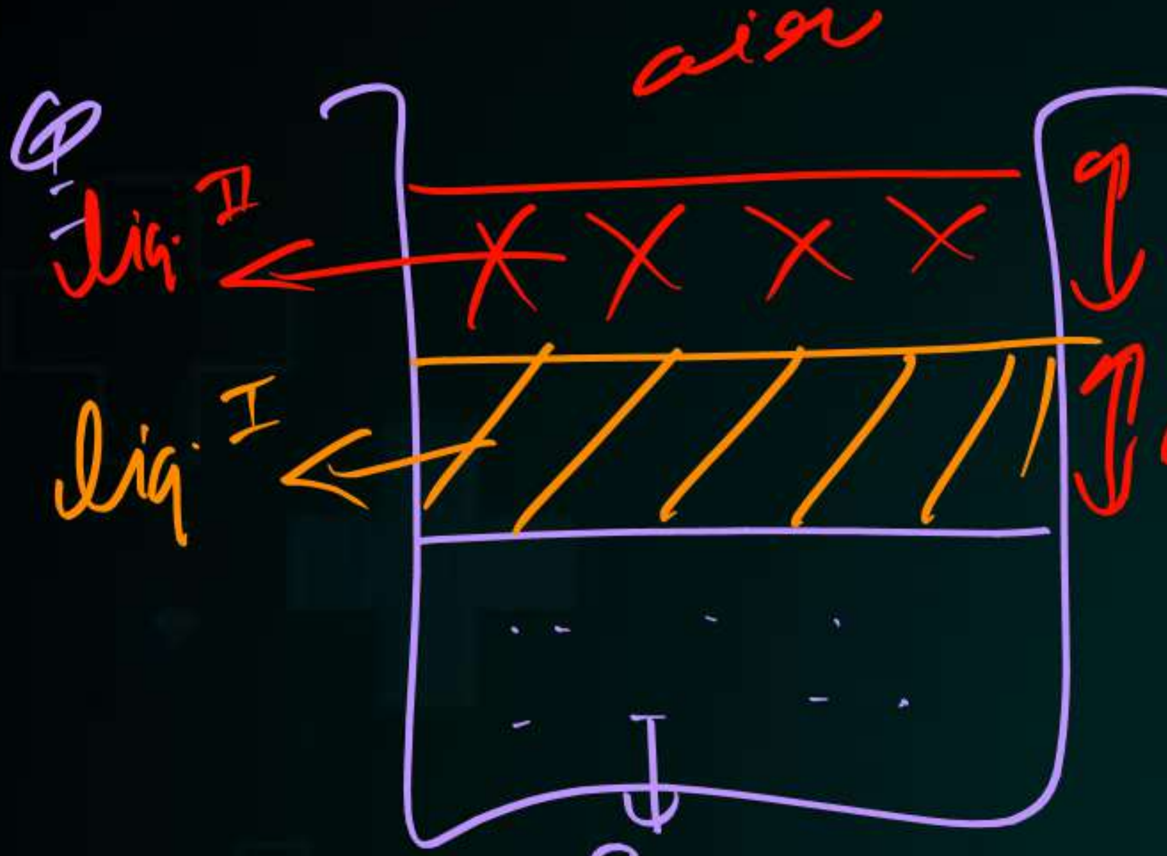
Q.



$h = 20\,cm$, $\rho = 6.8\,g/cm^3$

$P_{gas} = 76 + 10 = 86\,cm$ of Hg

$\rho_{Hg} = 13.6\,g/cm^3$



10 cm, $\rho = 27.2\ g/cm^3$

20 cm, $\rho = 6.8\ g/cm^3$

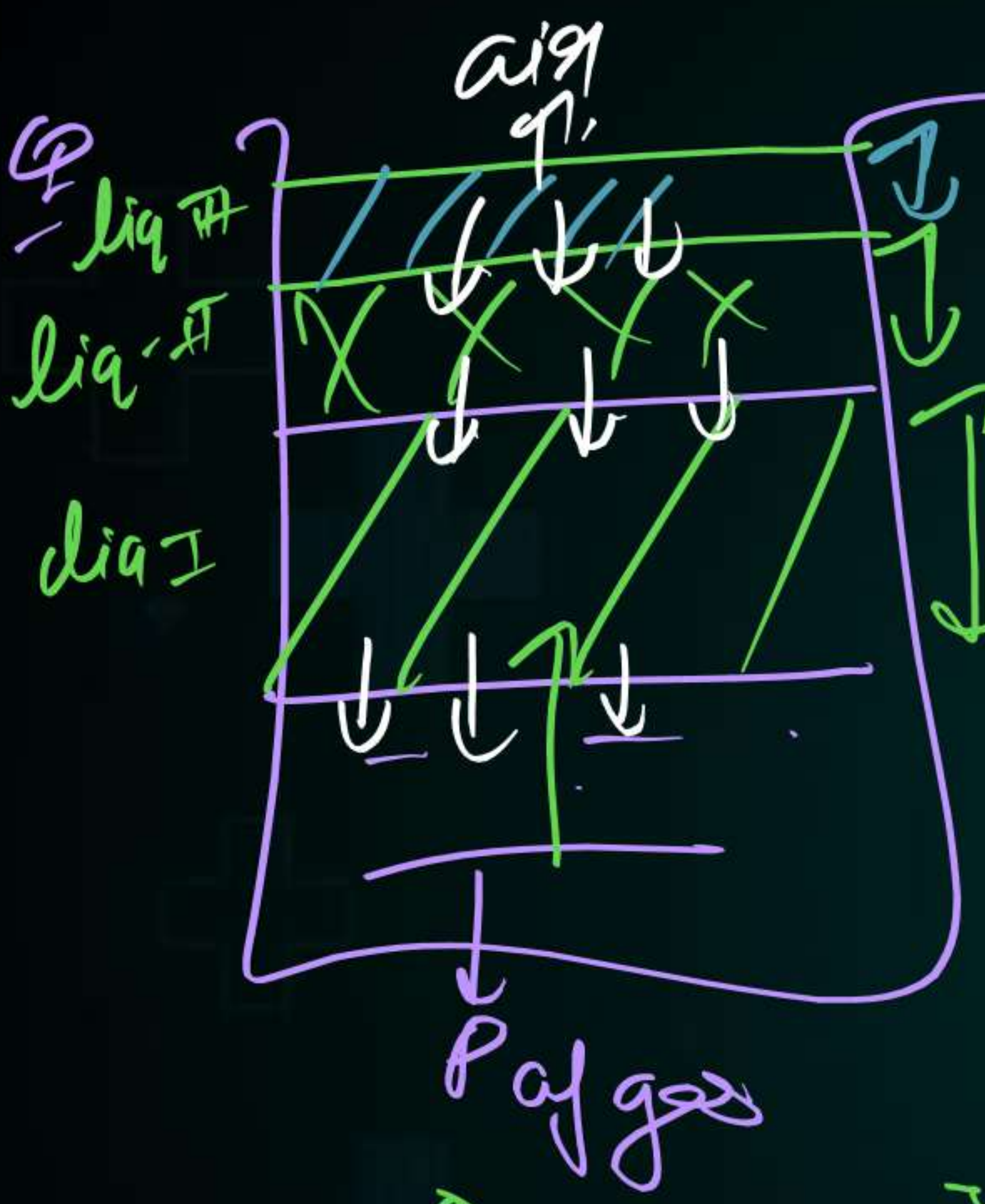
$\rho_{Hg} = 13.6\ g/cm^3$

$\frac{20}{2} = 10\ cm$

$10 \times 2 = 20\ cm$

$P_{gas} = 76 + 10 + 20$

$= 106$ cm of Hg



$\rho_{Hg} = 13.6\, g/cm^3$

20 cm, $\rho = 27.2\, g/cm^3$

6 cm, $\rho = 6.8\, g/cm^3$

20 cm $\rho = 3.4\, g/cm^3$

$$P_{gas} = P_{air} + P_{liq.I} + P_{liq.II} + P_{liq.III}$$

$$= 76 + \frac{20}{4} + \frac{6}{2} + 20\times 2$$

$$= 76 + 5 + 3 + 40$$

$$= 124 \text{ cm of Hg.}$$

MANOMETER

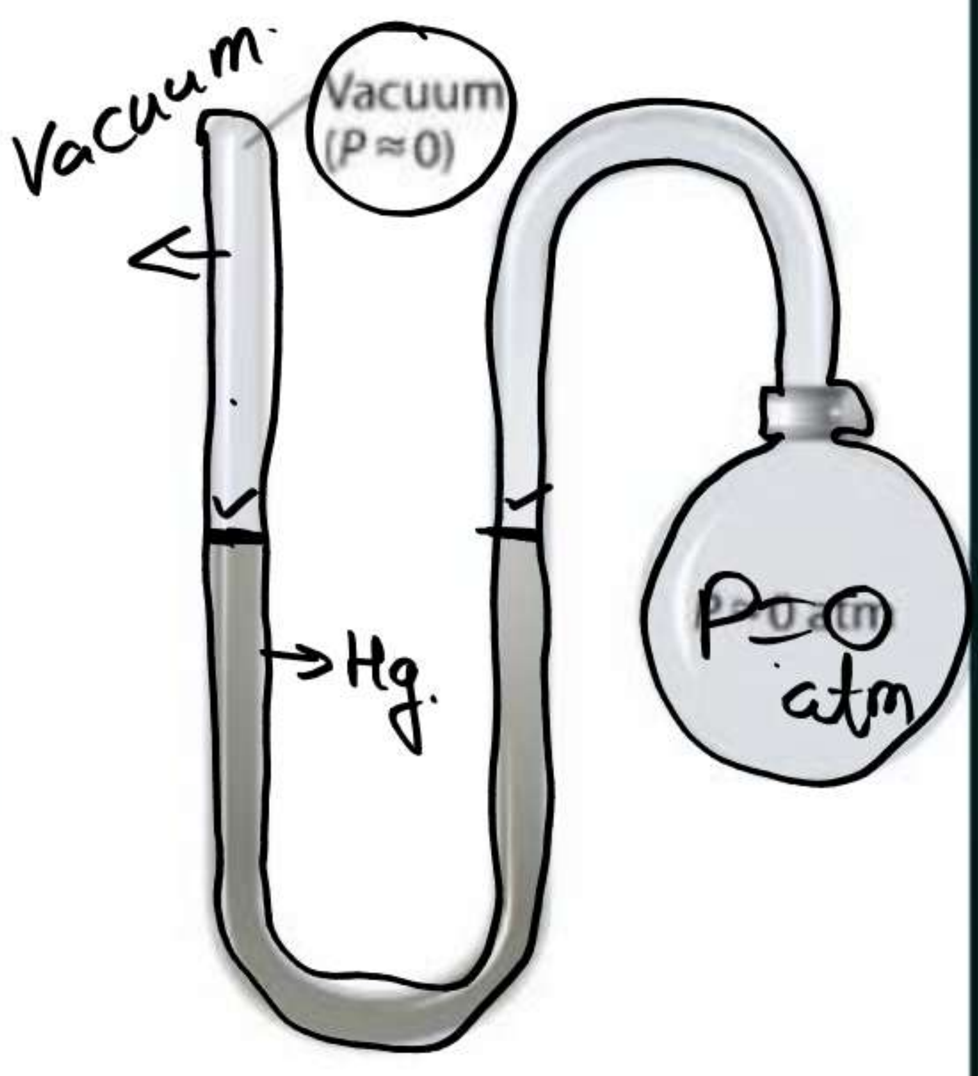
Instrument used to measure P of gas.

2 Types Manometer.

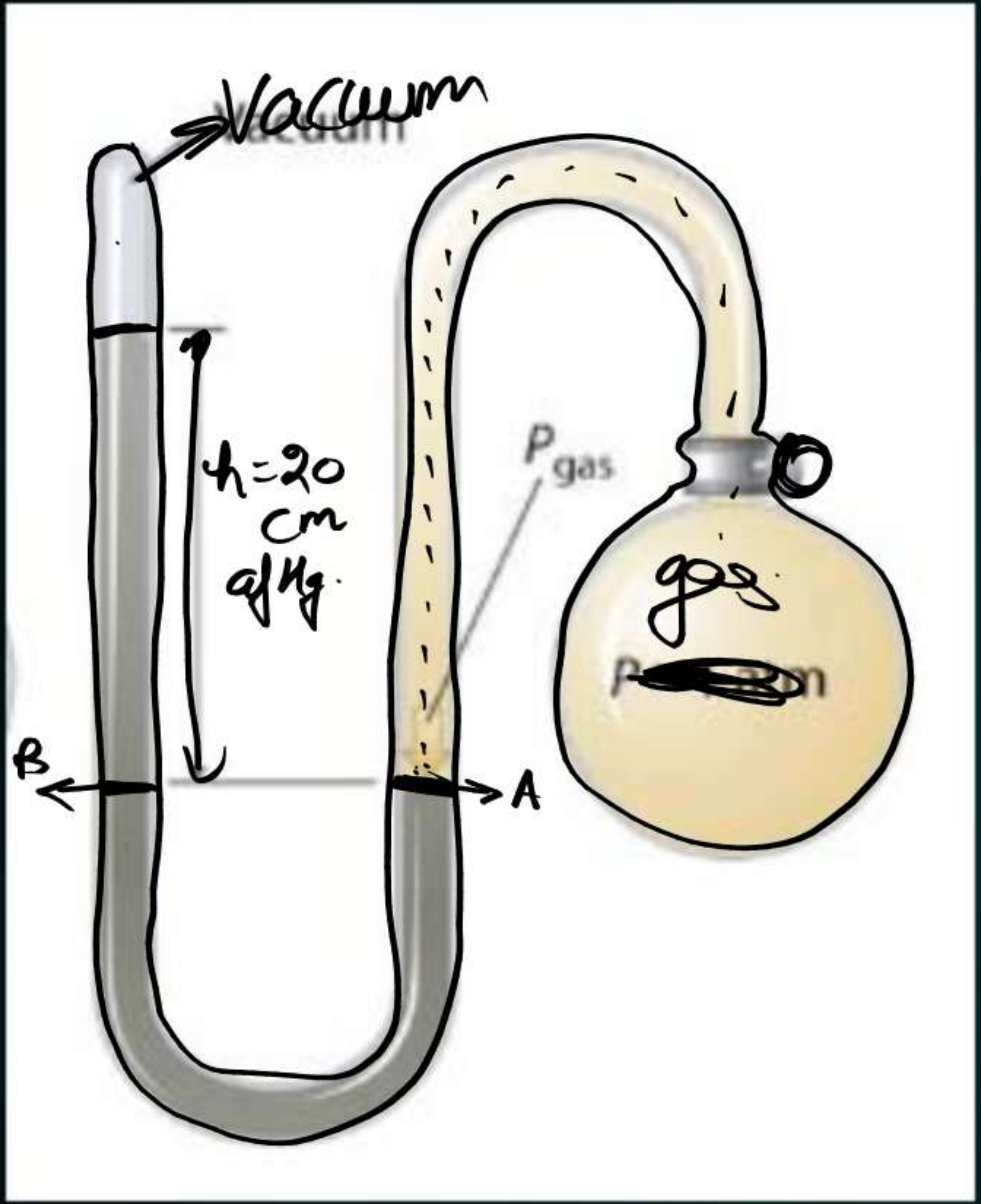
(1) Closed end manometer

(2) Open end "

CLOSED END MANOMETER



(a) Closed-end manometer

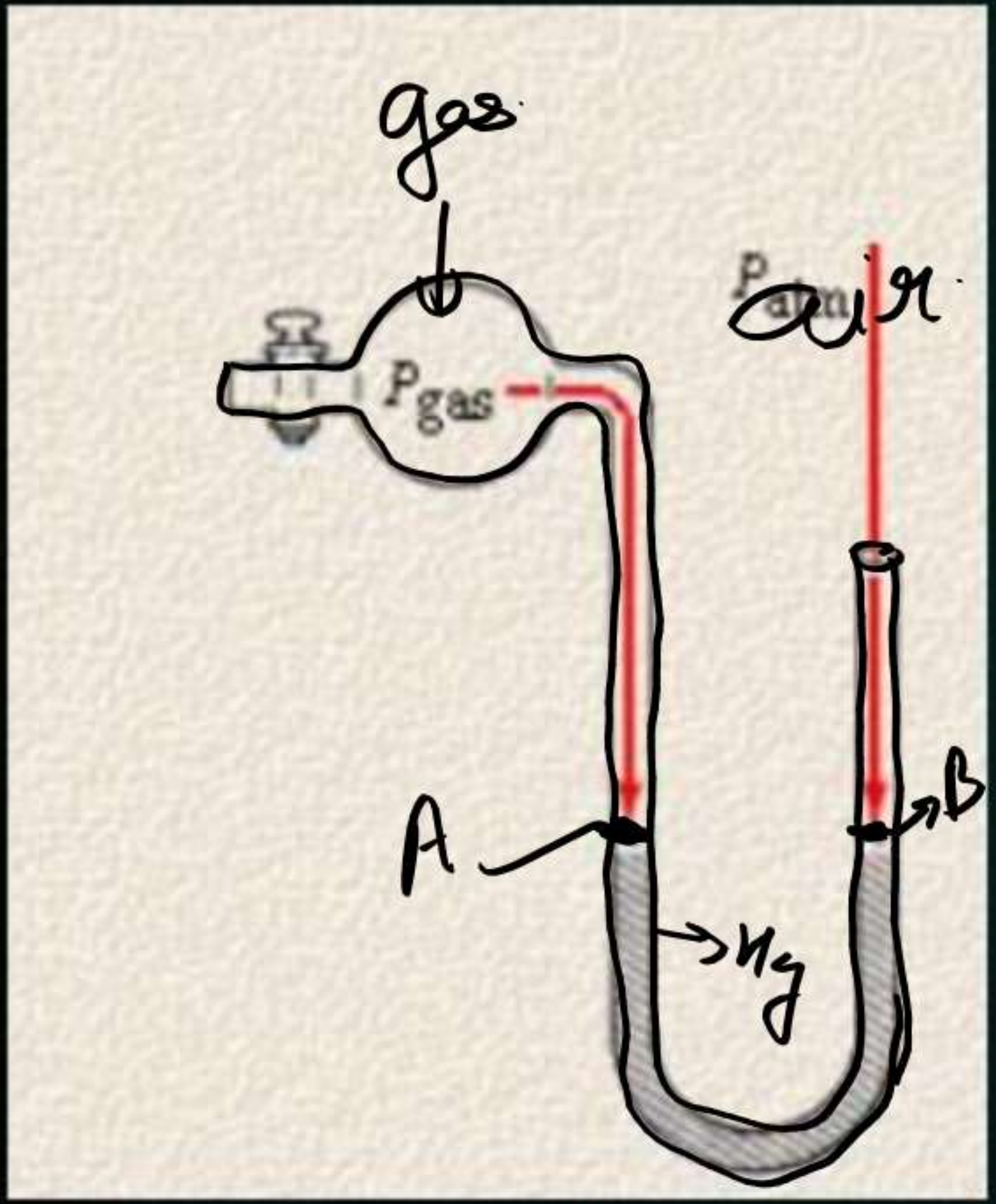


$$P_A = P_B$$

$$P_{gas} = P_{\text{due to Hg}}$$

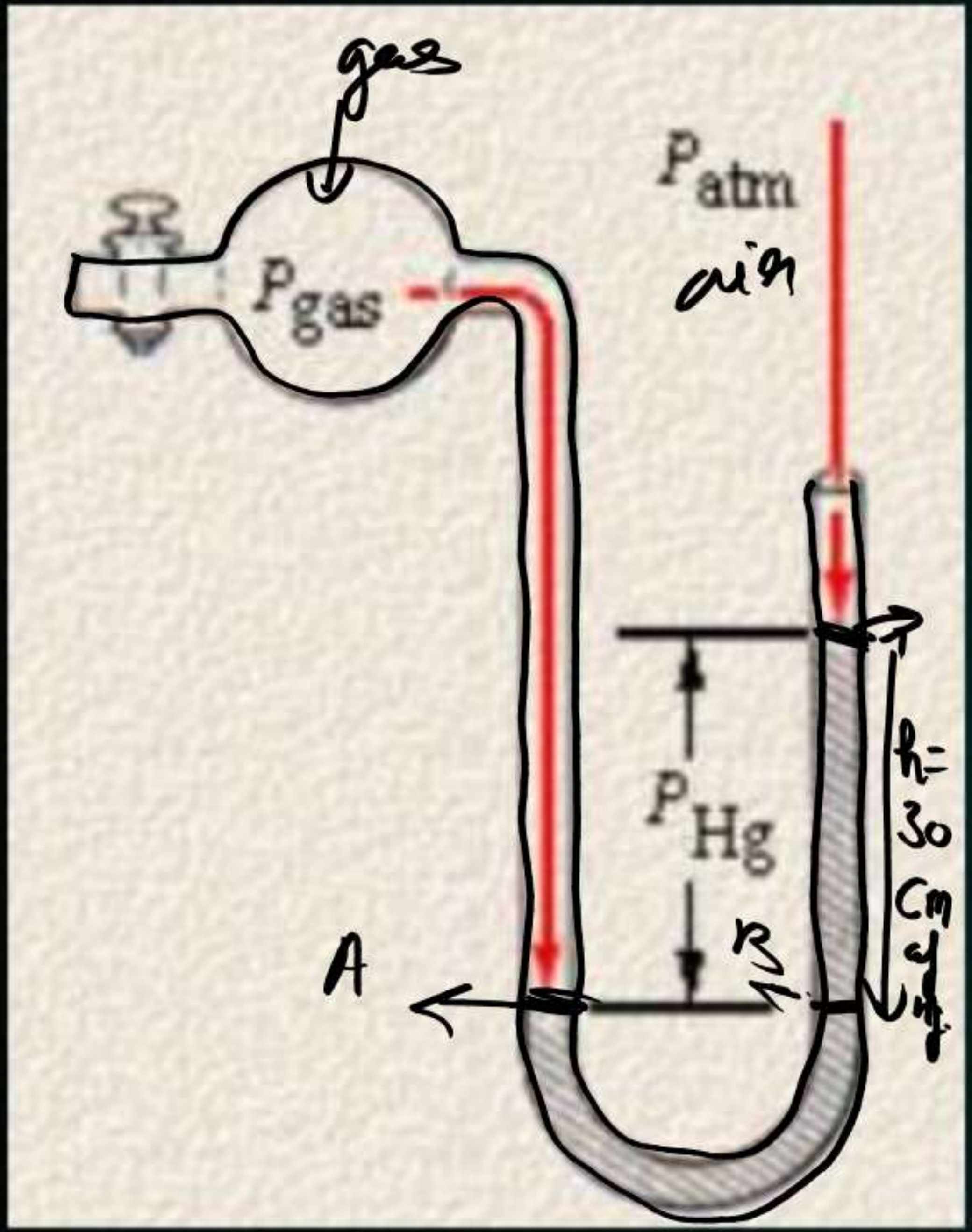
$$P_{gas} = 20 \text{ cm of Hg}$$

OPEN-END MANOMETER



$P_A = P_B$

$P_{gas} = P_{air} = 1\,atm = 76\,cm\ of\ Hg = 10.3\,m\ of\ H_2O$



$P_A = P_B$

$P_{gas} = P_{air} + P_{Hg}$

$= 76\,cm + 30\,cm$

$= 106\,cm$ of Hg.

Gas laws

1. Boyle's law

2. Charle's law

3. Amonton's law

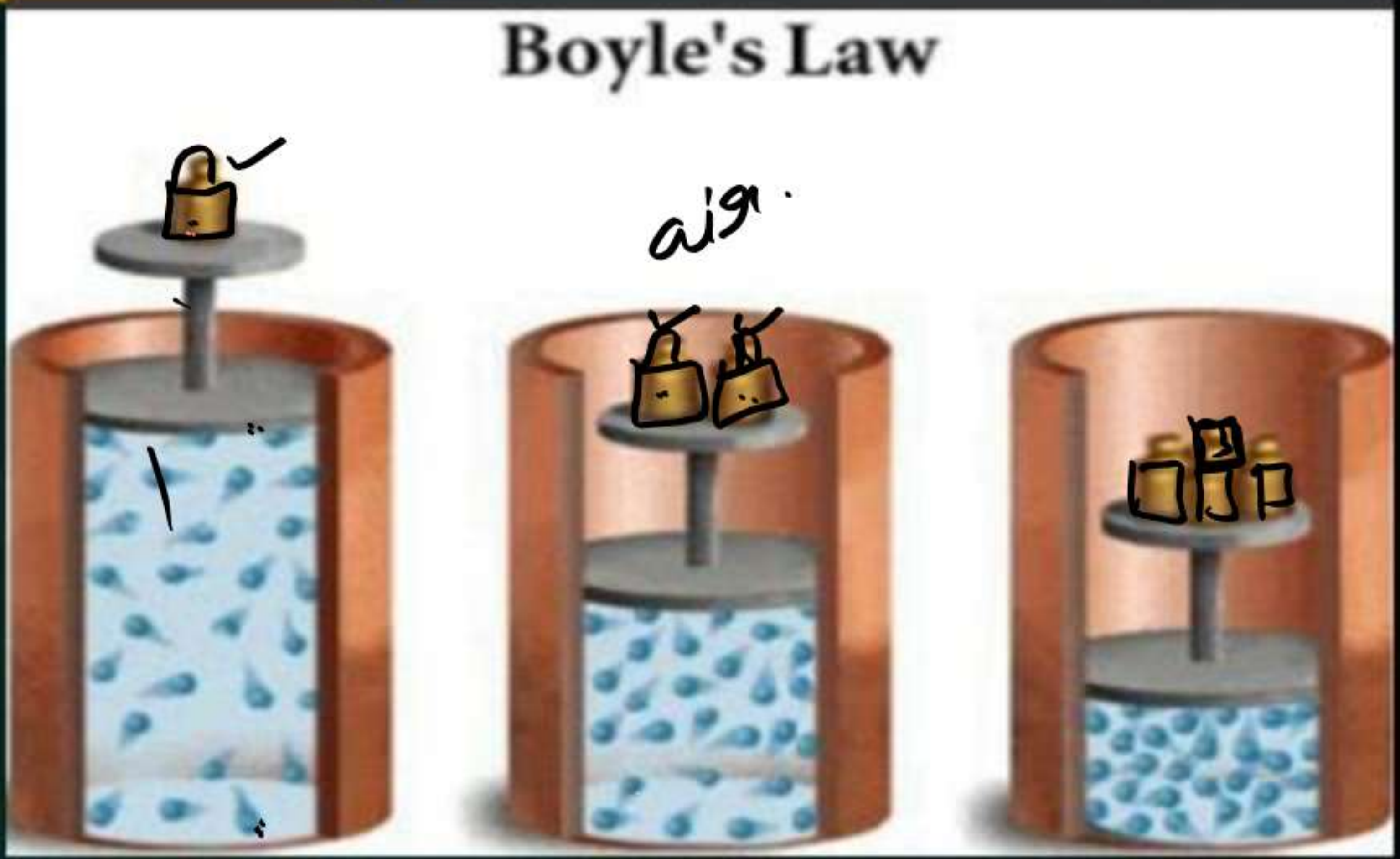
BOYLE'S LAW OR MARIOTHE'S LAW

at Constt. Temperature & mass (moles) of gas, P of gas is inversely prop. to Volume occupied by gas.

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

$$P = \frac{K}{V}$$

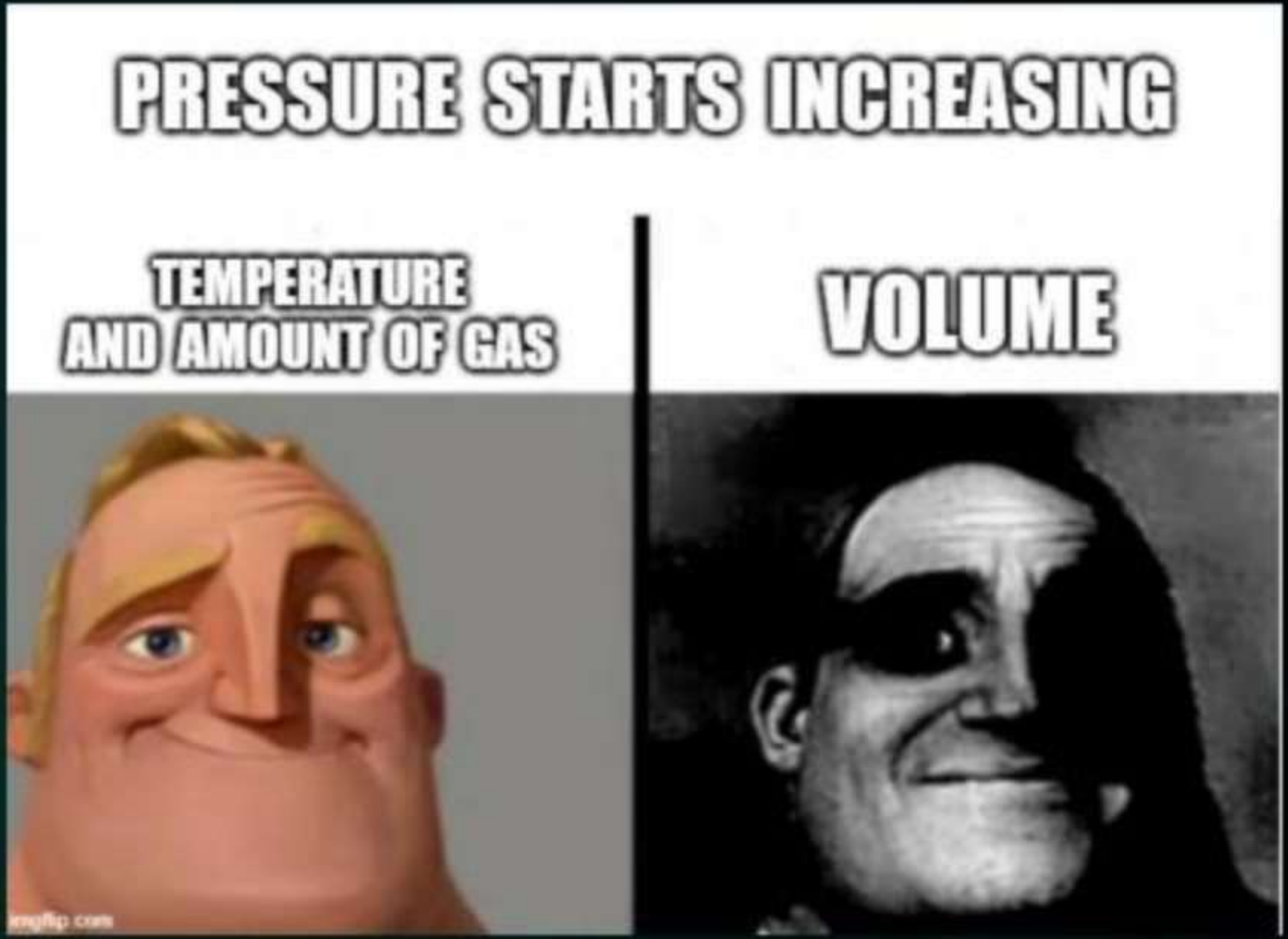
$$\boxed{PV = K} \rightarrow \text{Constt.}$$



Let $V_1 = 20\,L$
$P_1 = 2\,atm$
$P_1V_1 = 40\,L\,atm$

$P_2 = 4\,atm$
$V_2 = 10\,L$
$P_2V_2 = 40\,L\,atm$

$P_3 = 8\,atm$
$V_3 = 5\,L$
$P_3V_3 = 8 \times 5 = 40\,L\,atm$

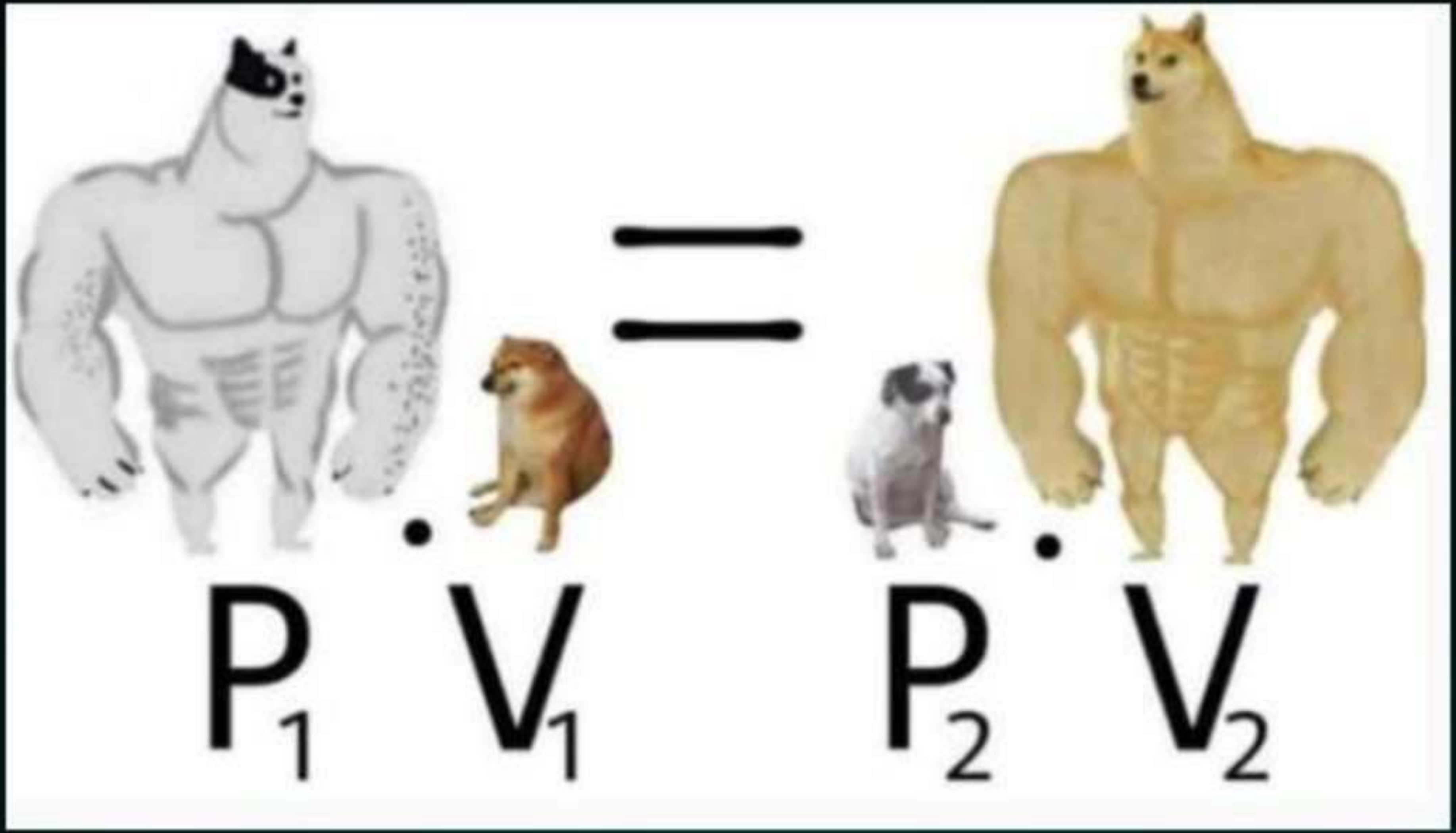

PRESSURE STARTS INCREASING
TEMPERATURE AND AMOUNT OF GAS
VOLUME

$PV = K.$

$P_1 V_1 = K.$ — (1)

$P_2 V_2 = K$ — (2)

$P_1 V_1 = P_2 V_2.$


$P_1 . V_1 = P_2 . V_2$

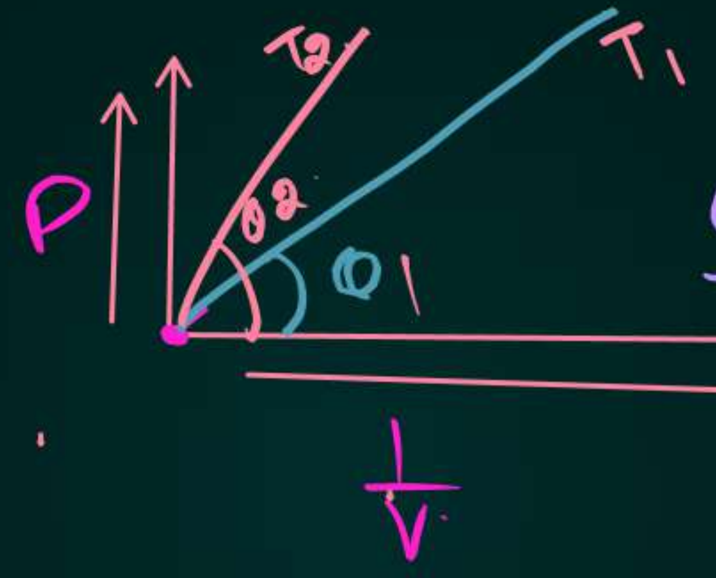
MIT

1. $P_1 V_1 = P_2 V_2$.

2. $PV = K$

$xy = \text{Constt}$

3. $\log P + \log V = \log K$.



$\theta_2 > \theta_1$

$T_2 > T_1$

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

$\log mn = \log m + \log n$

$\log \frac{m}{n} = \log m - \log n$.

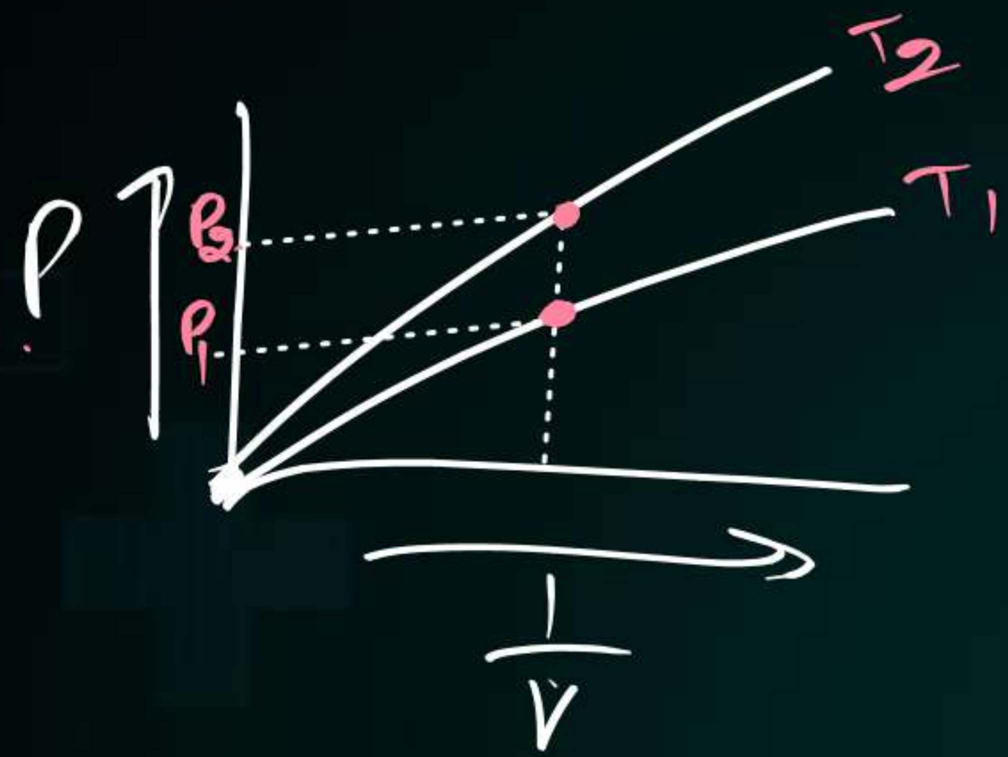
$\log m^{n} = n \log m$

$P = \frac{K}{V}$ Higher the $\theta \Rightarrow$ More the slope (K) $\Rightarrow$ T is high

$\downarrow$

$y = mx$

$x = \frac{1}{V}$, $m = K =$ slope $= \tan\theta = \frac{P}{B}$



$P_2 > P_1$

$P \propto T$

$T_2 > T_1$

$\log P + \log V = \log K$

$\log P = -\log V + \log K$

$\downarrow$

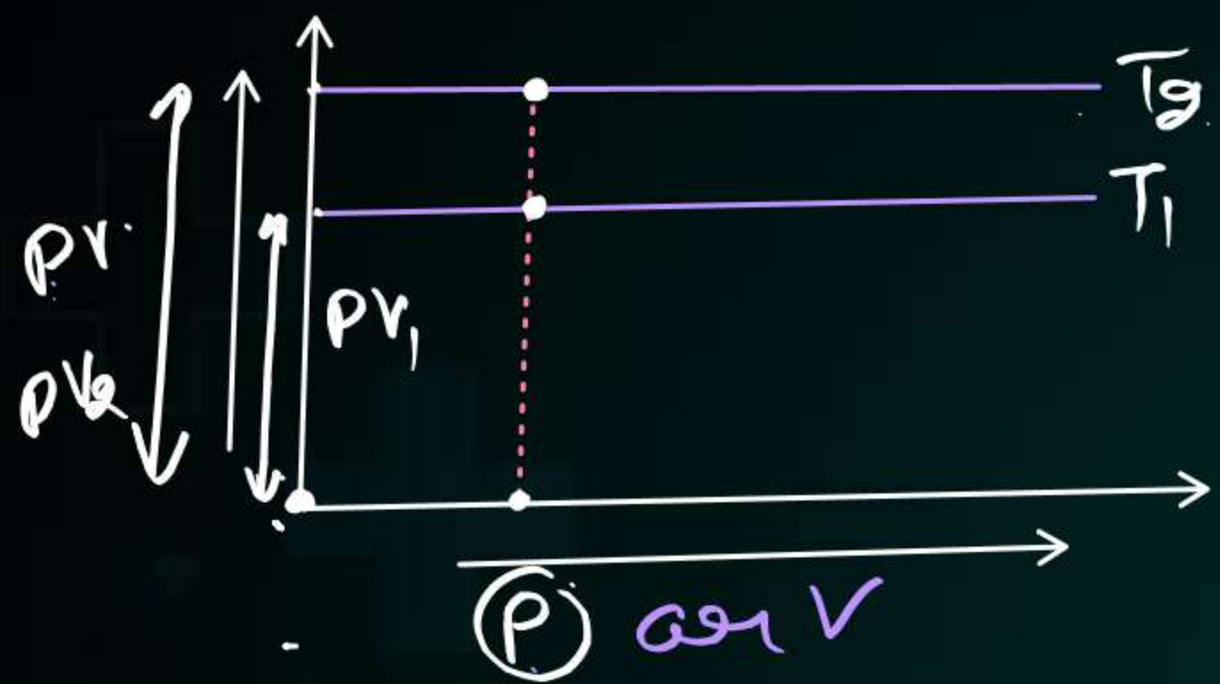
$y = mx + c$

$m = -1 = \text{slope}$

$y = \log P$

$c = \log K$

$x = \log V$

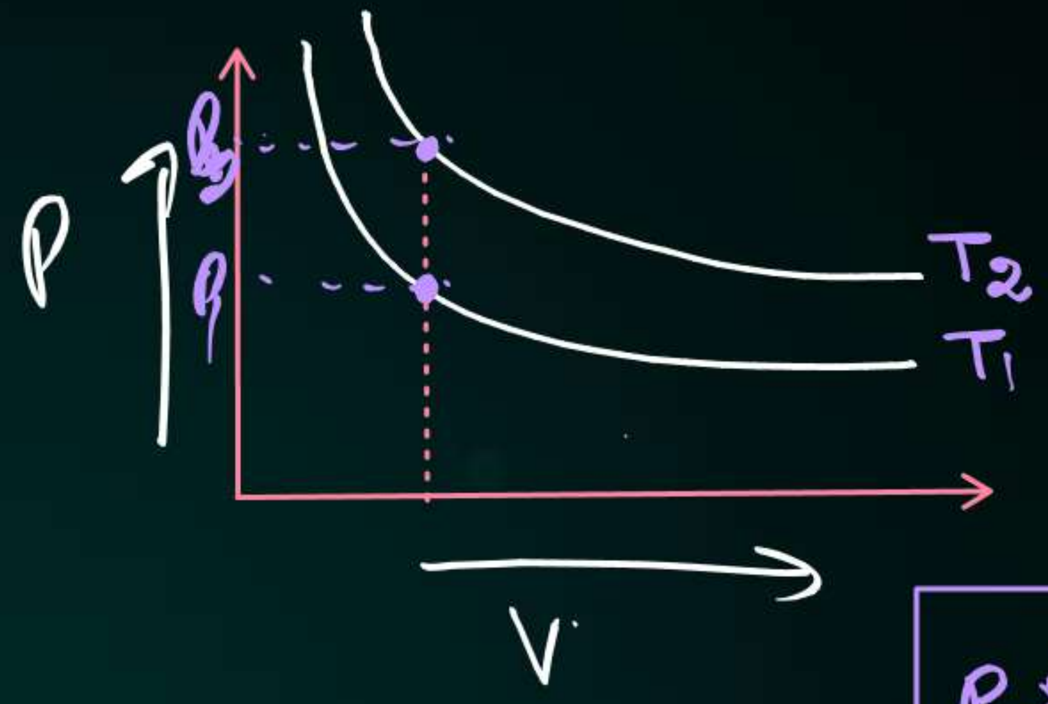


$V_2 > V_1 \quad (V \propto T)$

$T_2 > T_1$

MIT

PV vs P or V ke graph main, jitna upar T utna jyada



$P_2 > P_1$

$P \propto T$

$T_2 > T_1$

MIT

P & V ke graph main, jitna upar Temp. utna jyada

SIGNIFICANCE OF BOYLE'S LAW

(1) $\therefore P \propto \frac{1}{V}$

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

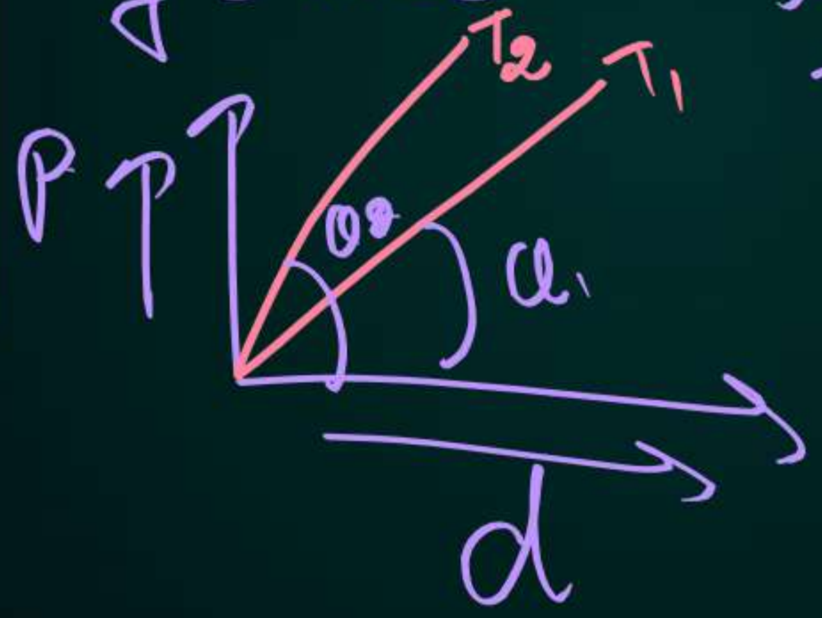
$V \propto \frac{1}{d}$

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

$P \propto d \rightarrow$ density of gas

$P = Kd$

$y = mx$



$\theta_2 > \theta_1$
↓
slope

$T_2 > T_1$

atm. P. dec.
density of air dec.

$\therefore$ breathing air difficulty

$\therefore$ O_2 Cylinders carried in high mountain

② P dec. → Vol. of gas inc.

∴ arteries/Veins burst.

∴ fish dead.

∴ fish dead.

P high.

sea bottom fish.

Question

When we inflate cycle tubes, the volume of tube as well as the pressure of air inside the tube increases.

V of air $\uparrow$
P of air $\uparrow$

A. It is an exceptional case of Boyle's law.

B. It happens because air is not ideal gas.

C. It happens because mass of air is not constant.

D. It happens because external force is applied in inflating the tubes.

Question

Volume of gas balloon at 2 atm pressure is 10 L. Gas starts leaking from balloon and volume reduces to 5L. What is final value of pressure.

A. 4 atm

B. 8 atm

C. 1 atm

D. None of these

$P_1 = 2\,atm$

$V_1 = 10\,L$

$V_2 = 5\,L$

$P_2 = ?$

$P_1V_1 = P_2V_2$

$2 \times \cancel{10}^{2} = P_2 \times \cancel{5}$

$P_2 = 4\,atm$

Question

Balloon filled with Ideal gas is taken from surface of sea, deep to a depth of 100 m. What will be it's volume in terms of original volume?

Ans

$P_1 = 1\,\text{atm} = 10.3\,\text{m of } H_2O \approx 10$

Let $V_1 = V\,L$

$V_2 = ?$

$P_2 = (100 + 10.3)\,\text{m of } H_2O = 110.3\,\text{m of } H_2O \approx 110$

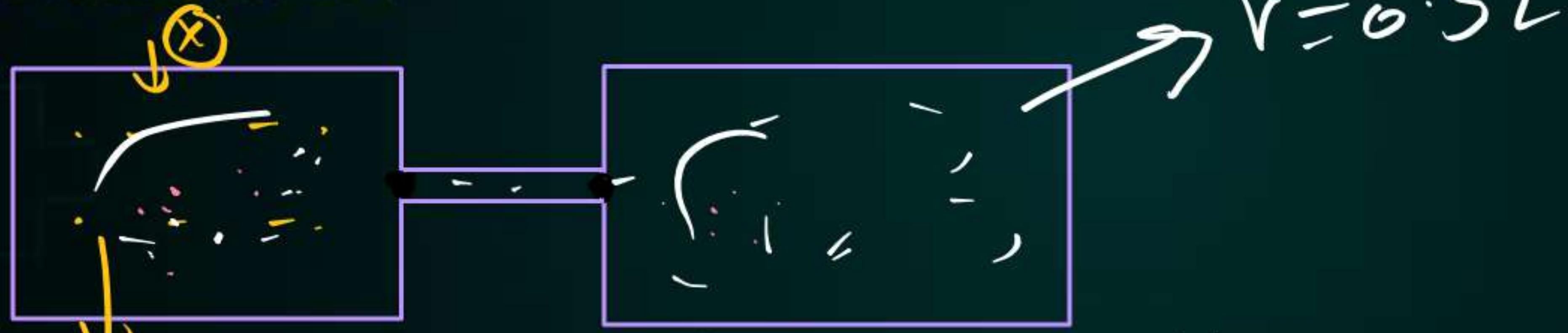
$$P_1V_1 = P_2V_2$$

$$V_2 = \frac{P_1V_1}{P_2} = \frac{10.3 \times V}{110.3} = \frac{103\,V}{1103}$$

Question

A bulb 'x' of unknown volume containing a gas at 1 atm pressure is connected to an evacuated bulb of 0.5 L capacity through a stop-cock. On opening the stop cock, the pressure in the whole system after some time was found to have a constant value of 570 mm at same temperature. What is volume of bulb 'x'?

Ans



$P_1 = 1\,atm = 760\,mm\ of\ Hg$

Let $V_1 = V\,L$

$P_2 = 570\,mm\ of\ Hg$

$V_2 = (V + 0.5)\,L$

$P_1 V_1 = P_2 V_2$

$\cancel{760}^{4} \times V = \cancel{570}^{3} \times (V + 0.5)\,L$

$\frac{4V}{3} = V + 0.5$

$\frac{4V}{3} - V = 0.5\,L$

$1.33V - V = 0.5\,L$

$0.33V = 0.5\,L$

$$\frac{1}{3}V = 0.5L$$

$$V = \underline{0.5}L \times 3$$

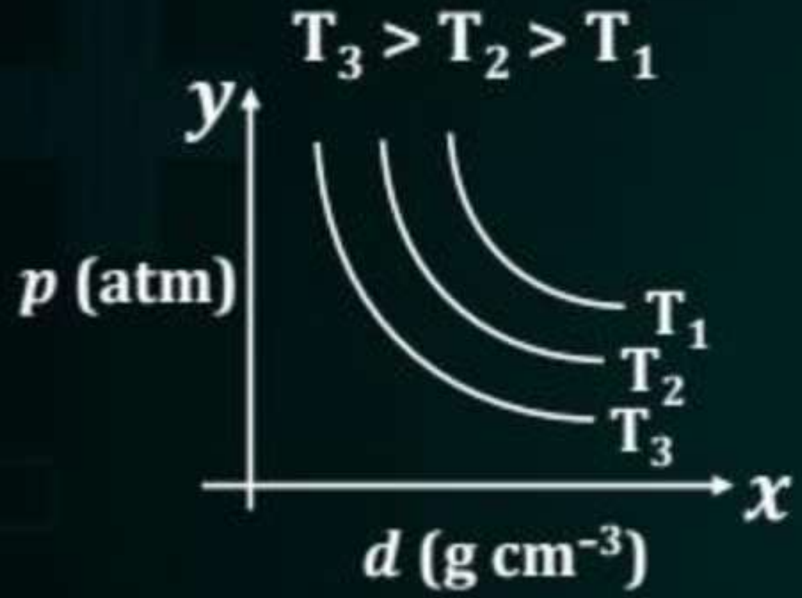
$$= 1.5L$$

Question

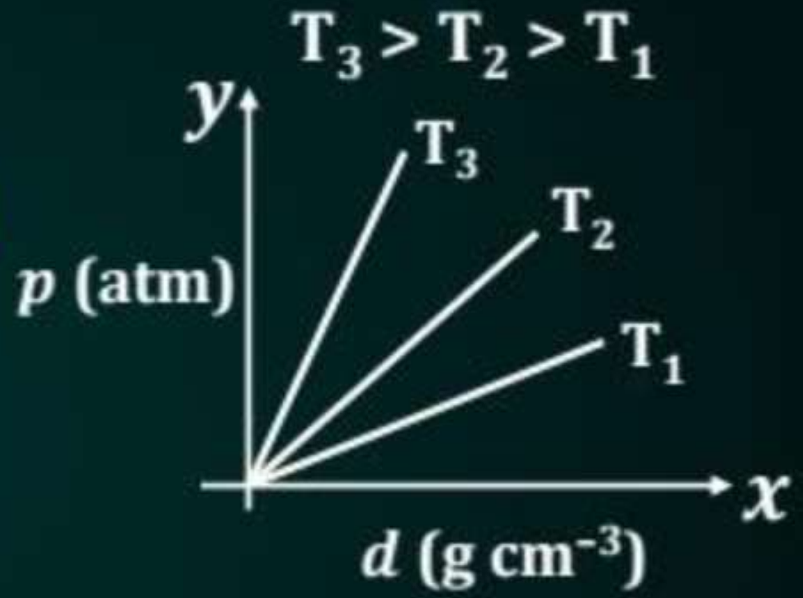
H.W.

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

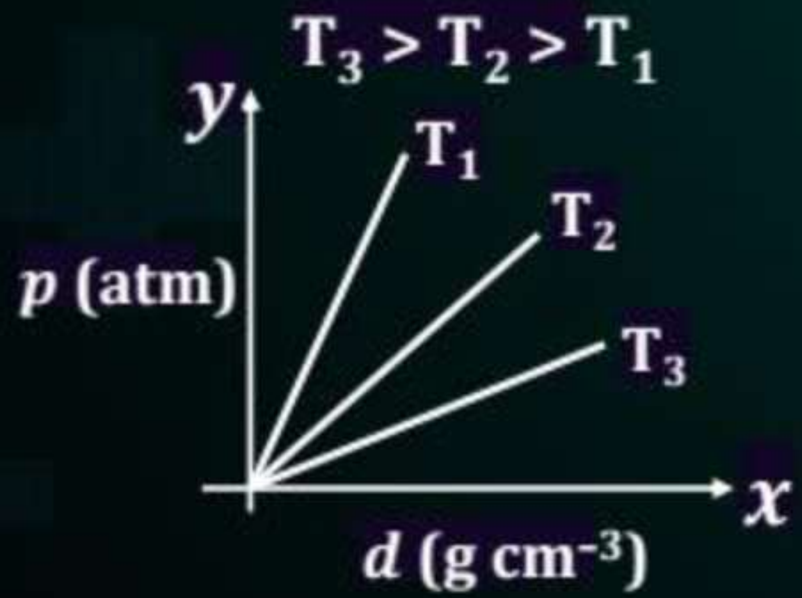
A



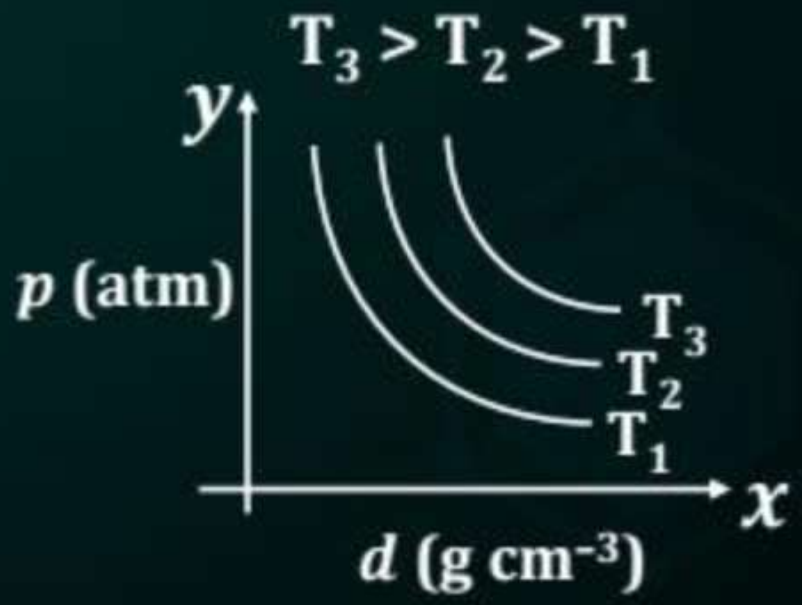
B



C



D



Question

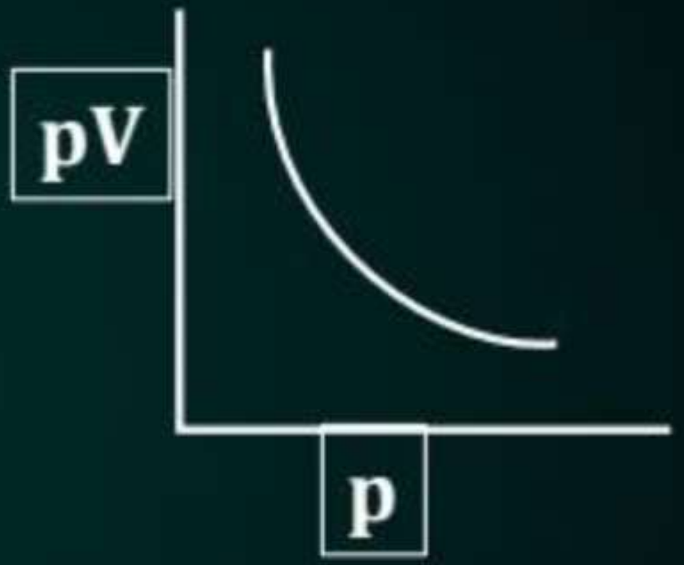
H.W.

Volume of gas cylinder containing 10 marbles at 1 atm P is 1L. When P is increased by 100% new volume become 625 ml. Calculate volume of each marble

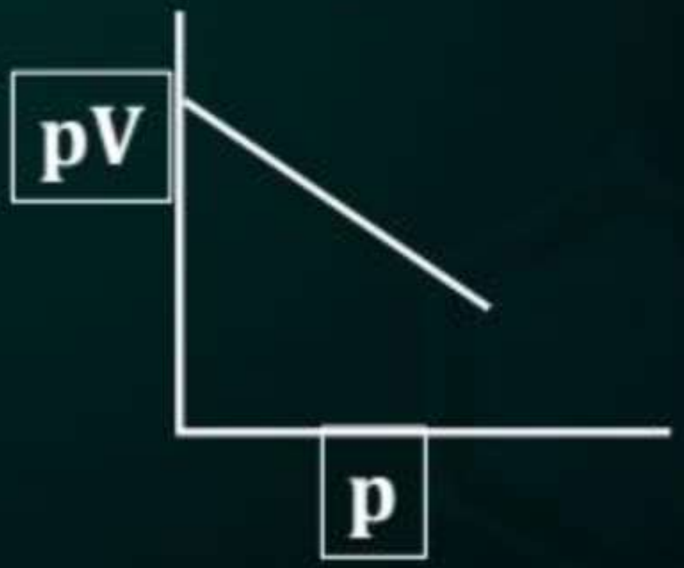
Question H. W.

Which one of the following is the correct pV vs p plot at constant temperature for an ideal gas? (p and V stand for pressure and volume of the gas respectively)

A 

B 

C 

D 

Question

H.W.

Volume of gas balloon at 2 atm pressure is 10 L. Gas starts leaking from balloon and volume reduces to 5L. What is final value of pressure.

A 4 atm

B 8 atm

C 1 atm

D None of these

Question

H.W. 1 L atm = 101.3 J

The value of Boyle's law constant (in S.I. unit) for 200 ml of gas at 1.2 atm is about

A 240 atm-ml

B 0.24 atm^{-1}

C 24.3J

D 0.24J

How to increase Your Focus ?

- Use Pen Technique - Discussed in chapter 1 Lecture 2
- Use Ear Plugs while Studying - Discussed in chapter 1 Lecture 3

How to increase Your Efficiency ?

- Use Pomodoro technique - Discussed in chapter 1 Lecture 5
- Join a Library – Discussed in Chapter 2 Lecture 6

How to stop Overthinking ?

- Use Appointment method - Discussed in chapter 1 Lecture 10

How to get Confidence in Physical Chemistry

- Make formula sheets & write each formula in rough copy 10 times after remembering it & practice a variety of questions after revising & doing each question discussed in your copy by yourself - Discussed in Chapter 1 Lecture 12

Thank You

YAKEEN 2.0

NEET 2024

- Subject – Physical Chemistry
- Chapter – States of Matter

Lecture No.- 3

BY: Amit Mahajan Sir

Today's Targets

1. Revision Of Last Class
2. Charle's Law , Amonton Law
3. Ideal Gas Equation
4. Home Work

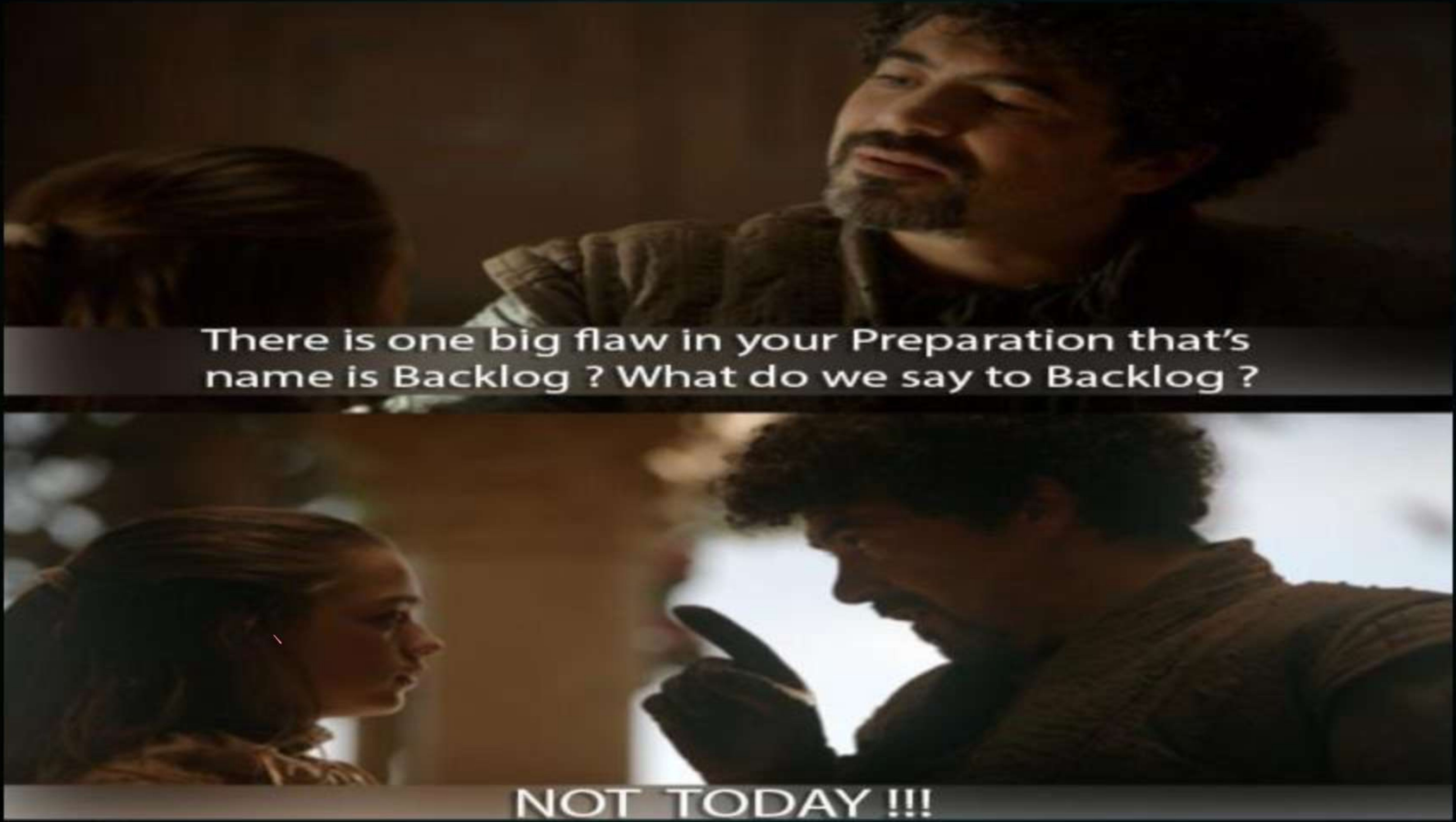
Gas laws (Part-02)

Rules to attend class

1. Always sit in a peaceful environment with headphone and be ready with your copy and pen.
2. Never ever attend a class from in between or don't join a live class in the middle of the chapter.
3. Make sure to revise the last class before attending the next class & always complete your home work along with DPP.
4. Never ever engage in chat whether live or recorded on the topic which is not being discussed in current class as by doing so u can be blocked by the admin team or your subscription can be cancelled.

Rules to attend class

5. Try to make maximum notes during the class if something is left then u can use the notes pdf after the class to complete the remaining class.
6. Always ask your doubts in doubt section to get answer from faculty. Before asking any doubt please check whether same doubt has been asked by someone or not.
7. Don't watch the videos in high speed if you want to understand better.


There is one big flaw in your Preparation that's name is Backlog ? What do we say to Backlog ?
NOT TODAY !!!

Revision Of Last Class

Pressure measure

(1) Barometer → atmospheric gases pressure measure

(2) Manometer → gases pressure measure

↓

2 Types

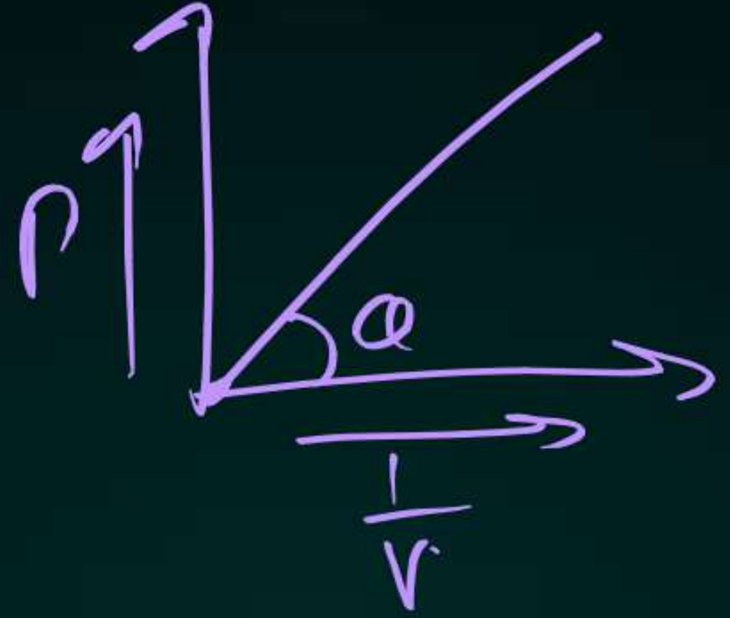
(1) Open-end

(2) Closed-end

Boyle's law.

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

$y = mx$



$PV = K$

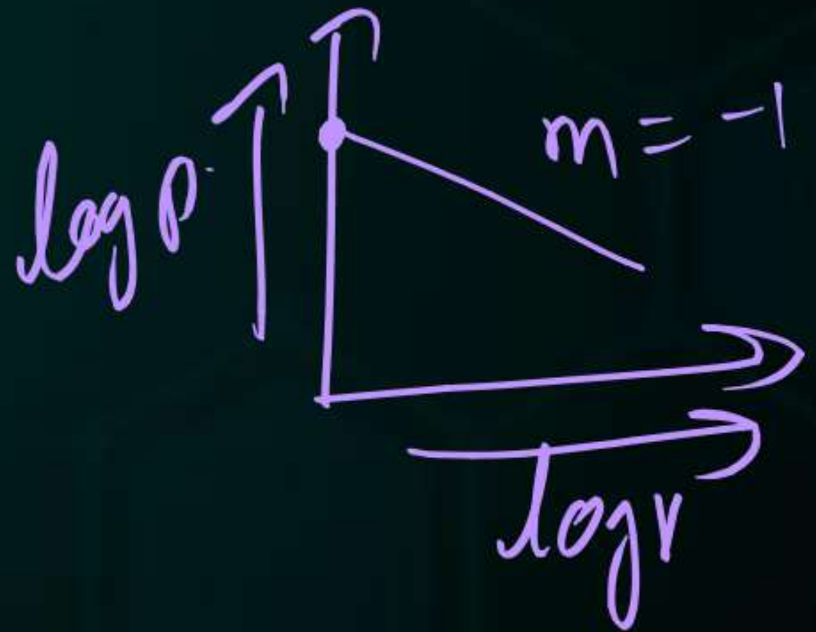
$xy = \text{Konstt.}$

$PV = K$

$\log P + \log V = \log K$

$\log P = -\log V + \log K$

$y = mx + c$



$P \propto \frac{1}{V}$ — (1)

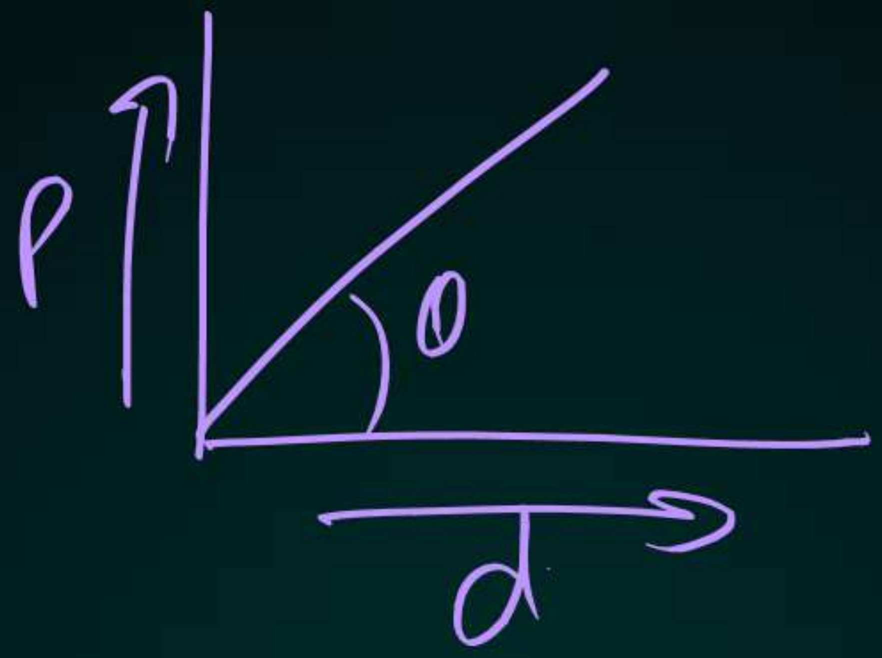
$d = \frac{m}{V}$

$d \propto \frac{1}{V}$ — (2)

$P \propto d$

$P = kd$

$y = mx$



CHARLE'S LAW

$T_1 = 20^\circ C = 20 + 273 = 293\,K$

$T_2 = 40^\circ C = 40 + 273 = 313\,K$

at Constant Pressure & mass (moles) then Volume of gas is directly proportional to temperature.

$V \propto T$

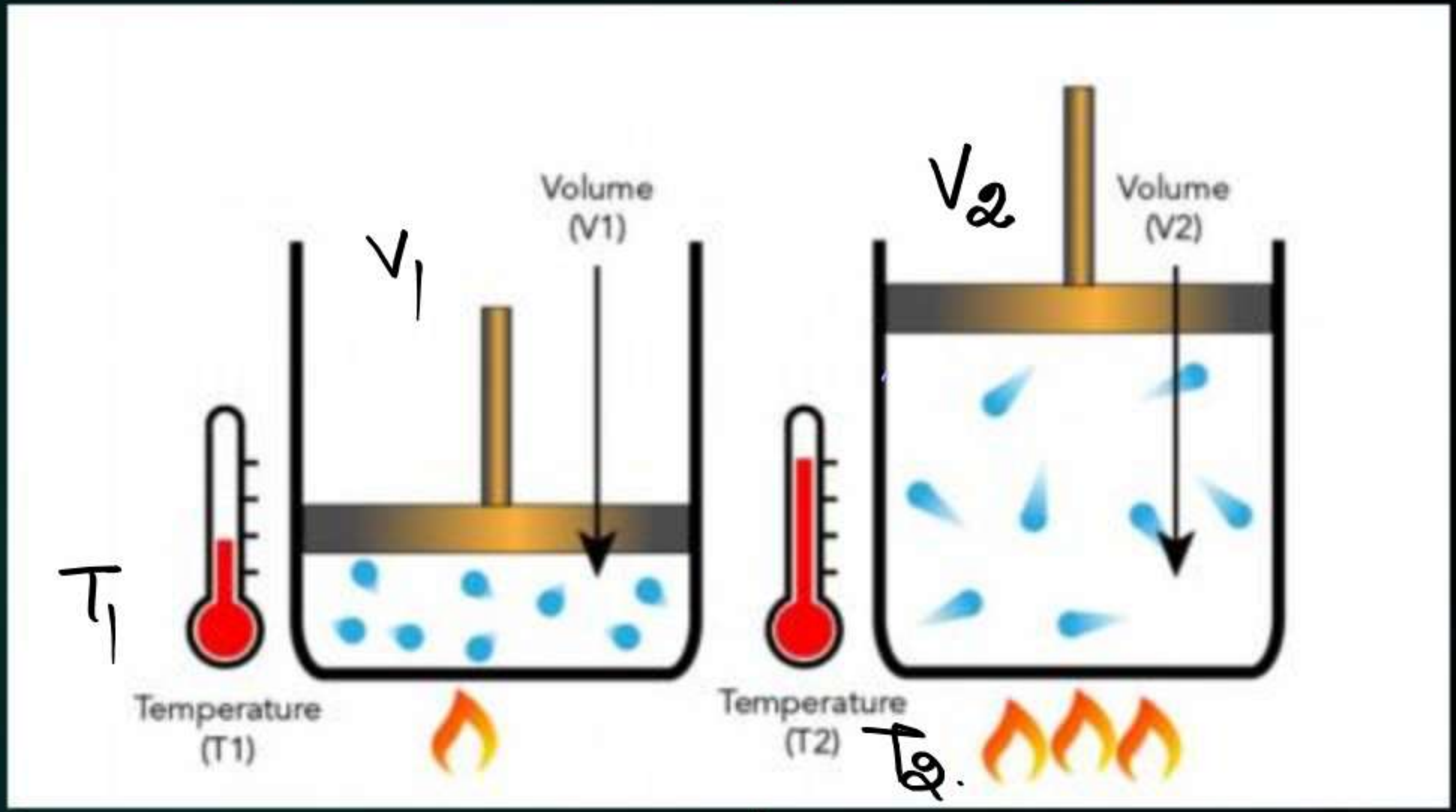
$V = KT$

$\frac{V}{T} = K$

$\frac{V_1}{T_1} = K$

$\frac{V_2}{T_2} = K$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$



$V_1 = 100\,ml$

$T_1 = 400\,K$

$\frac{V_1}{T_1} = \frac{100}{400} = \frac{1}{4}$

$V_2 = 400\,ml$

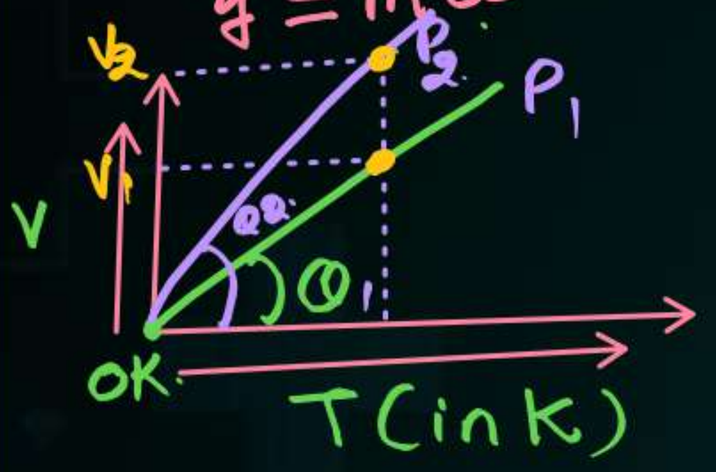
$T_2 = 1600\,K$

$\frac{V_2}{T_2} = \frac{4\cancel{00}}{16\cancel{00}} = \frac{4}{16} = \frac{1}{4}$

MIT

① $V = KT$

$y = mx$

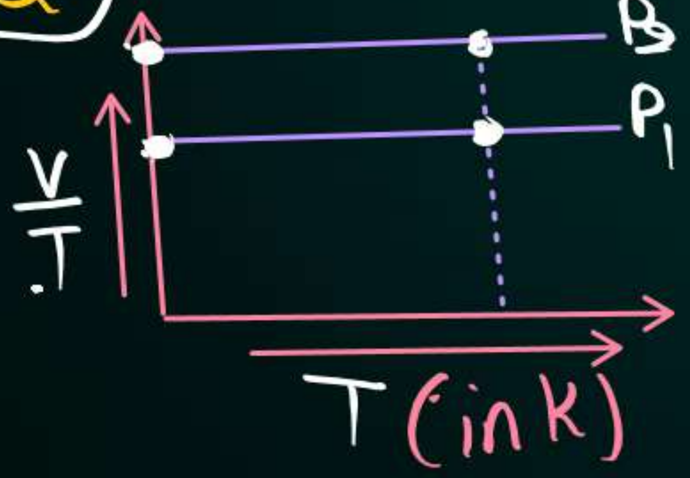


$\theta_2 > \theta_1$

$V_2 > V_1$ $\quad V \propto \frac{1}{P}$

$P_1 > P_2$

② $\frac{V}{T} = K$



$V_2 > V_1$

$P_2 < P_1$

③ $V_t = V_0 + \frac{1}{273} \times V_0 \times t$

V_0 = Volume of gas at $0°C$

t = Change in Temp. = $T_2 - T_1$

T_2 ↓ final temp

T_1 Initial temp

V_t = Final Volume of gas

if $t = 1$ $\quad V_t = V_0 + \frac{1}{273} \times V_0$ $\quad$ Let $V_0 = 546\,ml$

if $t = 1$

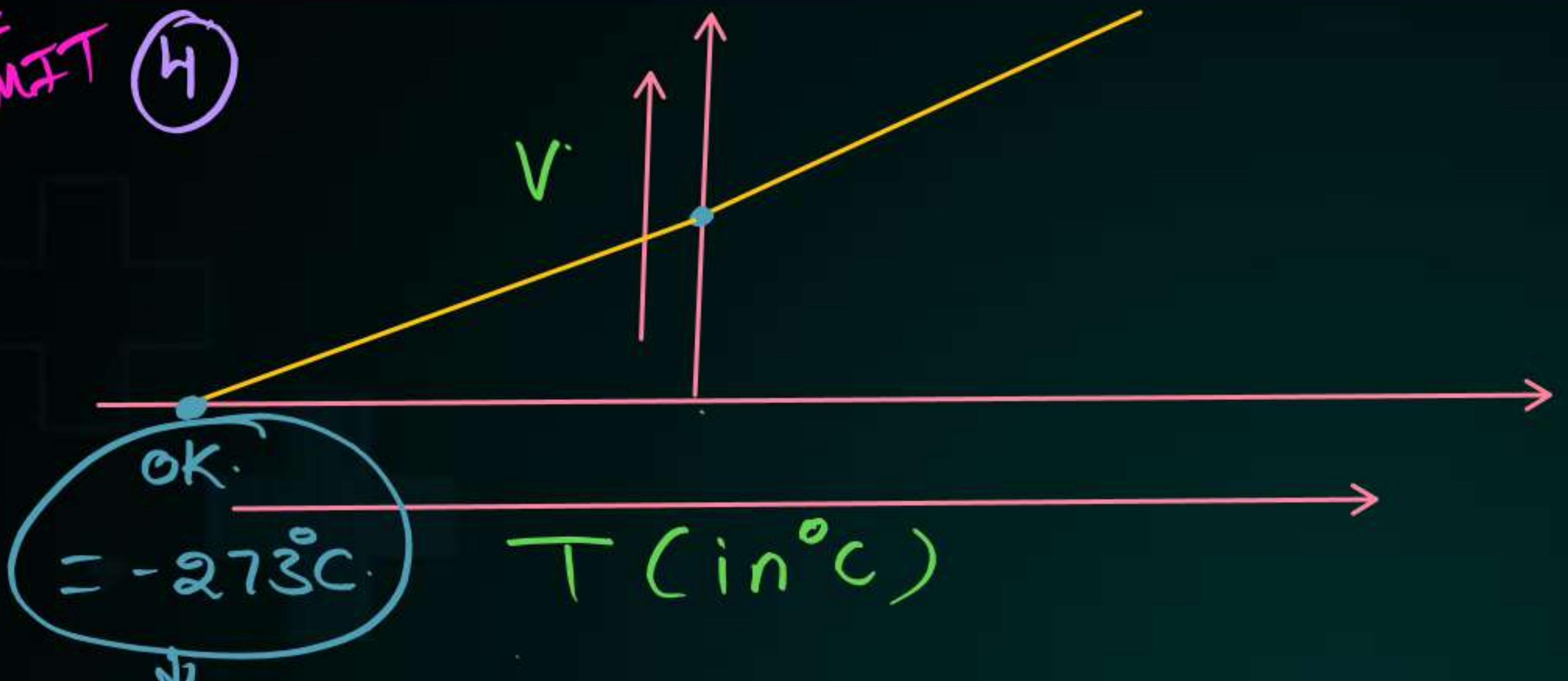
$V_t = V_0 + \frac{1}{273} \times V_0$

$V_t = 546 + \frac{1}{\cancel{273}} \times \cancel{546}^{\,2}$

$= 546 + 2 = 548\,ml$

#MIT

(4)



Absolute Zero

gas Volume is zero at 0 K or -273°C (absolute zero)

(5) Hot air ballon
due to High Temp
Volume of gas increases
∴ Hot air rises up

(6) for numericals on gas laws Temp. must be in Kelvin

If Temp. of gas doubles from 20°C to 40°C ⇒ Volume of gas also doubles = False

If Temp. doubled from 300 K to 600 K then Volume of gas doubles ⇒ true

Question

20 ml of H_2 measured at 15° C are heated to 35°C. What is the new volume at same pressure?

Ans

$V_1 = 20\,ml$ $\quad V_2 = ?$

$T_1 = 15^\circ C$ $\quad T_2 = 35^\circ C$

$= (273+15)$ $\quad T_2 = 35+273$

$= 288\,K$ $\quad = 308\,K$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow V_2 = \frac{V_1 \times T_2}{T_1} = \frac{20 \times 308}{288}\,ml$$

Question

At what temperature centigrade will the volume of gas at 0°C double itself, pressure remaining constant.

Ans

$T_1 = 0^\circ C = 273\,K$ | $T_2 = ?$

$V_1 = V$ | $V_2 = 2V$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$T_2 = \frac{V_2 \times T_1}{V_1} = \frac{2\cancel{V} \times 273}{\cancel{V}}$$

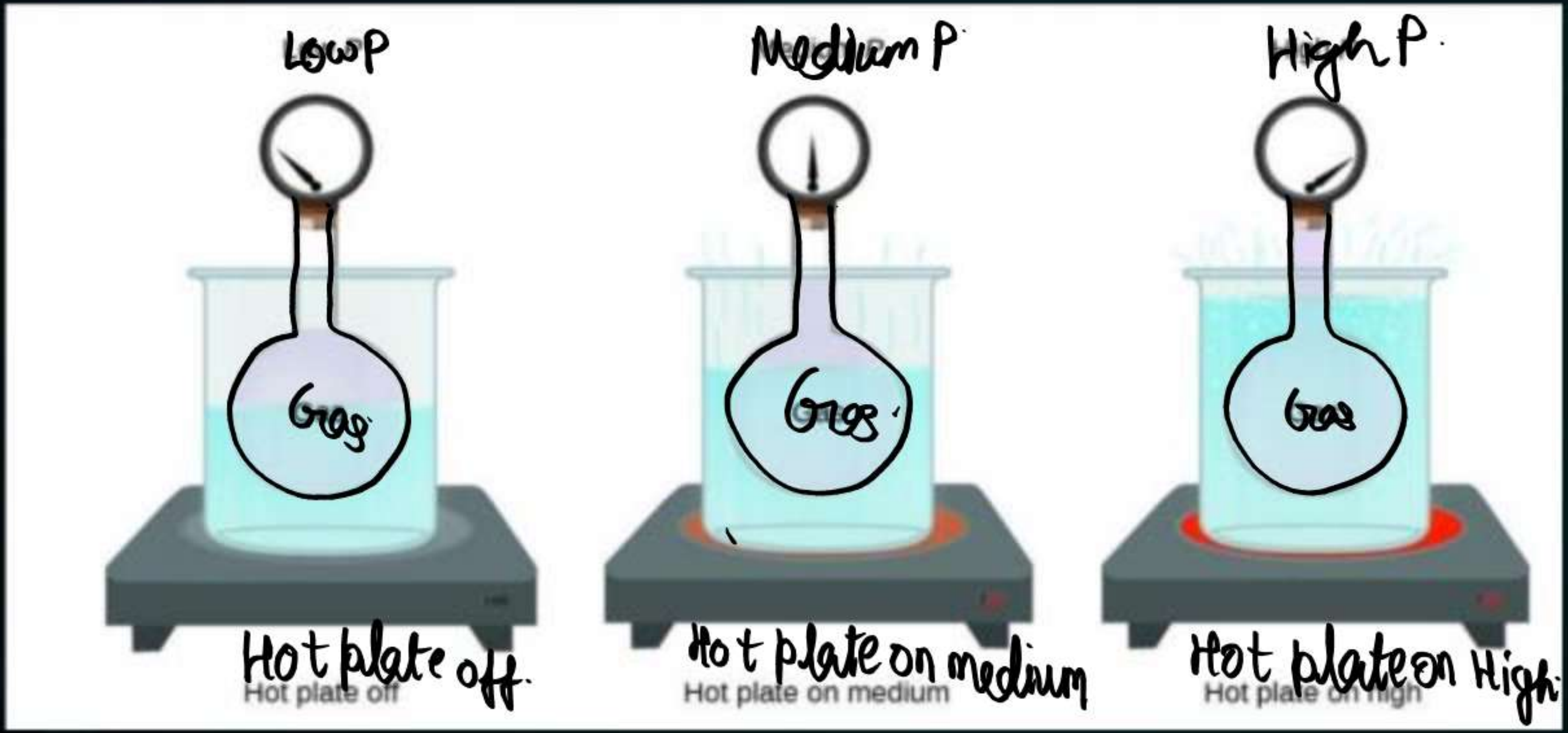
$$T_2 = 546\,K$$

$$T_2 = 546 - 273 = 273^\circ C$$

Amonton Law or Gay-Lussac law.

at Constt. Volume & mass (moles) of gas

Pressure of gas is directly proportional to temperature.



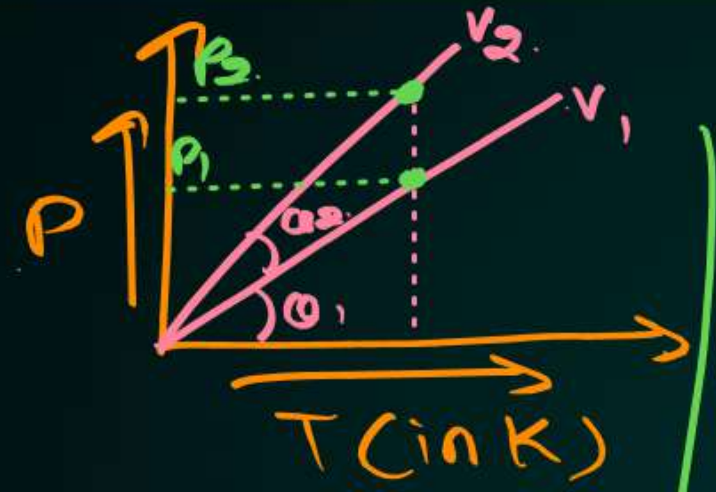
GRAPH OF AMONTON LAW

MIT

$P \propto T$

$P = KT$

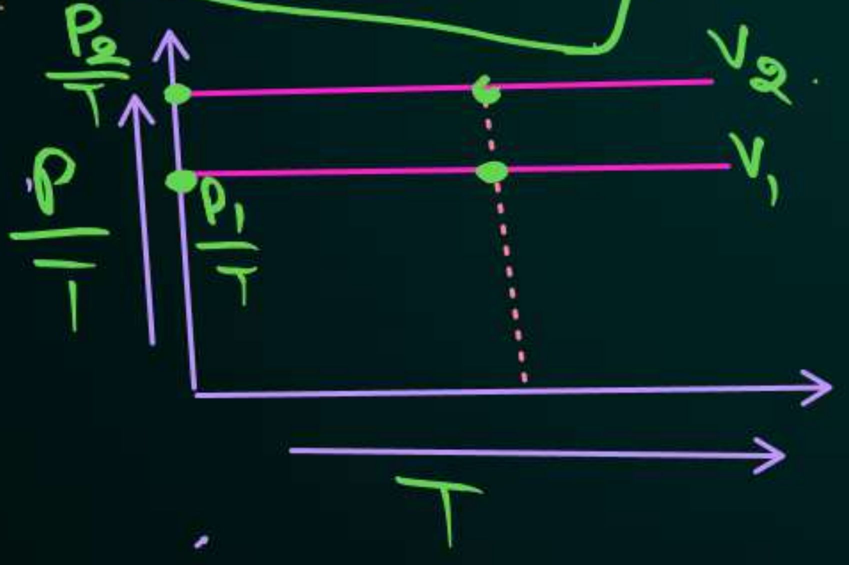
$y = mx$



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

$P_2 > P_1$
$V_2 < V_1$

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



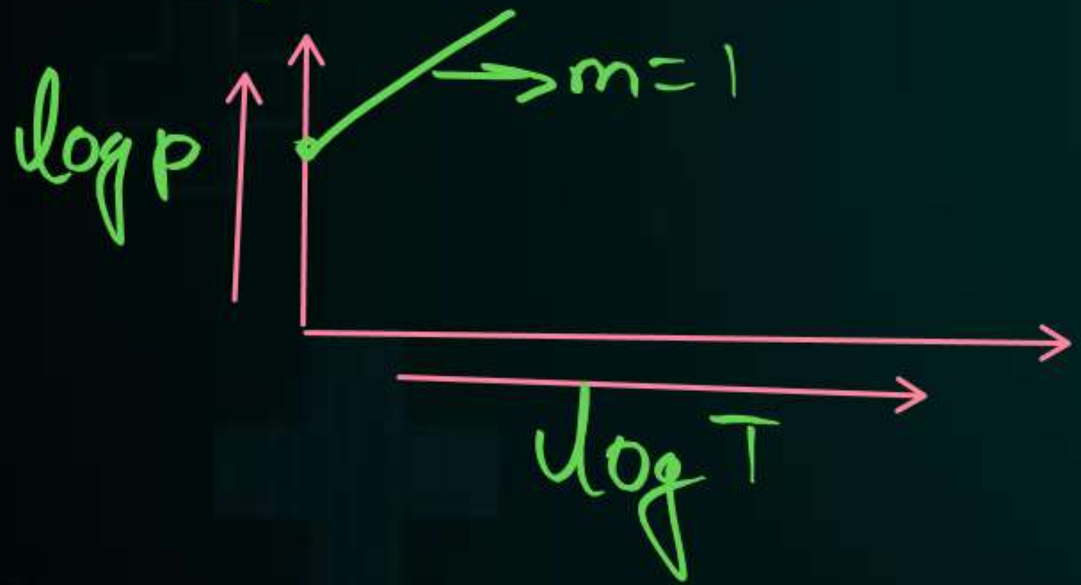
$P_2 > P_1$
$V_2 < V_1$

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

$$\log P - \log T = \log K$$

$$\log P = \log T + \log K$$

$$y = mx + c \quad c = \text{Intercept}$$



Charle's law

$$\frac{V}{T} = K$$

$$\log V - \log T = \log K$$

$$\log V = \log T + \log K$$

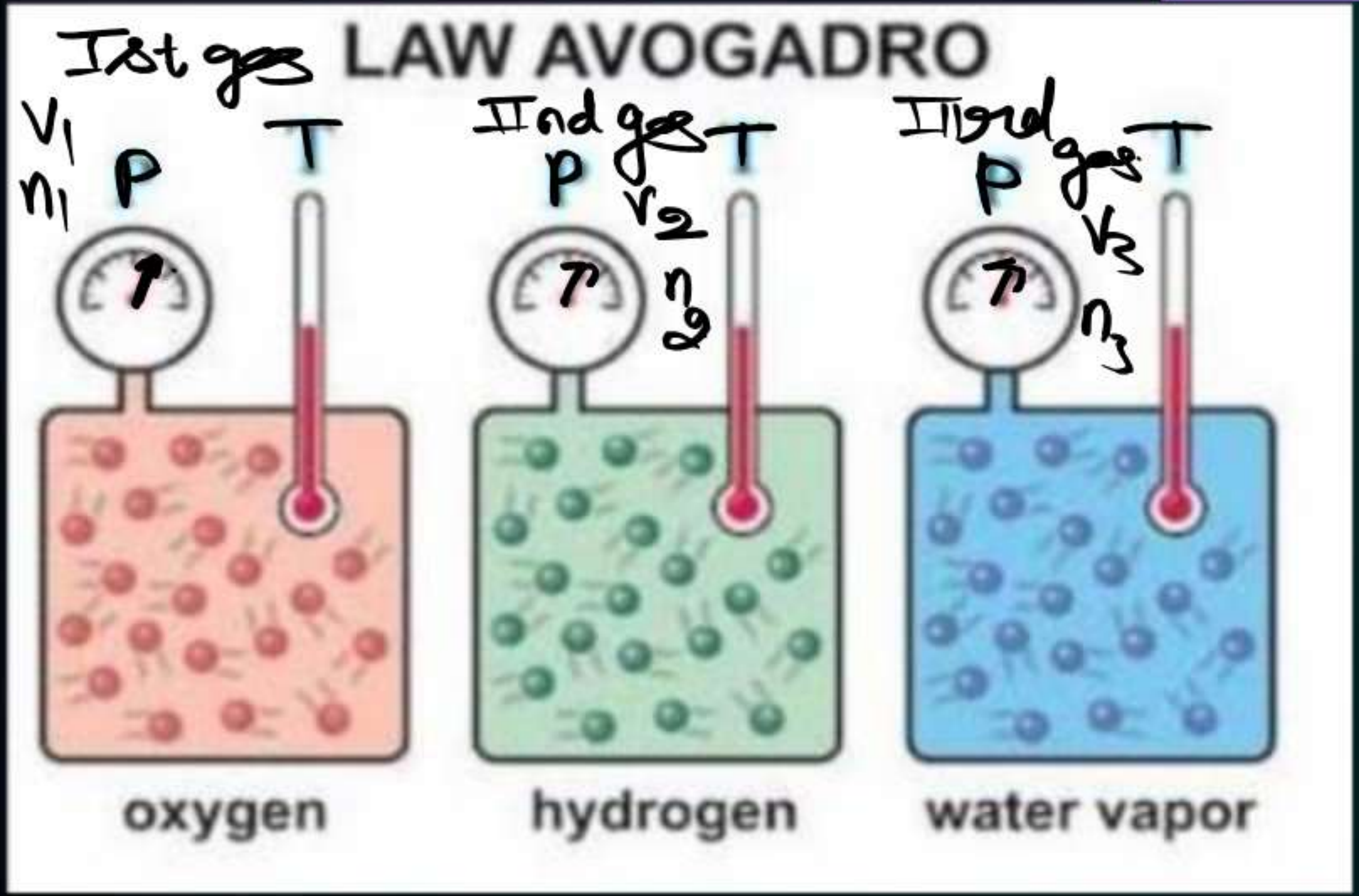
$$y = mx + c \quad c = \text{Intercept}$$

Avogadro Law

at same T & P & Mass Constt.

Vol of gas ratio = Moles of gas ratio or molecules

$V_1 : V_2 : V_3 = n_1 : n_2 : n_3$



$$\frac{V_1}{n_1} = \frac{V_2}{n_2} = \frac{V_3}{n_3}$$

$$\frac{V_1}{n_1} = \frac{V_2}{n_2} \Rightarrow \frac{V_1}{V_2} = \frac{n_1}{n_2}$$

Combined Gas Equation

$P \propto T$

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

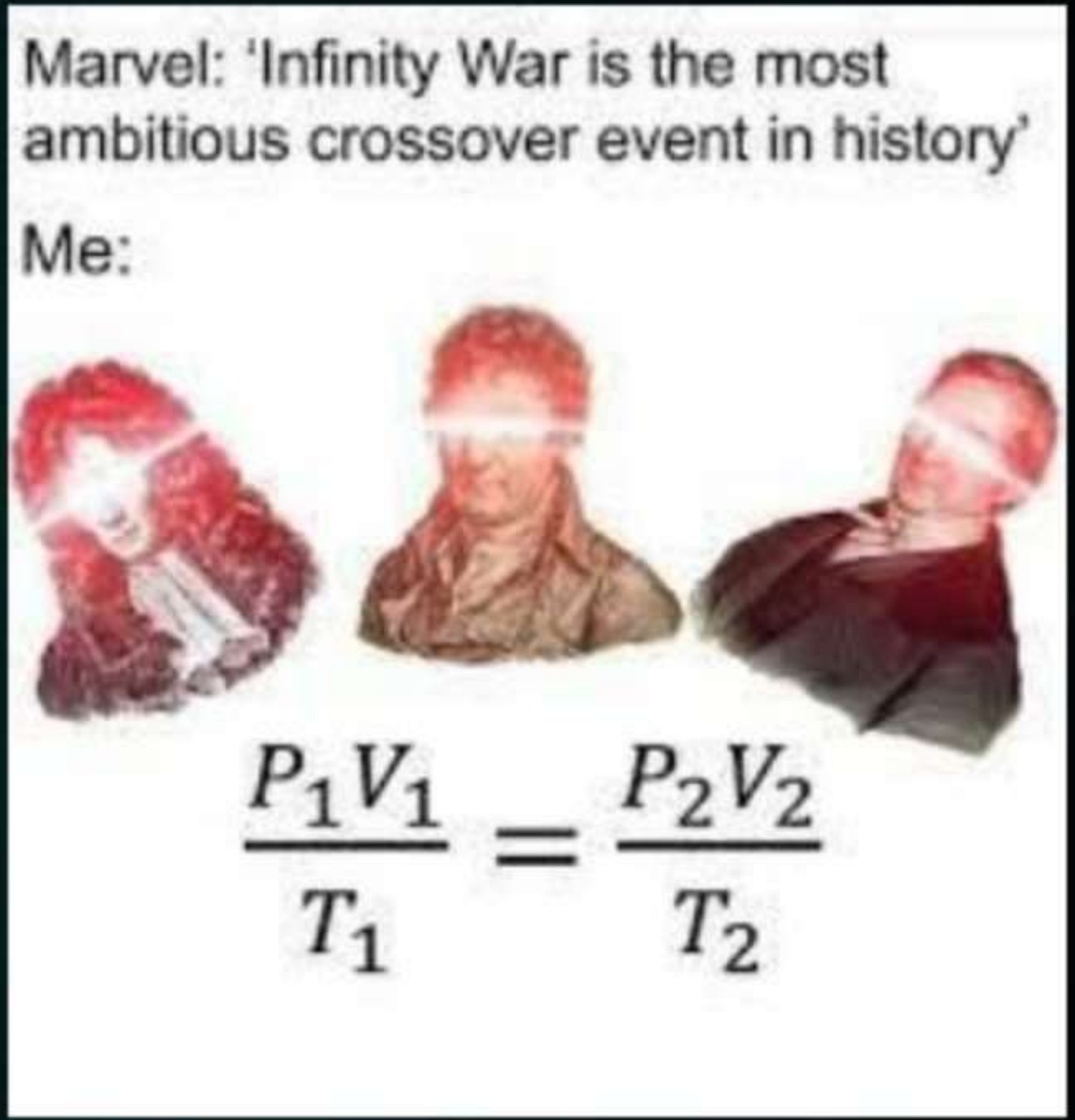
$P \propto \frac{T}{V}$

$P = K\frac{T}{V}$

$\frac{PV}{T} = K$

at Constt. mass

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}.$$



Ideal Gas Equation

$$\left.\begin{aligned} V &\propto \frac{1}{P} \\ V &\propto T \\ V &\propto n \end{aligned}\right] \rightarrow V \propto \frac{Tn}{P}$$

$$V = \frac{nRT}{P}$$

MIT

$$\boxed{PV = nRT}$$

P = Pressure of gas
V = Volume of gas
n = moles of gas

$R \approx 2\ \text{Cal}\ K^{-1}\ mol^{-1}$

R = Universal gas Constt

$R = 0.082 = \frac{1}{12}\ L\ atm\ K^{-1}\ mol^{-1}$

$R = 0.083\ L\ bar\ K^{-1}\ mol^{-1}$

$R = 8.314 = \frac{25}{3}\ J\ K^{-1}\ mol^{-1}$

$$PV = nRT$$

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

(M = Molar mass of gas) (G.M.M.)

w = mass of gas

$$PM = \frac{w}{V} RT$$

$d = \frac{w}{V} = \frac{\text{mass}}{\text{Volume}}$

$$PM = d\,RT$$

MFT

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

300 L of CO_2 gas at 20°C and 5 atm is allowed to expand in space of 600L and to a pressure of 1 atm, find drop in temperature.

Ans

CO_2

$V_1 = 300L.$

$T = 20^\circ C. = 293K$

$P_1 = 5\,atm$

$V_2 = 600L.$

$P_2 = 1\,atm$

$T_2 = ?$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$T_2 = \frac{P_2 V_2 T_1}{P_1 V_1}$$

$$= \frac{1 \times \cancel{600}^{2} \times \cancel{293}^{58.6}}{\cancel{5} \times \cancel{300}} = 117.2\,K$$

drop in temp. $= T_2 - T_1$

$= 117.2 - 293$

1 L flask of have vapour of ethanol at P = 1 atm and T = 25°C, is evacuated till pressure is 100 mm. How many molecules of ethanol are left in flask?

Ans: V of flask = 1 L.

$P = 1\,atm$

$T = 25^\circ C$.

$1\,atm = 760\,mm$ of Hg

$\frac{1}{760}\,atm = 1\,mm$ of Hg

$P' = 100\,mm$ of Hg

$V' = 1\,L$.

$T' = 25^\circ C$

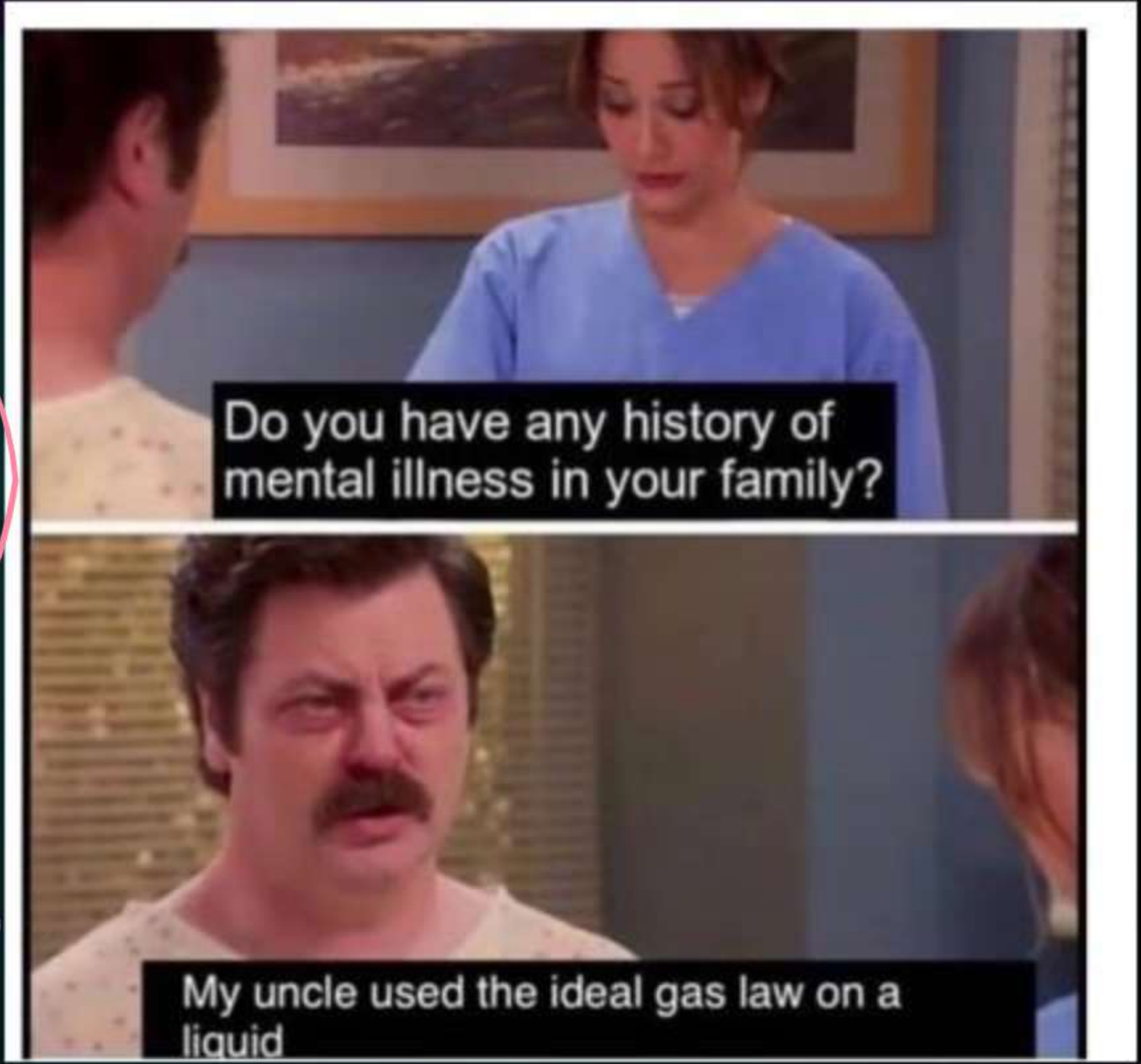
$= 298\,K$.

$P'V' = n'RT'$

$\frac{100}{760} \times 1 = n' \times \frac{1}{12} \times 298$

$P' = \frac{100}{760}\,atm$

$R = \frac{1}{12}\,L\,atm\,K^{-1}\,mol^{-1}$



$$n' = \frac{100 \times 1 \times 12}{760 \times 298} = \text{moles of gas}$$

$$\text{molecules of gas} = n' \times N_A$$

$$= \frac{100 \times 12}{760 \times 298} \times 6 \times 10^{23}$$

$$\simeq \frac{\cancel{100}^{2} \times \cancel{12} \times 6 \times 10^{23}}{\cancel{760} \times \cancel{300}}$$

$$\cancel{78} \quad \cancel{25}$$

$$13 \quad 5$$

$$\frac{2}{65} \times 10^{23}$$

Density of a gas is found to be 5.46 g/dm^3 at 27°C at 2 bar pressure. What will be its density at STP?

Ans

$d_1 = 5.46\ g/dm^3$

$T_1 = 27°C = 27+273 = 300\,K$

$P_1 = 2$ bar

$d_2 = ?$

S.T.P.

$T_2 = 273\,K$

$P_2 = 1$ bar

$d_1 = \frac{P_1 M}{R T_1}$

$d_2 = \frac{P_2 M}{R T_2}$

$\frac{d_2}{d_1} = \frac{P_2 \cancel{M} \times \cancel{R} T_1}{\cancel{R} T_2 \times P_1 \cancel{M}} = \frac{1 \times 300}{273 \times 2} = \frac{300}{546}$

$d_2 = \frac{\cancel{300}}{\cancel{546}} \times \frac{\cancel{546}}{\cancel{100}}\ g/dm^3$

$d_2 = 3\ g/dm^3$

Air bubble start from bottom of lake. Its diameter is 3.6 mm at bottom and 4 mm at surface. Depth of lake is 250 cm and temperature at surface is 40°C. What is temperature at bottom of lake (1 atm = 76 cm of Hg)

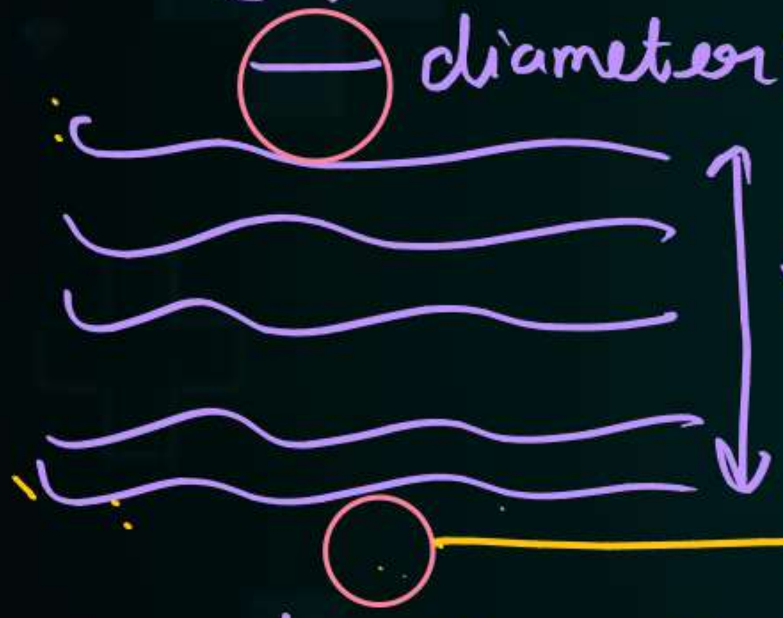
A.

$= 40 + 273 = 313K$

(T_2) Temp. $= 40^\circ C$

$P_2 = 1\,atm = 10.3\,m$ of H_2O

diameter $= 4\,mm \longrightarrow r_2 = \frac{4}{2} = 2\,mm \Rightarrow V_2 = \frac{4}{3}\pi r_2^3 = \frac{4}{3}\pi(2)^3$



$h = 250\,cm = 2.5\,m$

$\longrightarrow P_1 = 10.3 + 2.5 = 12.8\,m$ of H_2O

diameter $= 3.6\,mm \Rightarrow r_1 = \frac{3.6\,mm}{2} = 1.8\,mm \Rightarrow V_1 = \frac{4}{3}\pi r_1^3 = \frac{4}{3}\pi \times (1.8)^3$

Temp. $(T_1) = ?$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

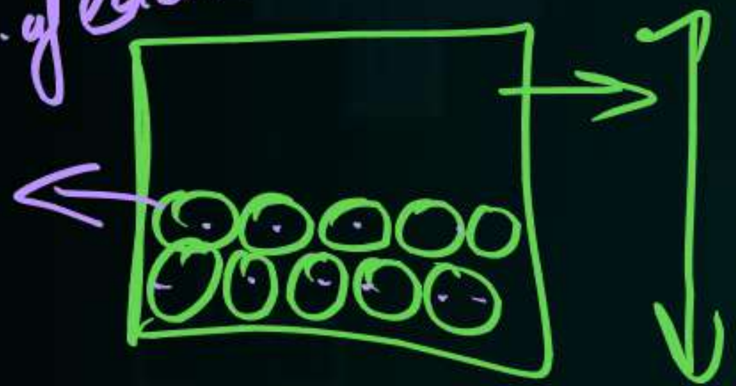
$$T_1 = \frac{P_1 V_1 T_2}{P_2 V_2}$$

$$T_1 = \frac{12.8 \times \cancel{4\pi} \times (1.8)^3 \times 313 \times \cancel{3}}{10.3 \times \cancel{3} \times \cancel{4\pi} \times (2)^3}$$

Question

Volume of gas cylinder containing 10 marbles at 1 atm P is 1L. When P is increased by 100% new volume become 625 ml. Calculate volume of each marble

Vol. of each marble = x ml.



$V = 1\text{L} = 1000$ ml

V of gas $= (1000 - 10x)$ ml.

$P_1 = 1$ atm.

$P_2 = 2$ atm

$V = 625$ ml.

$V_2 = (625 - 10x)$ ml

$P_1 V_1 = P_2 V_2$

$1 \times (1000 - 10x) = 2\,(625 - 10x)$

$1000 - 10x = 1250 - 20x$

$20x - 10x = 1250 - 1000$

$10x = 250$

$x = \frac{250}{10} = 25$ ml

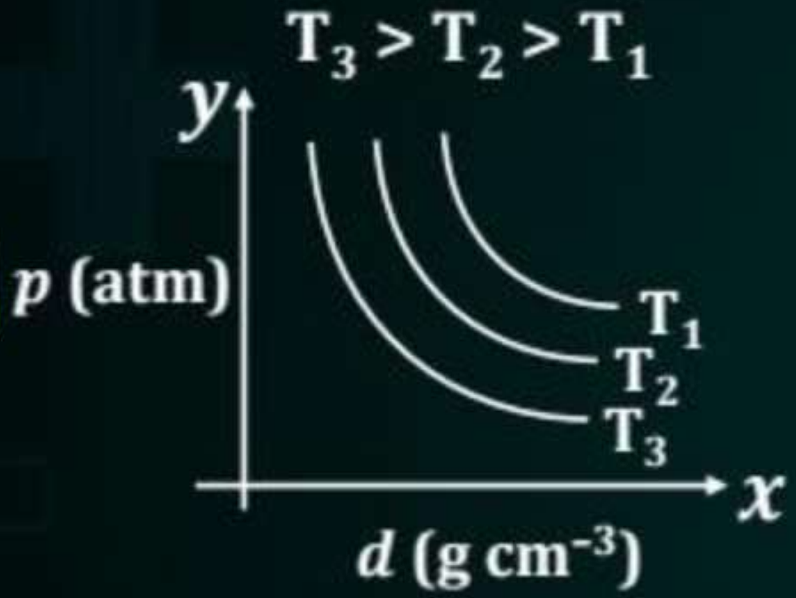
Vol. of 1 marble = 25 ml.

Question

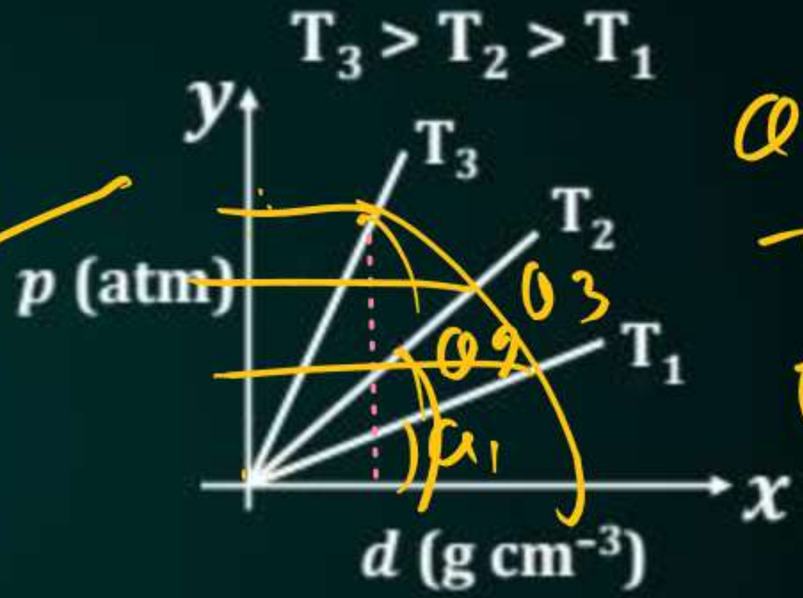
Which amongst the given plots is the correct plot for pressure (p) vs density (d) for an ideal gas?

$P \propto T$

A



B

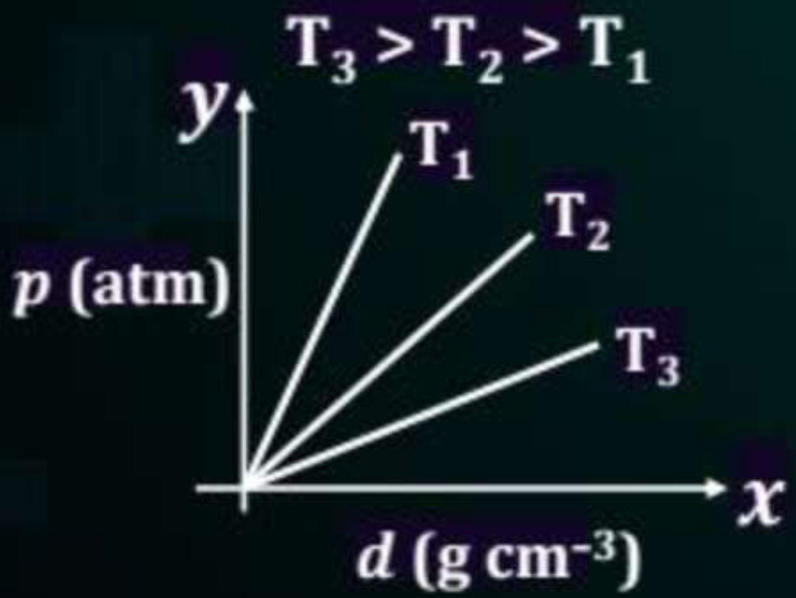


$\theta_3 > \theta_2 > \theta_1$

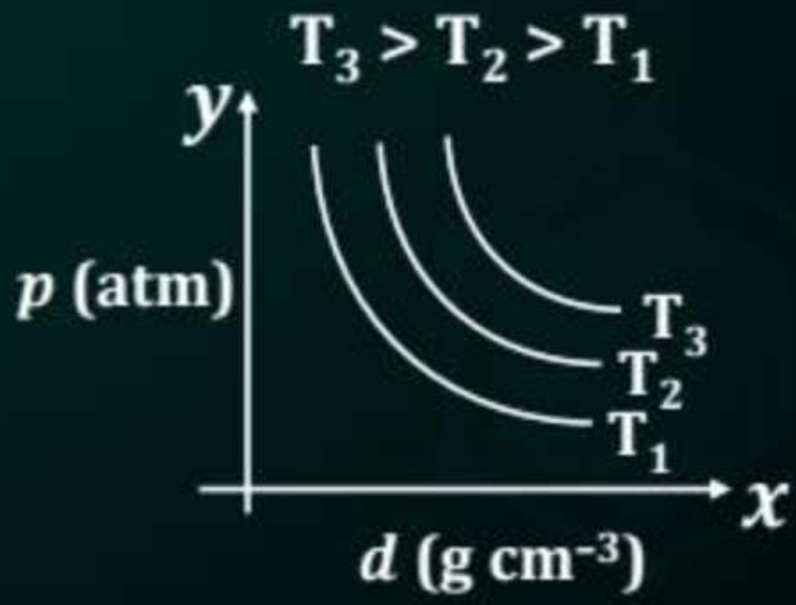
$T_3 > T_2 > T_1$

$P_3 > P_2 > P_1$

C



D

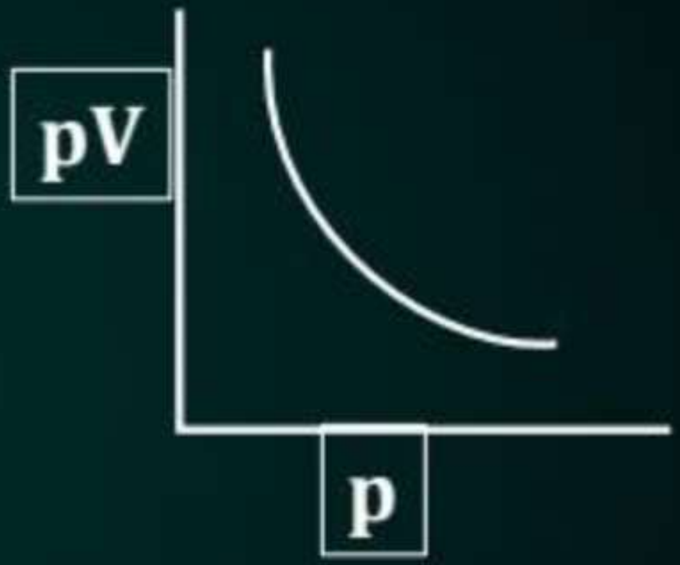


Question

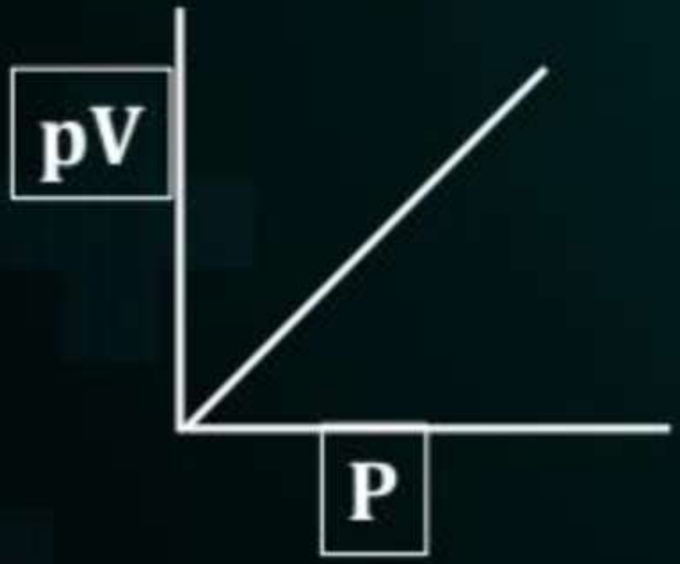
Which one of the following is the correct pV vs p plot at constant temperature for an ideal gas? (p and V stand for pressure and volume of the gas respectively)

A

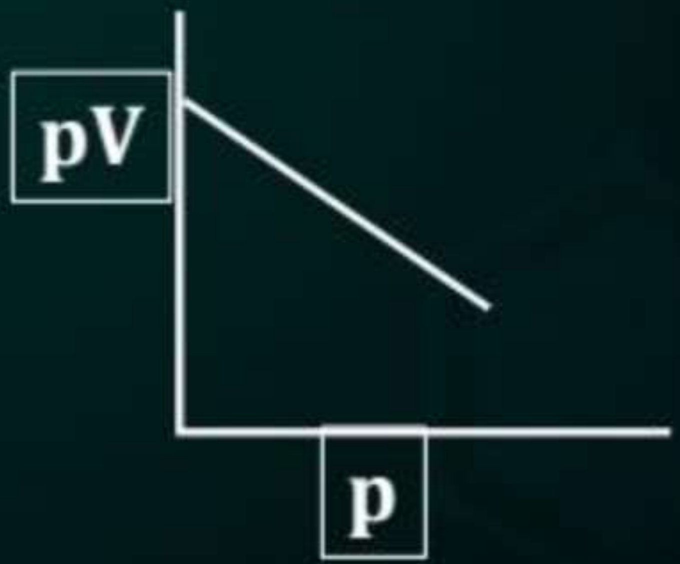
B



C



D



Question

Volume of gas balloon at 2 atm pressure is 10 L. Gas starts leaking from balloon and volume reduces to 5L. What is final value of pressure.

A 4 atm

B 8 atm

C 1 atm

D None of these

$P_1 = 2\,atm$ $\quad V_2 = 5\,L$

$V_1 = 10\,L$ $\quad P_2 = ?$

Boyle's law not applicable.

Question

$1 L\text{-}atm = 101.3\ J$

The value of Boyle's law constant (in S.I. unit) for 200 ml of gas at 1.2 atm is about

(A) 240 atm-ml

(B) 0.24 atm^{-1}

(C) 24.3J

(D) 0.24J

$K = ?$

$V = 200\ ml = \frac{200}{1000} = 0.2\ L$

$P = 1.2\ atm$

$PV = K$

$K = 1.2 \times 0.2\ L\,atm$

$= 0.24\ L\,atm$

$= 0.24 \times 101.3\ J = 24.3\ J$

How to increase Your Focus ?

- Use Pen Technique - Discussed in chapter 1 Lecture 2
- Use Ear Plugs while Studying - Discussed in chapter 1 Lecture 3

How to increase Your Efficiency ?

- Use Pomodoro technique - Discussed in chapter 1 Lecture 5
- Join a Library – Discussed in Chapter 2 Lecture 6

How to stop Overthinking ?

- Use Appointment method - Discussed in chapter 1 Lecture 10

How to get Confidence in Physical Chemistry

- Make formula sheets & write each formula in rough copy 10 times after remembering it & practice a variety of questions after revising & doing each question discussed in your copy by yourself - Discussed in Chapter 1 Lecture 12

Thank You

YAKEEN 2.0

NEET 2024

- Subject – Physical Chemistry
- Chapter – States of Matter

Lecture No.- 4

BY: Amit Mahajan Sir

Today's Targets

1. Revision Of Last Class
2. Open Vessel Concept, Pay Load

   Dalton
3. Daltion law of Partial Pressure
4. Home Work

Rules to attend class

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5. Try to make maximum notes during the class if something is left then u can use the notes pdf after the class to complete the remaining class.
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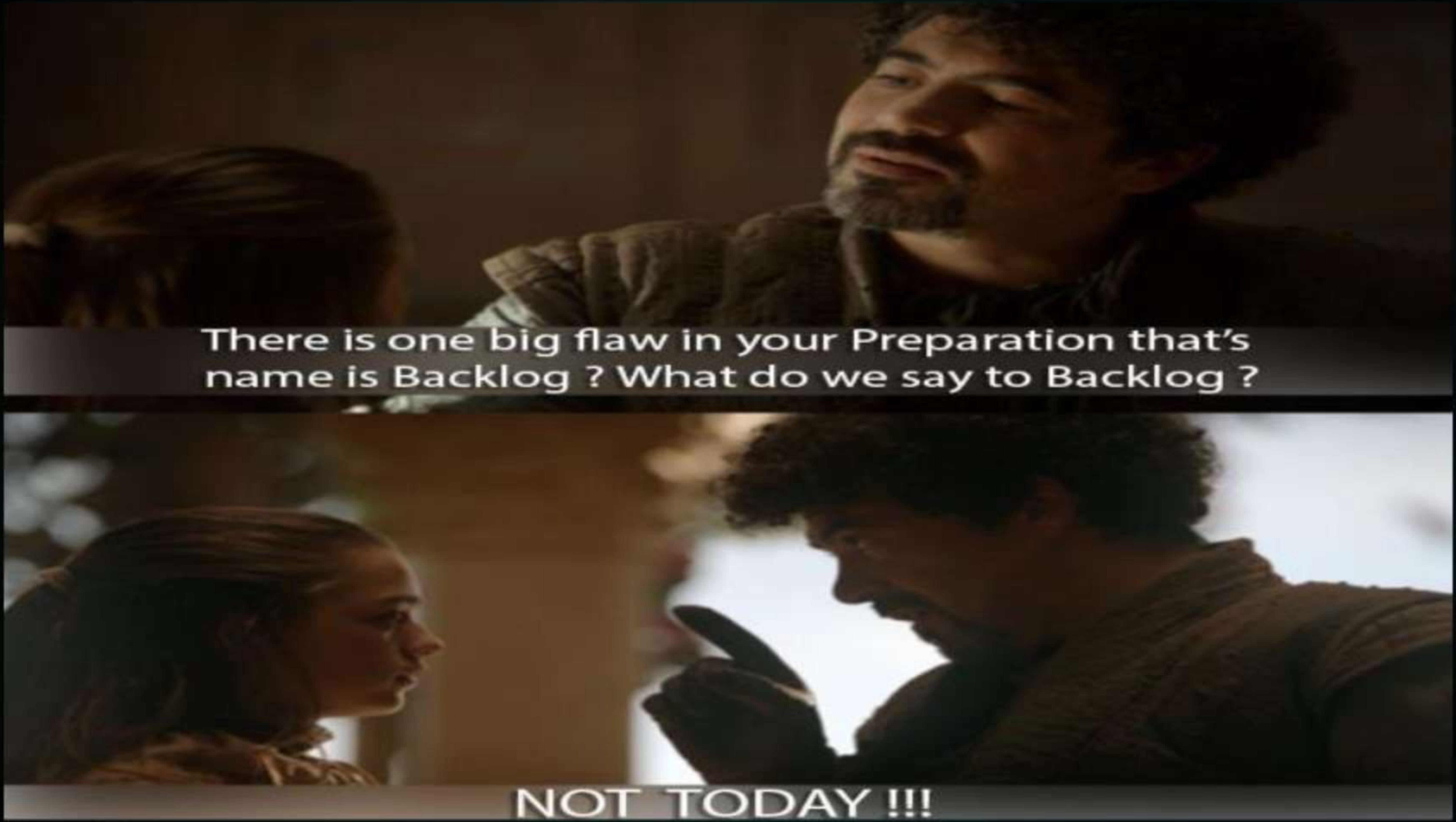
7. Don't watch the videos in high speed if you want to understand better.


There is one big flaw in your Preparation that's name is Backlog ? What do we say to Backlog ?
NOT TODAY !!!

Revision Of Last Class

Charle's law

$V \propto T$

$V = KT$

$\frac{V}{T} = K$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_t = V_0 + \frac{1}{273} \times V_0 \times t$

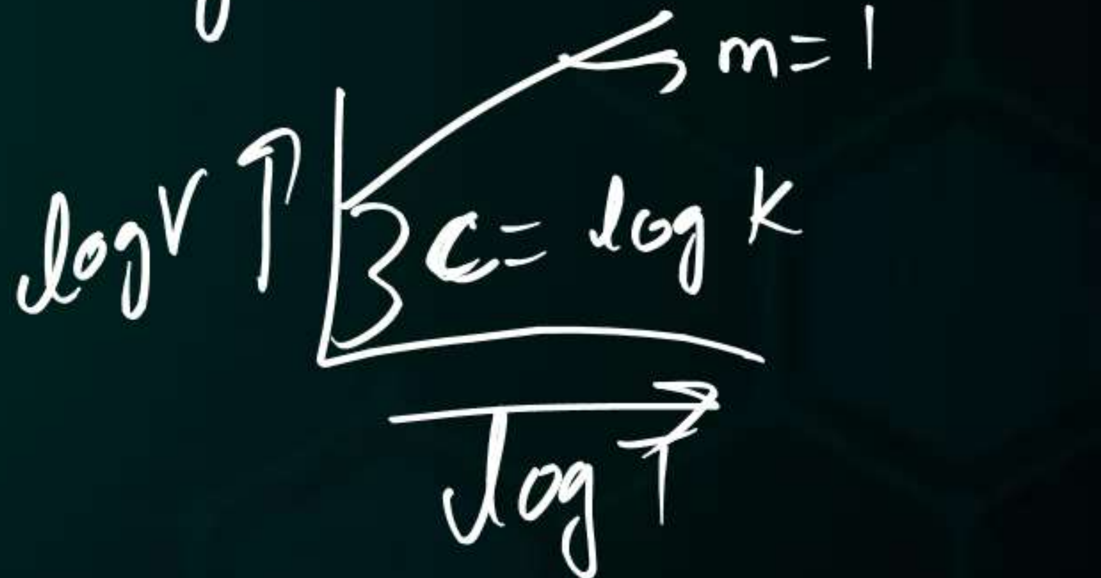
$t =$

$\frac{V}{T} = K$

$\log V - \log T = \log K$

$\log V = \log T + \log K$

$y = mx + c$



Amontor's law
V constt, mass of gas constt.

$P \propto T$

$P = KT$

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

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

Avogadro's law

↓ same T & P

V of gases ratio = moles of gases ratio
= molecules of gases ratio

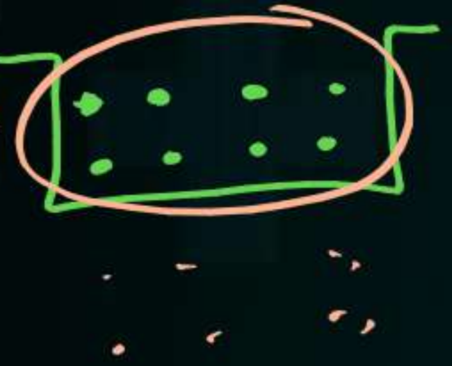
$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$PV = nRT$

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

Open Vessel Concept

P high
V low



$$PV = \text{Constt.}$$

n_1 = moles of gas present initially

T_1 = Temp. of gas initially

$$\Rightarrow PV = n_1RT_1 \quad \text{--- (1)}$$

V high
P low

$$PV = \text{Constt.}$$

n_2 = moles of gas present finally

T_2 = Temp. of gas finally

$$\Rightarrow PV = n_2RT_2 \quad \text{--- (2)}$$

$n_1 \cancel{R} T_1 = n_2 \cancel{R} T_2$

$$\frac{n_1 - n_2}{n_1} = \frac{w_1 - w_2}{w_1}$$

$$\frac{\frac{w_1}{M} - \frac{w_2}{M}}{\frac{w_1}{M}} = \frac{1 \cdot (w_1 - w_2) \times \cancel{M}}{\cancel{M} \times w_1}$$

MIT

① Open Vessel Concept:

$n_1 T_1 = n_2 T_2$ | $\frac{w_1}{\cancel{M}} T_1 = \frac{w_2}{\cancel{M}} T_2$

n_1 = moles of gas at Temp. T_1 (in Kelvin)

n_2 = 〰〰〰 T_2 ———

w_1 = mass of gas at Temp. T_1

w_2 = 〰〰〰 T_2

mass of gas escaped $= w_1 - w_2$

moles of gas escaped $= n_1 - n_2 = \frac{w_1}{M} - \frac{w_2}{M}$

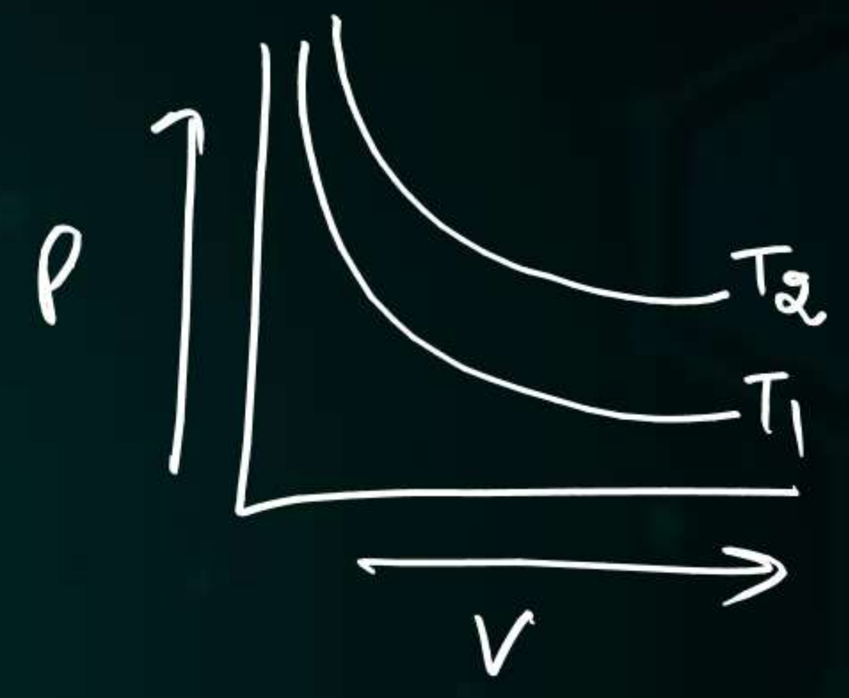
%age of moles of gas escaped $= \frac{n_1 - n_2}{n_1} \times 100$

%age of mass of gas escaped $= \frac{w_1 - w_2}{w_1} \times 100$

S.T.P. = Standard Temp. & Pressure.

T = 273 K

P = 1 atm → new NCERT P = 1 bar



S.A.T.P

↓

T = 298 K

P = 1 atm → new NCERT = 1 bar

Question

An open vessel at 27°C is heated until two fifth of the air (assumed as an ideal gas) in it has escaped from the vessel. Assuming that the volume of the vessel remains constant, the temperature at which the vessel has been heated is

(A) 750 K

(B) 500 K

(C) 750C

(D) 500C

$T = 27°C = 27 + 273 = 300\,K$

Let $n_1 = n$

$n_2 = \frac{n}{1} - \frac{2}{5}n$

$= \frac{5n - 2n}{5} = \frac{3n}{5}$

$T_2 = ?$

$n_1 T_1 = n_2 T_2$

$\cancel{n} \times \cancel{300}^{100} = \frac{\cancel{3}\cancel{n}}{5} \times T_2$

$T_2 = 500\,K$

Question

Open vessel has 200 mg of air at 17°C, what weight %age of air would be expelled in vessel is heated to 117°C.

Ans

$w_1 = 200\ mg$

$T_1 = 17°C = 273 + 17 = 290\ K$

$T_2 = 117°C = 273 + 117 = 390\ K.$

$w_1 T_1 = w_2 T_2$

$200 \times 29\cancel{0} = w_2 \times 39\cancel{0}$

$w_2 = \frac{200 \times 29}{39} = 148.72\ mg$

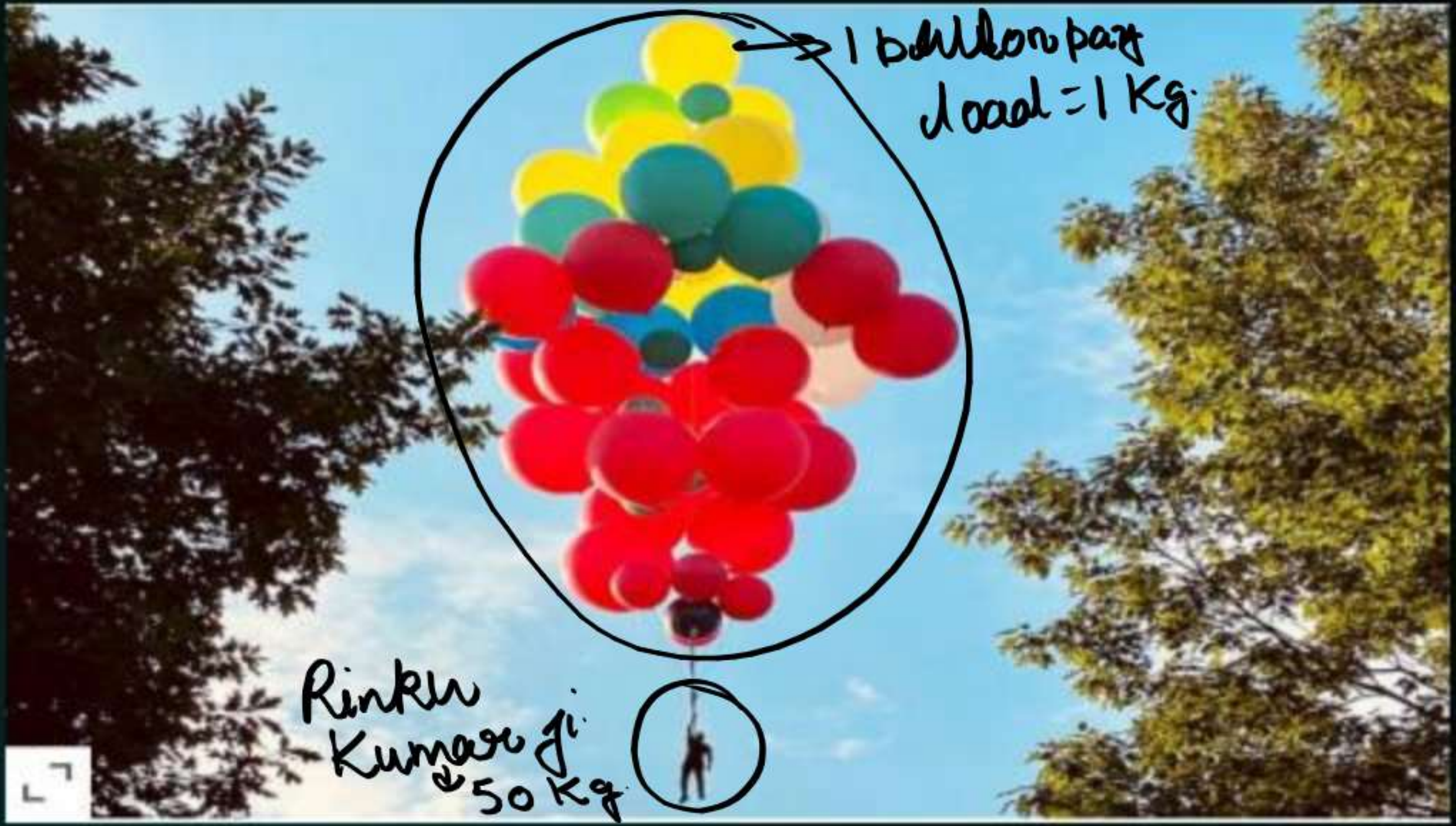
weight %age of air expelled $= \frac{w_1 - w_2}{w_1} \times 100$

$= \frac{200 - 148.72}{200} \times 100$

$= \frac{51.28}{2} = 25.64\ \%$

Pay Load

① Pay Load = Mass which Can be Carried by balloon in air with itself.



Pay Load = mass of ballon filled with air − mass of ballon filled with gas

#MI − = V of air × density of air − [mass of empty ballon + mass of gas filled in ballon]

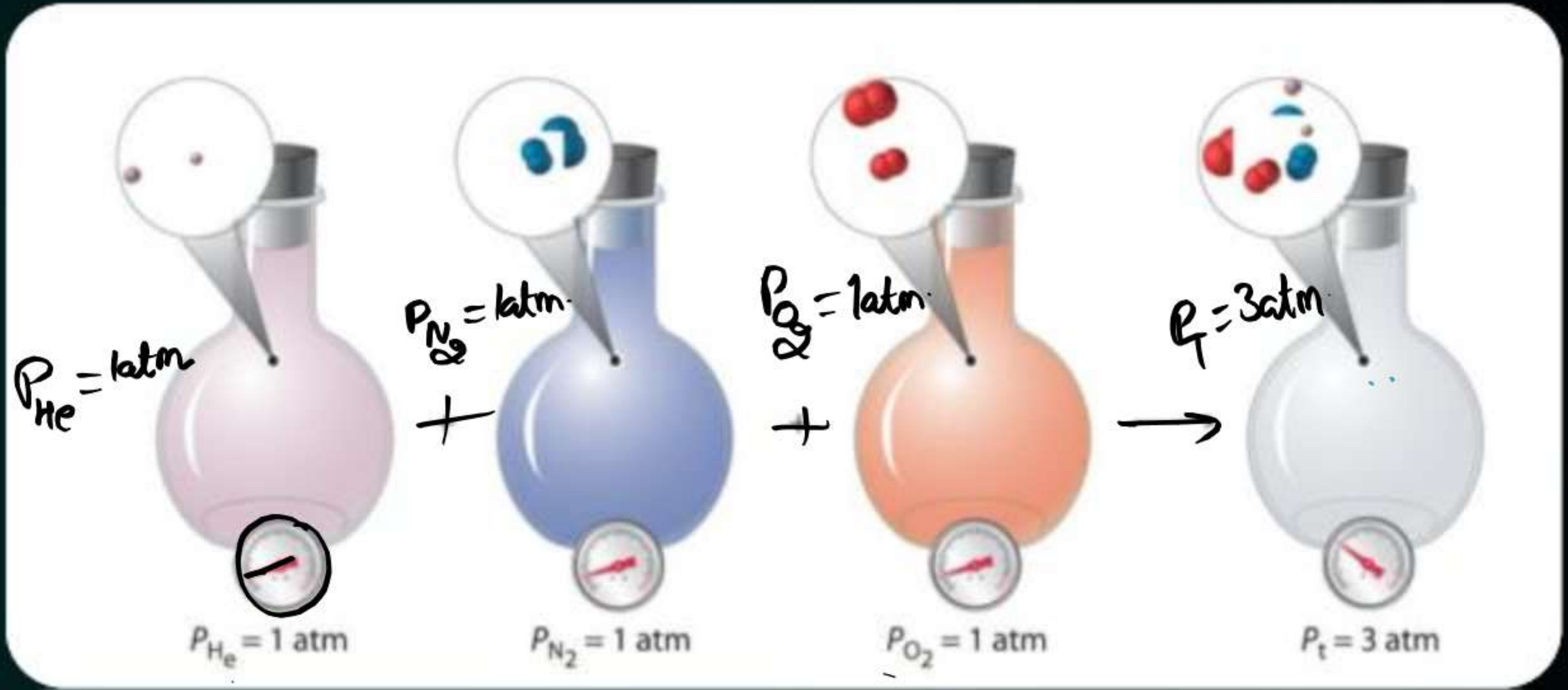
$$\boxed{\text{Pay Load} = V \text{ of ballon} \times \text{density of air} - [\text{mass of empty ballon} + \text{mass of gas filled in ballon}]}$$

Dalton's Law of Partial Pressure

(1) Total P of gas
= Sum of Partial P of
each gas.

$$P_T = P_{He} + P_{N_2} + P_{O_2}$$

(2) P_{He} = Partial P of He.
P_{N_2} = ________ N_2
P_{O_2} = ________ O_2
P_T = Total Pressure.



$n_T = n_A + n_B$

$A(g)$ & $B(g)$

$\downarrow \qquad \downarrow$

$n_A \qquad n_B$

P_A = Partial P of A

$P_A V = n_A RT$ — ①

$P_B V = n_B RT$ — ②

$P_T V = n_T RT$ — ③

Divide ① by ③

$$\frac{P_A \cancel{V}}{P_T \cancel{V}} = \frac{n_A \cancel{R} \cancel{T}}{n_T \cancel{R} \cancel{T}}$$

$$\frac{P_A}{P_T} = \frac{n_A}{n_T}$$

$$\frac{P_A}{P_T} = \frac{n_A}{n_A + n_B}$$

$$\frac{P_A}{P_T} = x_A = Y_A$$

$$P_A = Y_A P_T$$

$$P_A = x_A P_T$$

solution

$$P_A = Y_A P_S$$

P_A = Partial P of A

$P_T = P_S$ = Total Pressure

$x_A = Y_A$ = Mole fraction of A in gas

$$P_B = Y_B P_T$$

MIT

① Partial P of gas = Mole fraction of gas × Total Pressure

② Dalton's law not applicable for reacting gases

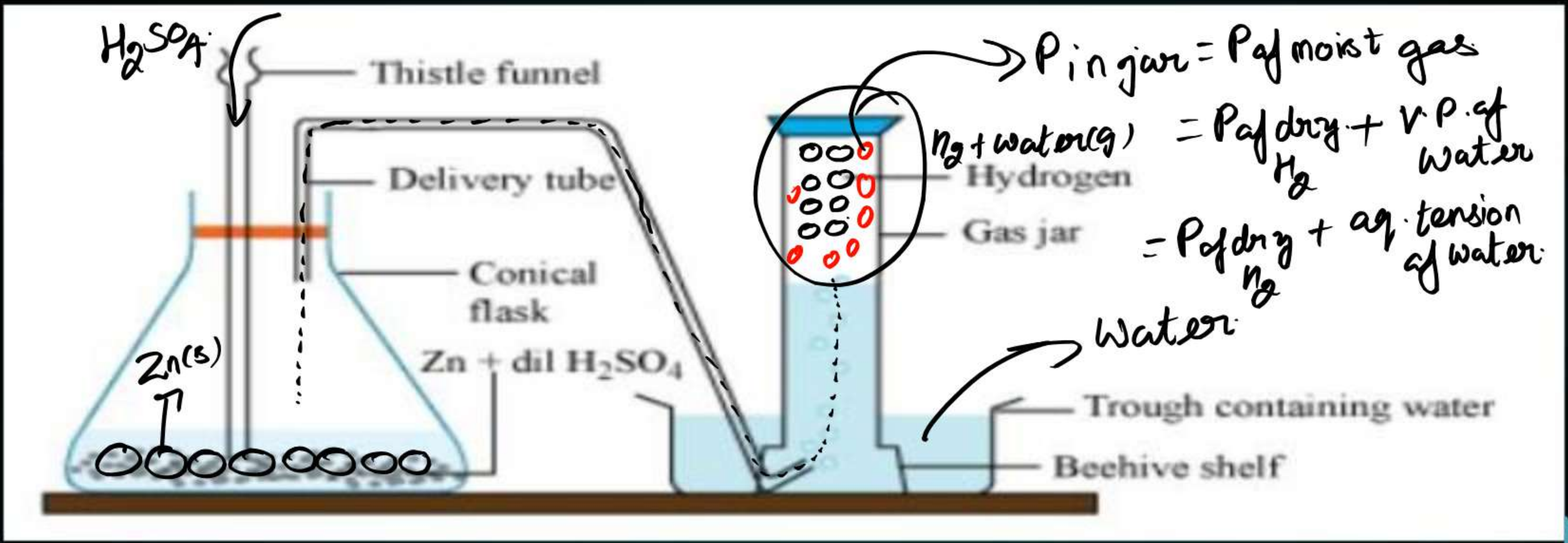
$$1H_2(g) + 1Cl_2(g) \xrightarrow{h\nu} 2HCl(g)$$

③ P of dry gas = P of moist gas − Aq. tension

P of dry gas → Used in numericals

P of moist gas → Total P

Aq. tension → V.P. of H_2O



P in jar = P of moist gas

= P of dry H_2 + V.P. of water

= P of dry H_2 + aq. tension of water.

$$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2(g)$$

P of moist H_2 = P of dry H_2 + aq. tension

P of dry H_2 = P of moist H_2 − aq. tension

Question

To which of following pair Dalton's law of partial pressure is not applicable:

A $He + Ne$

B $N_2 + O_2$

C $H_2 + Cl_2 \xrightarrow{h\nu} 2HCl$

D $Ar + F_2$

Question

Neon-Cl_2 mixture has 142 g of Cl_2 and 80 g of Ne. If pressure of mixture of gases is 20 bar, what is partial pressure of Cl_2 and Ne in mixture (Atomic mass of Ne = 20 g) G.M.M. of Cl_2 = 71g.

Ans

$w_{Cl_2} = 142g$ | $n_{Cl_2} = \frac{142}{71} = 2$

$w_{Ne} = 80g$ | $n_{Ne} = \frac{80}{20} = 4$

$P_T = 20$ bar

$P_{Cl_2} = x_{Cl_2} \times P_T$

$P_{Ne} = x_{Ne} \times P_T$

$x_{Cl_2} = \frac{2}{2+4} = \frac{2}{6}$

$x_{Ne} = \frac{4}{6} =$

$P_{Cl_2} = \frac{\cancel{2}}{\cancel{6}_3} \times 20 = 6.66$ bar

$P_{Ne} = \frac{\cancel{4}^{2}}{\cancel{6}_3} \times 20 = 13.34$ bar

$P_{Cl_2} = 6.66$ bar

$P_{Ne} = 20 - 6.66$

$= 13.34$ bar

Question

30 ml of moist H_2 is collected over water at 27^0C and 750 mm of pressure. Calculate volume of gas at 0^0C and 760 mm of pressure. If aqueous tension of H_2O is 30 mm Hg at 27^0C

Ans $V_{1H_2} = 30 ml$

$T_1 = 27^\circ C = 300 K$

$P_{\text{of moist } H_2} = 750$ mm of Hg

Aq. tension = 30 mm of Hg

$P_{\text{of dry gas}} = 750 - 30$

$P_1 = 720$ mm of Hg

$V_2 = ?$

$T_2 = 0^\circ C = 273 K$

$P_2 = 760$ mm of Hg

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1}$$

$$V_2 = \frac{72\cancel{0} \times \cancel{30} \times 273}{76\cancel{0} \times \underset{10}{\cancel{300}}} = 25.86\, ml$$

Question

Equal weight of H_2 and CH_4 are mixed in container at 25^0C. Calculate fraction of total pressure exerted by H_2?

$\frac{8}{9}$

Ans G.M.M. of $H_2 = 2g$

——— $CH_4 = 16g$

L.C.M. of H_2 & CH_4 G.M.M $= 16g$.

$n_{H_2} = \frac{16}{2} = 8$

$n_{CH_4} = \frac{16}{16} = 1$

$x_{H_2} = \frac{8}{8+1}$

$= \frac{8}{9}$

$\frac{P_{H_2}}{P_T} = ?$

$P_{H_2} = x_{H_2} \times P_T$

$\frac{P_{H_2}}{P_T} = x_{H_2} = \frac{8}{9} = 0.88$

Question

A mixture of one mole each of H_2, He and O_2 each are enclosed in a cylinder of volume, V at temperature T. If the partial pressure of H_2 is 2 atm, the total pressure of the gases in the cylinder is

A 14 atm

B 38 atm

C 22 atm

D 6 atm

$n_{H_2} = n_{He} = n_{O_2} = 1$

$P_{H_2} = 2\,atm$

$P_T = ?$

$P_{H_2} = x_{H_2} P_T$

$\frac{P_{H_2}}{x_{H_2}} = P_T$

$x_{H_2} = \frac{1}{1+1+1} = \frac{1}{3}$

$\frac{2 \times 3}{1} = P_T$

$P_T = 6\,atm$

How to improve efficiency

1 hr.
20min - 30min.

MOBILE ADDICTION

All Class over
DPP. solve
Revision + Practice

NO MOBILE IN YOUR ROOM

25min

1. Focus mode
2. Flipp. app / Focus app

Home Work From Module

Exercise-1 (Topicwise)

Q 8 to Q 27

Exercise-2 (Learning Plus)

Q 3, Q 6

Question

H.W.

A container contains CH_4 and SO_3 in 3 : 5 weight ratio. Calculate ratio of $P_{CH_4} : P_{SO_3}$?

G.M.M. of $CH_4 = 16\,g$

——— $SO_3 = 80\,g$.

Question

H.W.

An open flask contains air at 27°C. Calculate temperature which it should be heated so that $1/3^{rd}$ of air measured at 27°C escapes out?

Question H.W.

At which of the following four conditions, the density of an ideal gas will be maximum?

A. 0°C and 0.1 atm.

B. 0°C and 0.2 atm.

C. 273°C and 0.1 atm.

D. 273°C and 0.2 atm.

Question H.W.

The molar volume of CO_2 is maximum at

A 273 K and 1 atm

B 546 K and 1 atm

C 273 K and 2 atm

D 546 K and 2 atm

Question H.W

The ratio of universal gas constant and molar mass of gas is called molar gas constant. The value of molar gas constant is greater for

A He

B N_2

C H_2

D Same for all

Question

H.W. $\Rightarrow$ V of balloon = sphere volume = $\frac{4}{3}\pi r^3$

A balloon of diameter 20 m weighs 100 kg. Calculate pay load if it is filled with He at 1 atm and 27°C. Density of air is 1.2 kg/m^3. (R = 0.082 dm^3 atm K^{-1} mol^{-1})

Thank You

YAKEEN 2.0

NEET 2024

- Subject – Physical Chemistry
- Chapter – States of Matter

Lecture No.- 5

By: Amit Mahajan Sir

Today's Targets

1. Revision Of Last Class
2. Diffusion, Effusion
3. PYQ on these topics
4. Home Work discussion & Home Work

Rules to attend class

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2. Never ever attend a class from in between or don't join a live class in the middle of the chapter.
3. Make sure to revise the last class before attending the next class & always complete your home work along with DPP.
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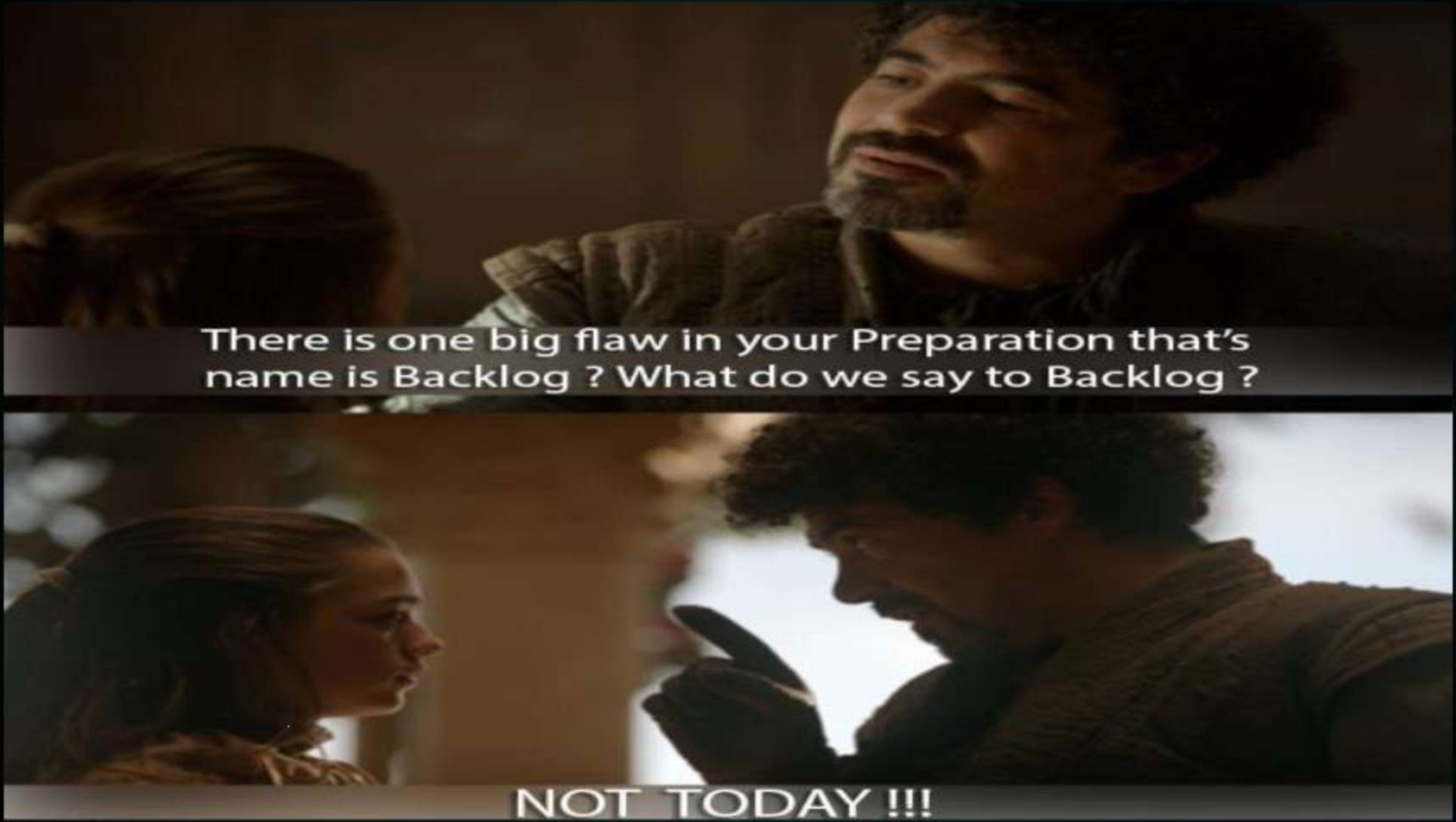
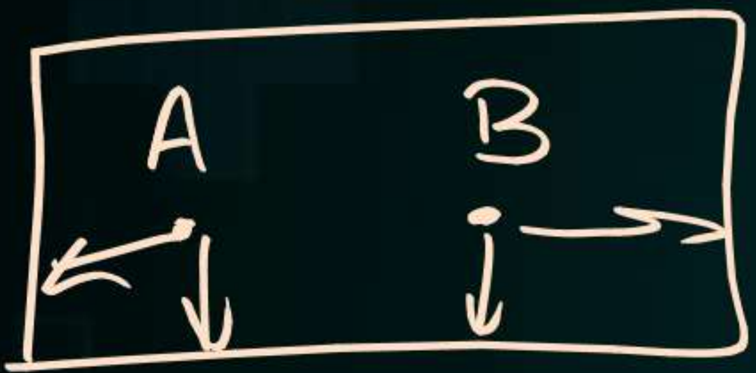

There is one big flaw in your Preparation that's
name is Backlog ? What do we say to Backlog ?
NOT TODAY !!!

Revision Of Last Class

Dalton's law of Partial Pressure :



Total Pressure = $P_T = P_A + P_B$

Law applicable to non-reacting gases.

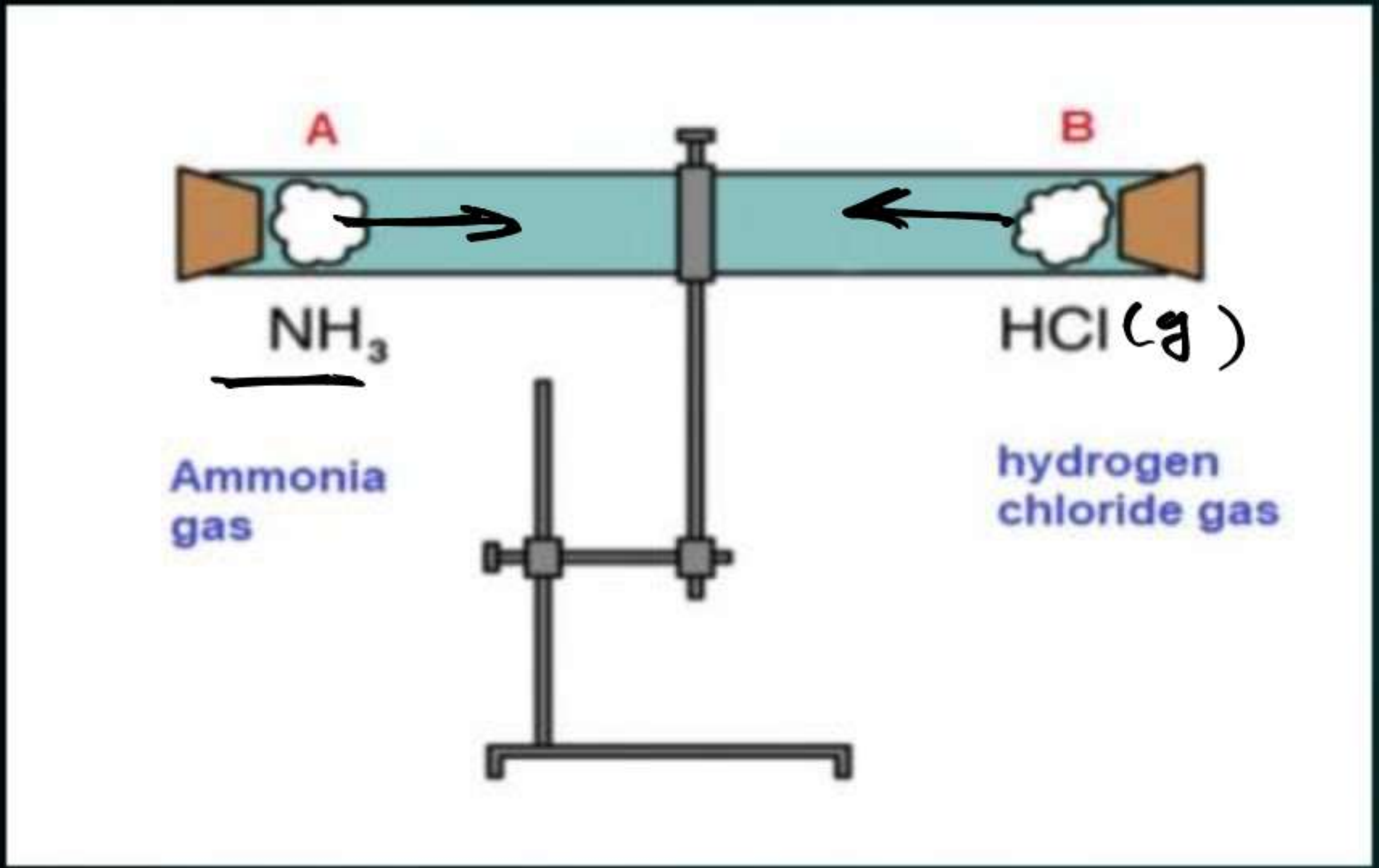
(1) $P_A = x_A P_T$

(2) P of moist gas = P of dry gas + V. P. of water (aqueous tension)

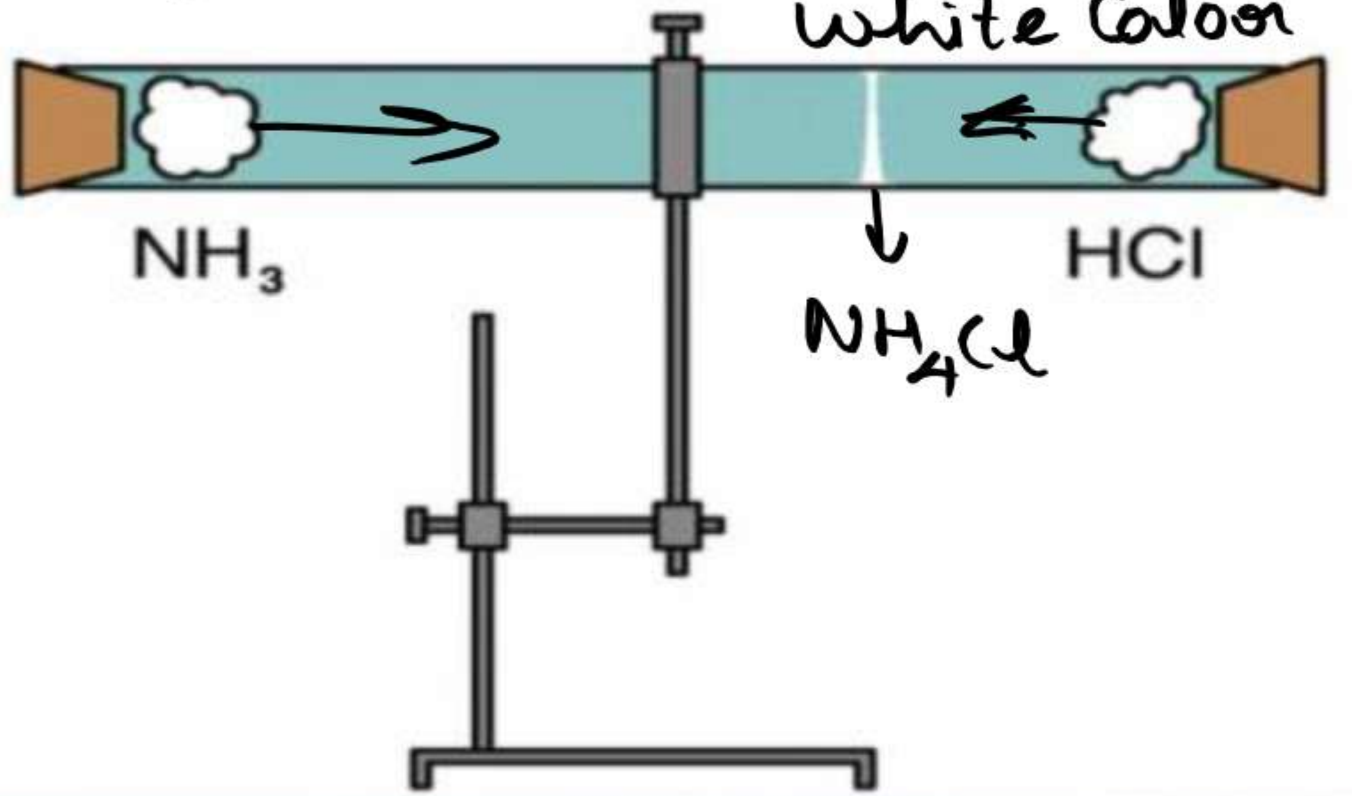
P of dry gas = P of moist gas − aqueous tension.

Diffusion

→ intermixing of gases



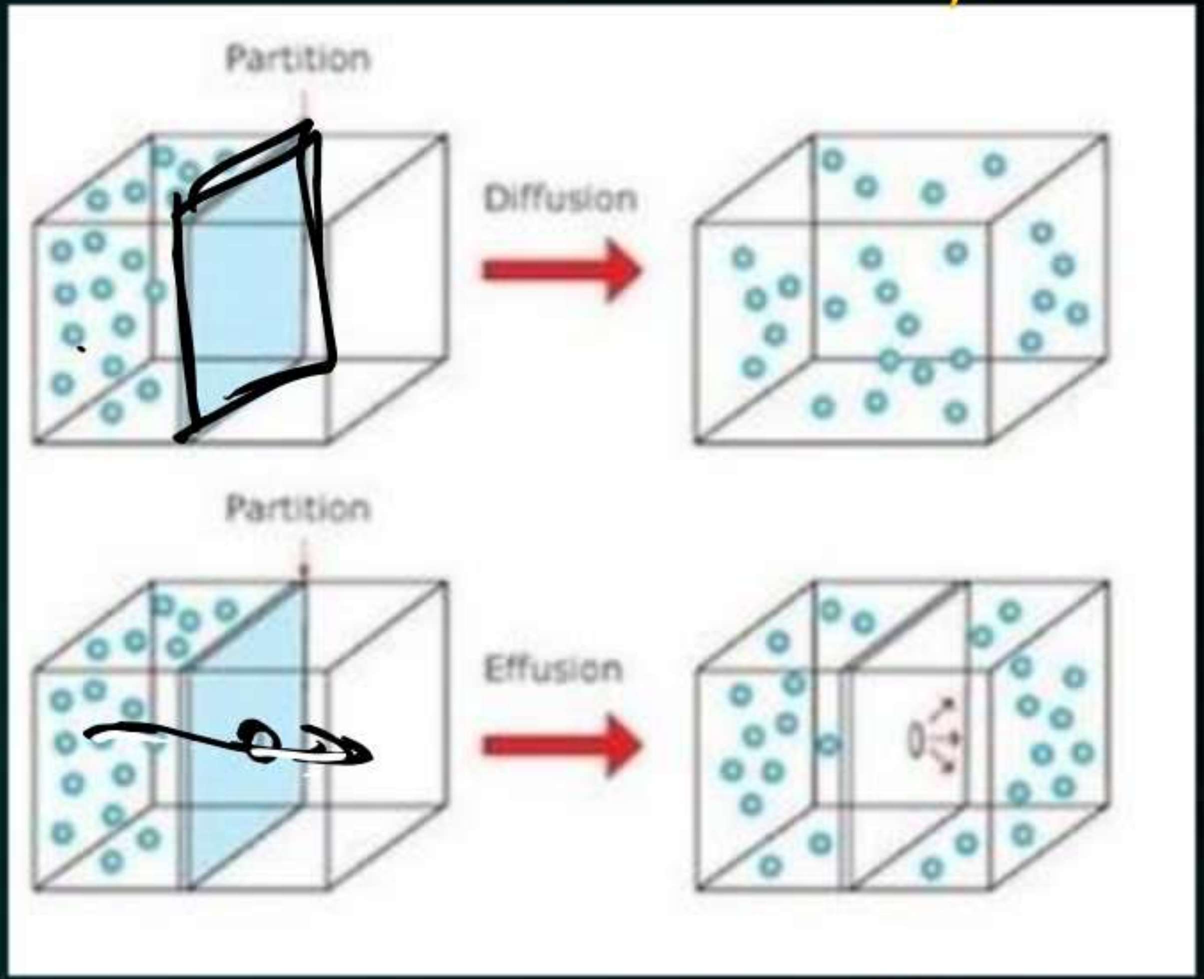
$NH_3 + HCl \rightarrow \underline{NH_4Cl}$ fumes
White Colour



Effusion

↓

Intermixing of gases



Graham's Law of Diffusion

$A_{(g)}$ & $B_{(g)}$

$n_A = n_B$

$P_A = P_B$

$T_A = T_B$

rate of diffusion $(r^t) \propto \dfrac{1}{\sqrt{\text{Molar mass of gas}}}$

$$r_A \propto \frac{1}{\sqrt{M_A}} \Rightarrow r_A = \frac{K}{\sqrt{M_A}} \quad \text{— (1)}$$

$$r_B \propto \frac{1}{\sqrt{M_B}} \Rightarrow r_B = \frac{K}{\sqrt{M_B}} \quad \text{— (2)}$$

$$\frac{r_A}{r_B} = \frac{\sqrt{M_B}}{\sqrt{M_A}} = \sqrt{\frac{M_B}{M_A}} \quad \text{— (3)}$$

G.M.M. = 2 × vapour density

$$M = 2 \times V.D.$$

$$M_A = 2 \times (V.D.)_A$$

$$M_B = 2 \times (V.D.)_B \quad \text{— (4)}$$

$$\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{\cancel{2} \times (V.D)_B}{\cancel{2} \times (V.D)_A}}$$

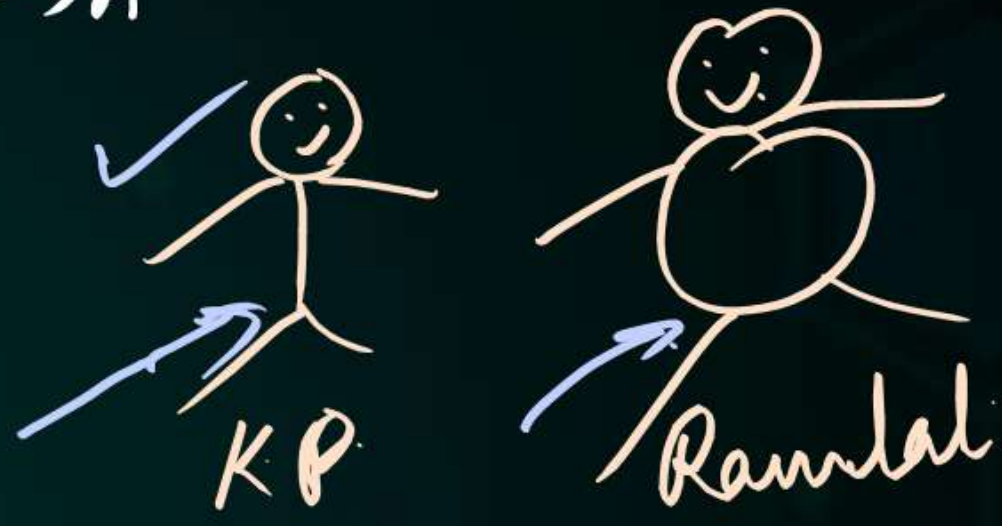
$$\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{(V.D)_B}{(V.D)_A}}$$

MJT

(1)

$$\boxed{\begin{array}{c} A \ \& \ B \\ n_A = n_B \\ P_A = P_B \\ T_A = T_B \end{array}}$$

$$\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{(V.D.)_B}{(V.D.)_A}}$$



(2) r^t of diffusion $\propto \frac{1}{\sqrt{\text{Molar mass}}}$

(3) Gases with lower Molar mass $\Rightarrow$ has higher rate of diffusion.

—— Higher ,, ,, $\Rightarrow$ has lower ——

$$\boxed{\begin{array}{l} A \ \& \ B \\ n_A = n_B \\ T_A = T_B \\ P_A = P_B \end{array}}$$

Rakhi SaVaNT

$n'_A = 1\ \text{mol}$ (A) $\qquad$ (B) $n'_B = 2\ \text{mol}$

$t_A = t_B = 20\ \text{min.}$

#MIT

(4) r^t of diffusion.

$$\frac{r_A}{r_B} = \frac{S_A \times t_B}{t_A \times S_B} = \frac{V_A \times t_B}{t_A \times V_B} = \frac{n'_A \times t_B}{t_A \times n'_B} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{(V.D)_B}{(V.D)_A}}$$

s_A = distance travelled by gas A

s_B = ———————— B

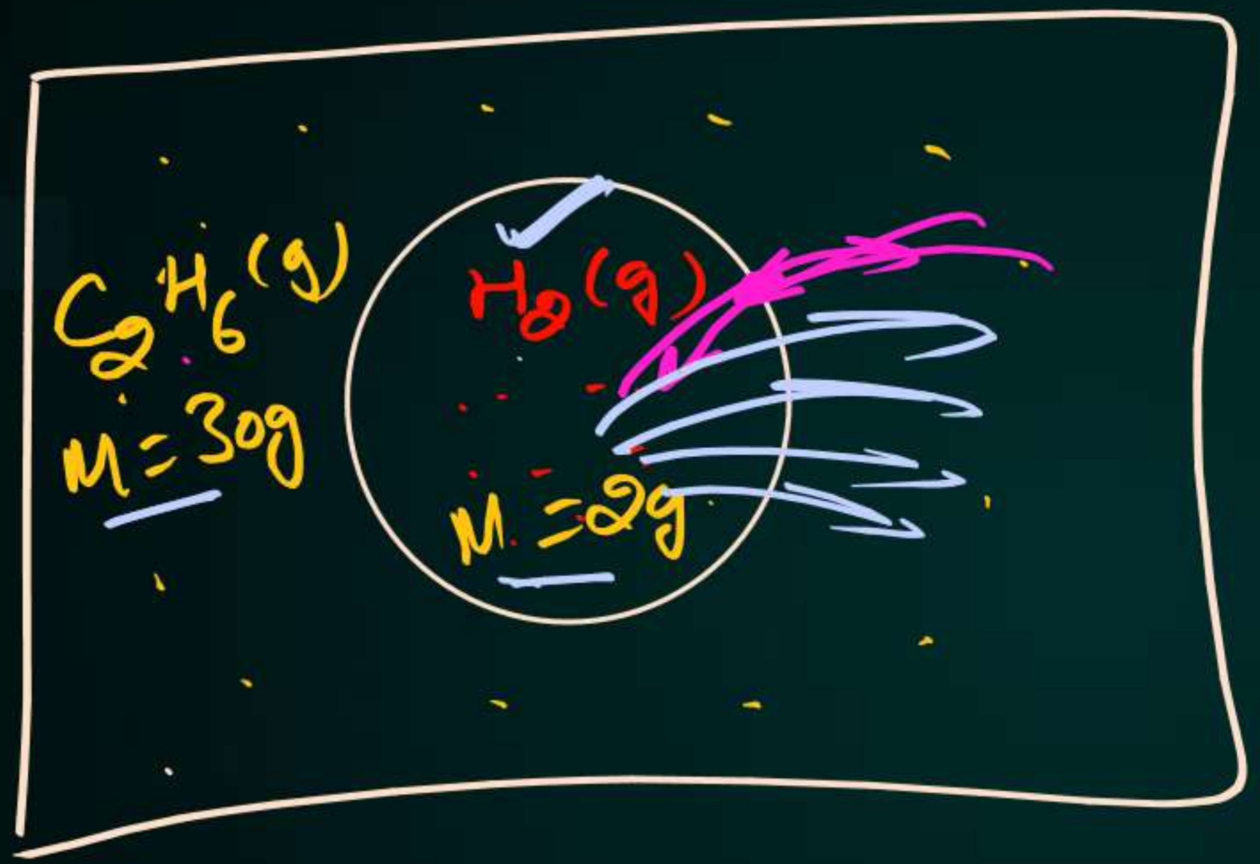
V_A = Volume of gas A diffused

V_B = ———————— B ————

n'_A = moles of gas A diffused.

n'_B = ———————— B ————

Q. On pricking the ballon size of ballon will



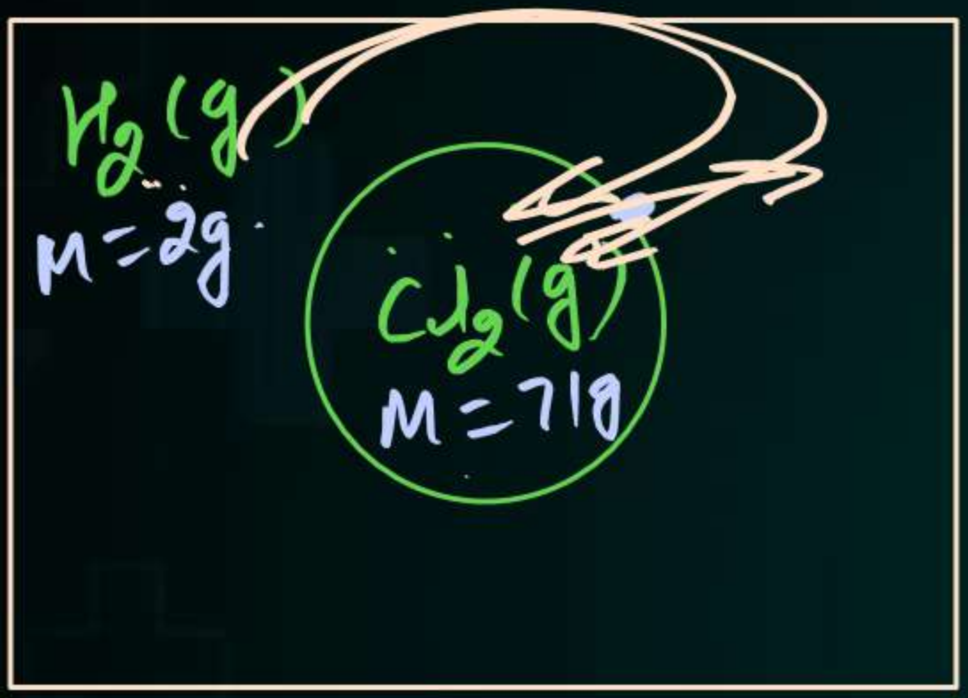
(a) increase

(b) decrease

(c) remain same

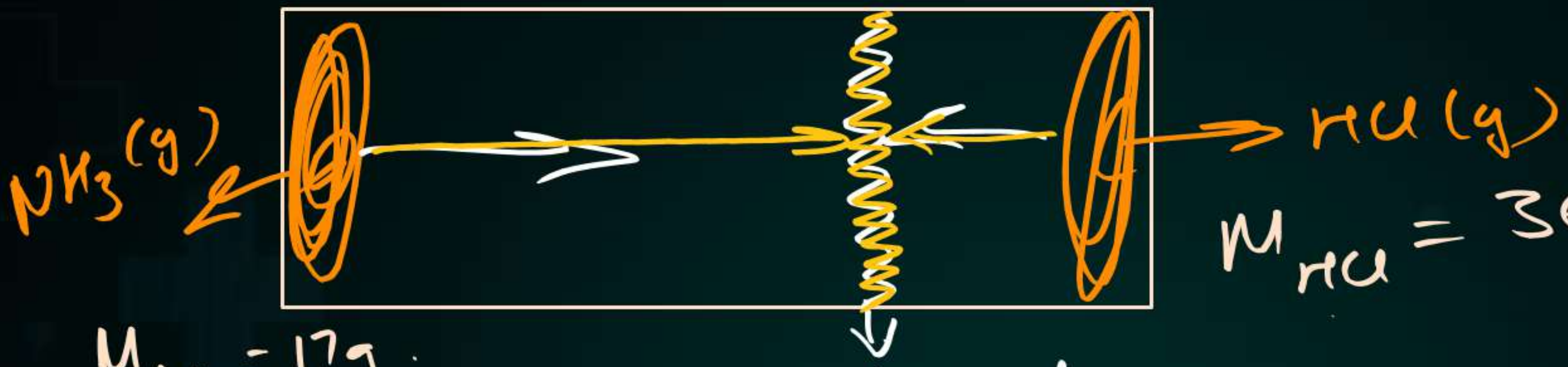
(d) None of these

Q/ on pricking the balloon size will.



increase due to high rate of diffusion of H_2

Q/



$M_{HCl} = 36.5 g$.

$M_{NH_3} = 17 g$.

White fumes of NH_4Cl

G.M.M. less ⇒ r^t of diffusion more

At which end, white fumes of NH_4Cl first?

(a) Middle of tube (b) Near HCl end

(c) Near NH_3 end (d) None of these.

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(5) if $t_A = t_B$

$$\frac{r_A}{r_B} = \frac{s_A}{s_B} = \frac{V_A}{V_B} = \frac{n'_A}{n'_B} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{(V.D)_B}{(V.D)_A}}$$

(6) if $s_A = s_B$ or $V_A = V_B$ or $n'_A = n'_B$

$$\frac{r_A}{r_B} = \frac{t_B}{t_A} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{(V.D)_B}{(V.D)_A}}$$

Question

Equal volume of 2 gases A and B diffuse through a hole in 20 and 10 seconds. If molar mass of A is 80, calculate molar mass of B.

Ans

$V_A = V_B$

$t_A = 20$ sec.

$t_B = 10$ sec.

$M_A = 80$ g/mol.

$M_B = ?$

$$\frac{r_A}{r_B} = \frac{t_B}{t_A} = \sqrt{\frac{M_B}{M_A}}$$

$$\frac{\cancel{10}}{\cancel{20}} = \sqrt{\frac{M_B}{80}}$$

$$(\sqrt{2})^2 = 2$$

Squaring both sides

$$\frac{1}{4} = \frac{M_B}{80}$$

$$M_B = \frac{80}{4} = 20 \text{ g/mol}$$

Question

In a glass tube of uniform cross section, a mixture of HCl and He gases are sent from one end and a mixture of NH_3 and Ar gases are sent from the another end at the same time. The white fumes of NH_4Cl will appear first

A At the middle of the tube.

B Closer to NH_3 end.

C Closer to HCl end.

D At the NH_3 end.

Question

At room temperature, $NH_3(g)$ and $HX(g)$ are passed into a 1m long tube from two opposite ends at the same pressure. The formation of $NH_4X(s)$ will be closest from the injection of HX end when HX is

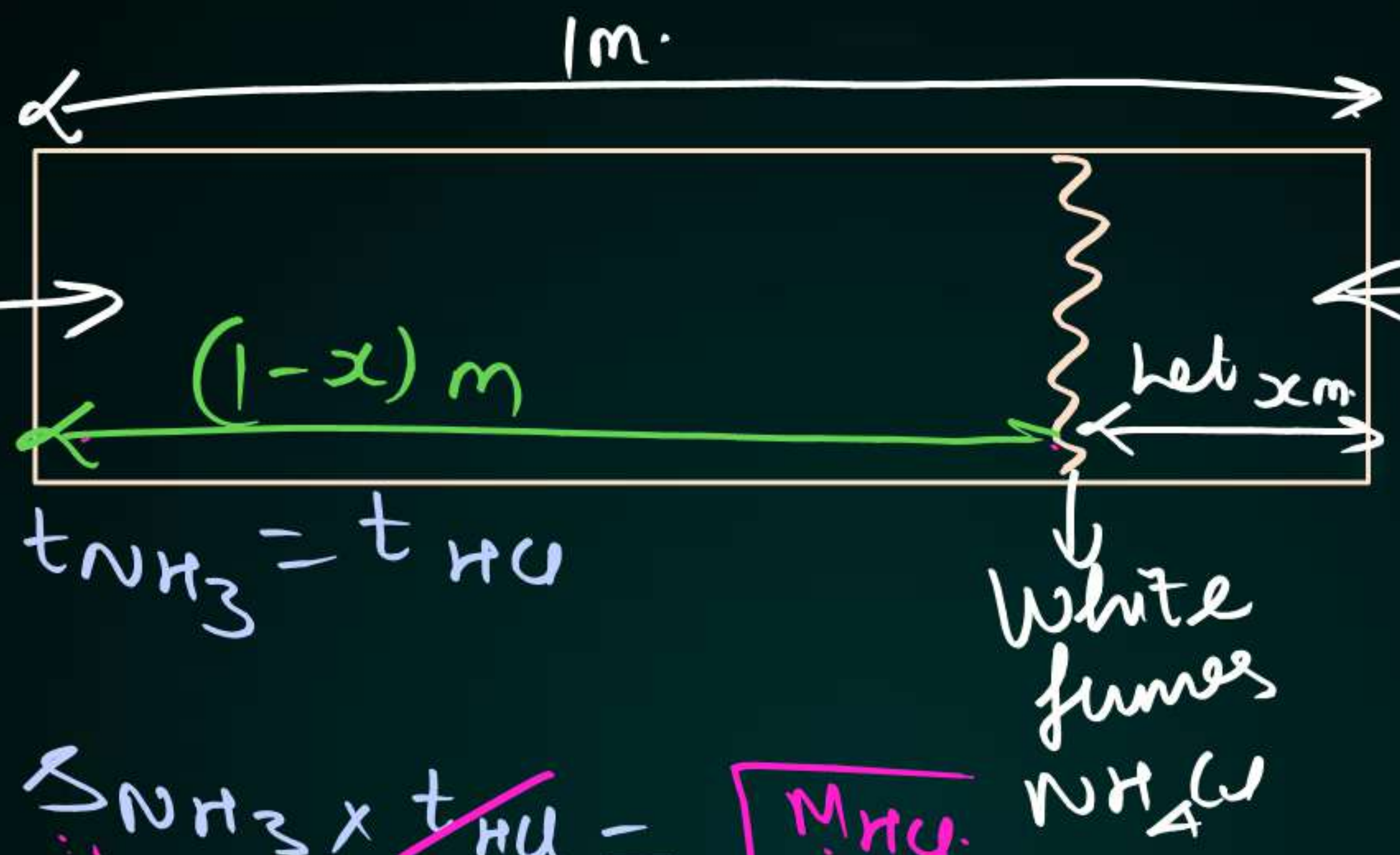
(A) HF

(B) HCl

(C) HBr

(D) HI → G.M.M. Highest.

Q1



$M_{NH_3} = 17g$

$M_{HCl} = 36.5g$

$t_{NH_3} = t_{HCl}$

$$\frac{r_{NH_3}}{r_{HCl}} = \frac{S_{NH_3} \times \cancel{t_{HCl}}}{\cancel{t_{NH_3}} \times S_{HCl}} = \sqrt{\frac{M_{HCl}}{M_{NH_3}}}$$

$$\frac{1-x}{x} = \sqrt{\frac{36.5}{17}} \rightarrow \text{Squaring both sides}$$

$$\frac{(1-x)^2}{x^2} = \frac{36.5}{17}$$

$$17\left[(1-x)^2\right] = 36.5x^2$$

$$17\left[1+x^2-2x\right] = 36.5x^2$$

$$17+17x^2-34x = 36.5x^2$$

$$17-34x+17x^2-36.5x^2 = 0$$

$$17-34x-19.5x^2 = 0$$

quadratic eqn.

solve it.

Question

Amit Mahajan Sir

L.G. → $M_{L.G.} = 44$

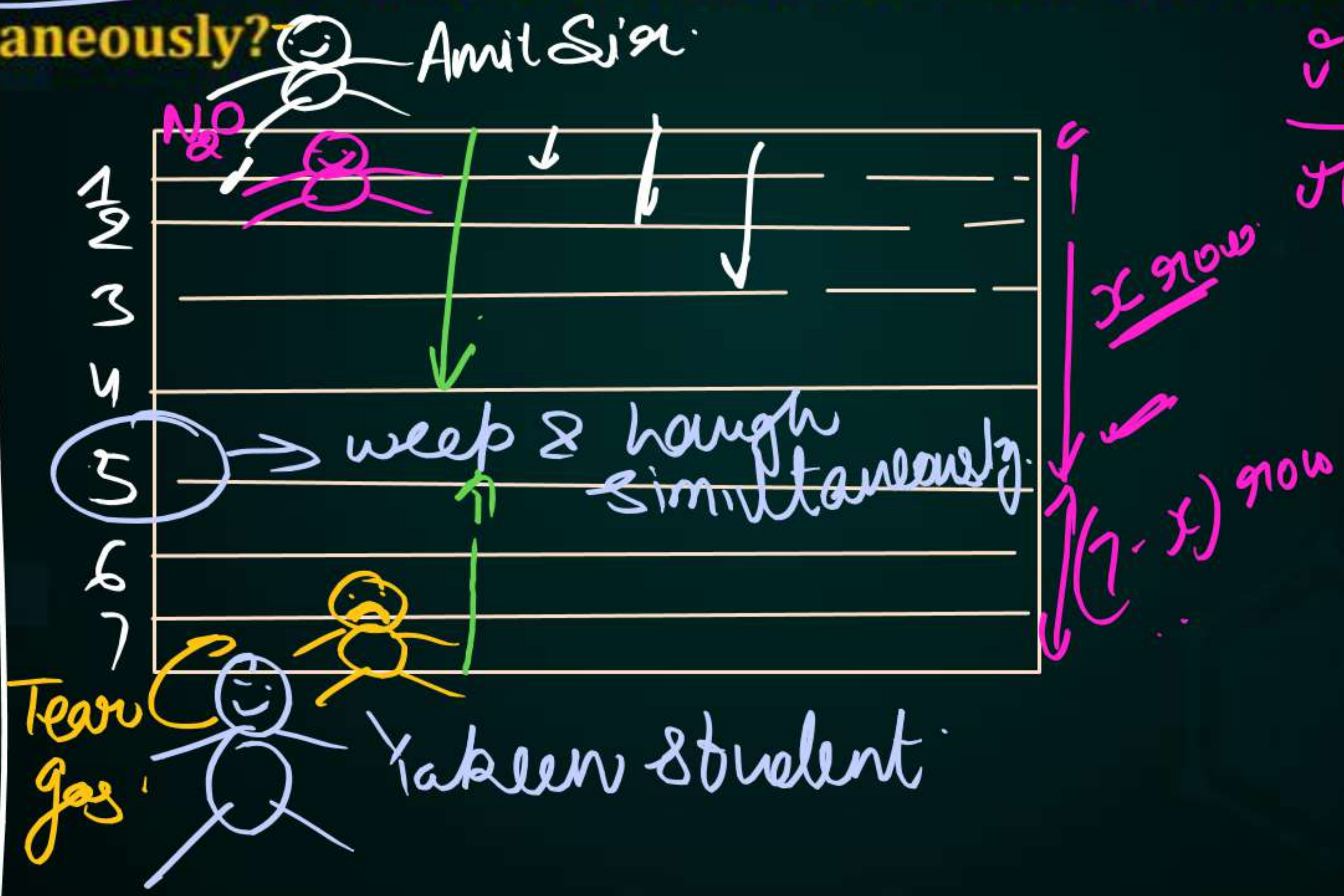
A class consists of 7 rows. The teacher releases laughing gas N_2O from the front row and mischievous student releases a tear gas molecular weight 176 from the rear end. The student of which row from the first will weep and smile simultaneously?

A) Fifth

B) First

C) Second

D) Third



$$\frac{r_{l.g.}}{r_{T.g.}} = \frac{x}{7-x} = \sqrt{\frac{M_{T.G}}{M_{L.G}}}$$

$$\frac{x}{7-x} = \sqrt{\frac{\cancel{176}\,4}{\cancel{44}}}$$

$$\frac{x}{7-x} = \sqrt{4} = \frac{2}{1}$$

$$\frac{x}{(7-x)} = \frac{2}{1}$$

$$14 - 2x = x$$

$$14 = 3x$$

$$x = \frac{14}{3} \approx 5$$

Question

A gas with formula C_nH_{2n+2} diffuses through the porous plug at a rate one-sixth of the rate of diffusion of hydrogen gas under similar conditions. The formula of gas is

gas

A C_2H_6

B $C_{10}H_{22}$

C C_5H_{12}

$M_{gas} = 72g.$

D C_6H_{14}

$$r_{gas} = \frac{1}{6} r_{H_2} \Rightarrow \frac{r_{gas}}{r_{H_2}} = \frac{1}{6}$$

$$\frac{r_{gas}}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{gas}}}$$

$$M_{H_2} = 2g.$$

$$\frac{1}{6} = \sqrt{\frac{2}{M_{gas}}}$$

Squaring Both sides

$$\frac{1}{36} = \frac{2}{M_{gas}}$$

$$M_{gas} = 72g.$$

A & B

$r_A \neq r_B$

$P_A \neq P_B$

$$\frac{r_A}{r_B} = \sqrt{\frac{T_A M_B}{T_B M_A}}$$

at same Pressure

PARiTaM

MIT

$$\frac{r_A}{r_B} = \frac{P_A}{P_B}\sqrt{\frac{M_B}{M_A}}$$

at same Temp.

$$\frac{r_A}{r_B} = \frac{A_A}{A_B}\sqrt{\frac{M_B}{M_A}} \rightarrow T \,\&\, P \text{ constt.}$$

A_A = area from which A gas escape

A_B = ______ B ______

Bucket list
↓
Nakamyab log → Present → Man → Man marji
↓
responsible for failure.

Kamyab log → absent

Yakeen 1.0
↓
Yakeen 2.0
↳ Yakeen 3.0 → Yakeen fast track
↓
NEET Ultimate Crash Course
↓
Umeed 4.0
↓
Maha revision
↓
Exam

1 Lakh → 100 student → Man karta hai Padne ka.
↳ 4000 student → selection
↓
3900 students → Man nahi karta Padne ko.

96000 Student
↓
Majority.

Q. Find the Correct relation?

(a) $r^t \propto P\sqrt{M}$

(b) $r^t \propto \frac{P}{\sqrt{M}}$

(c) $r^t \propto P \times M$

(d) $r^t \propto \frac{P}{M}$

Q. find Correct relation?

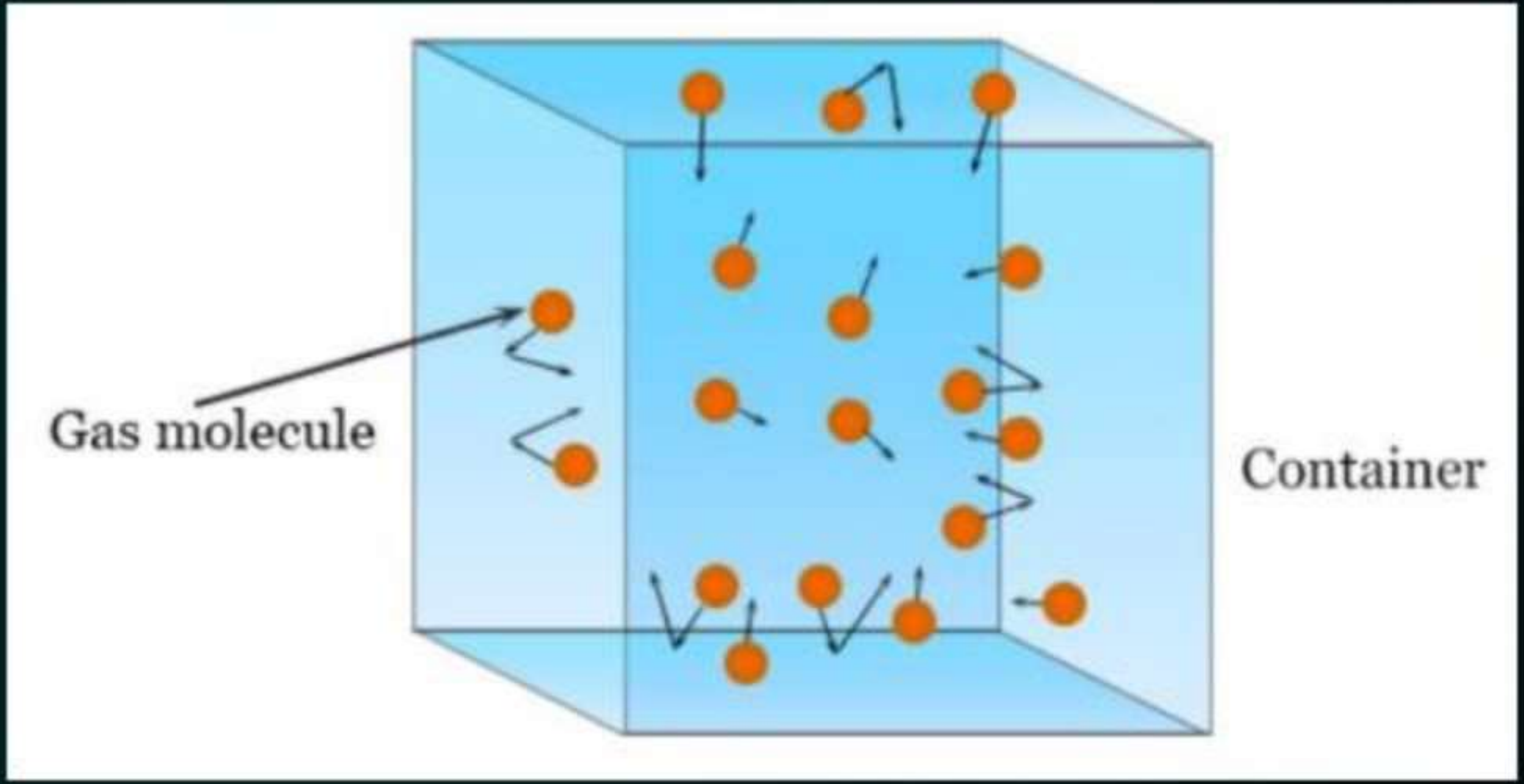
(a) $r^t \propto \sqrt{\frac{T}{M}}$

(b) $r^t \propto \sqrt{TM}$

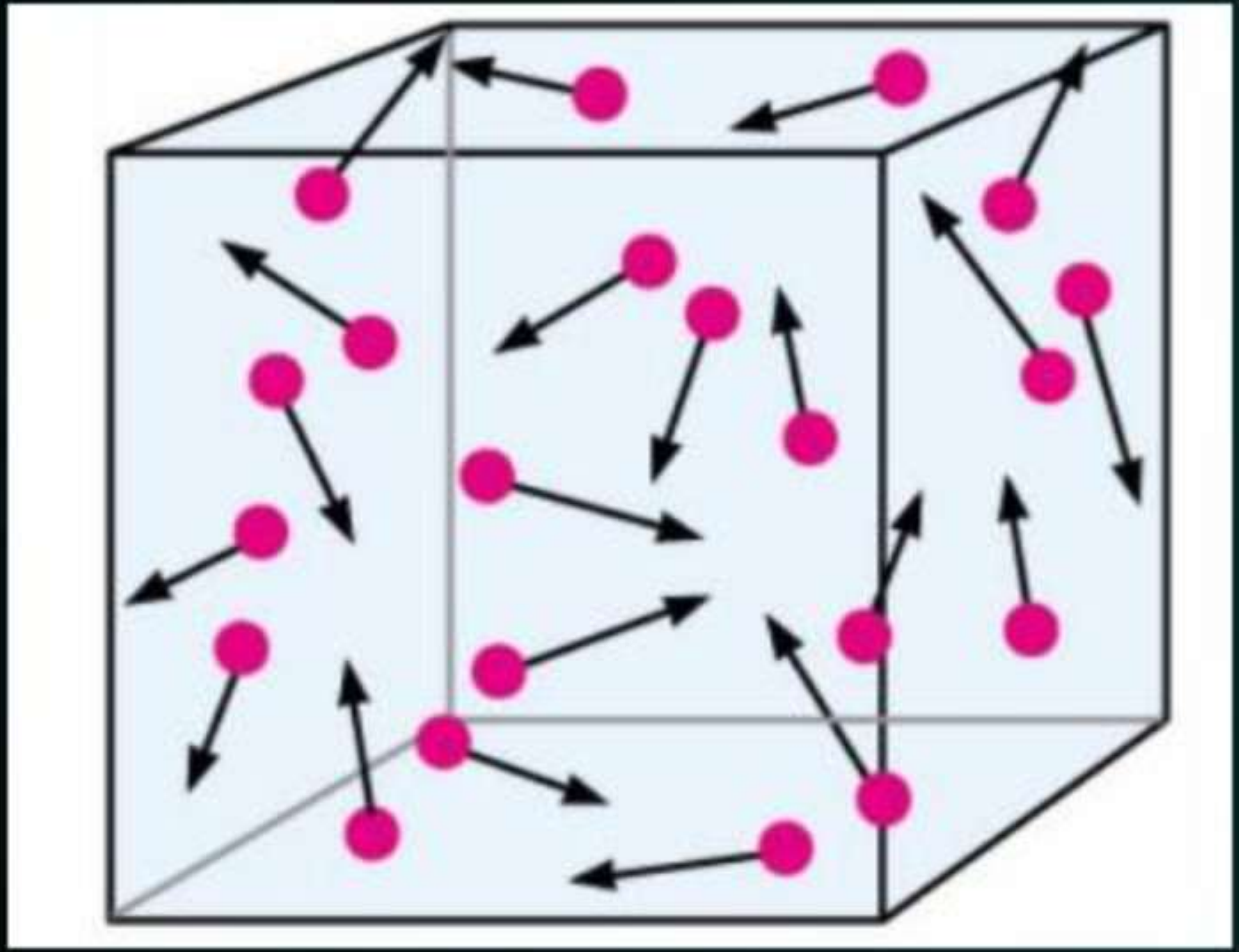
(c) $r^t \propto \frac{1}{\sqrt{TM}}$

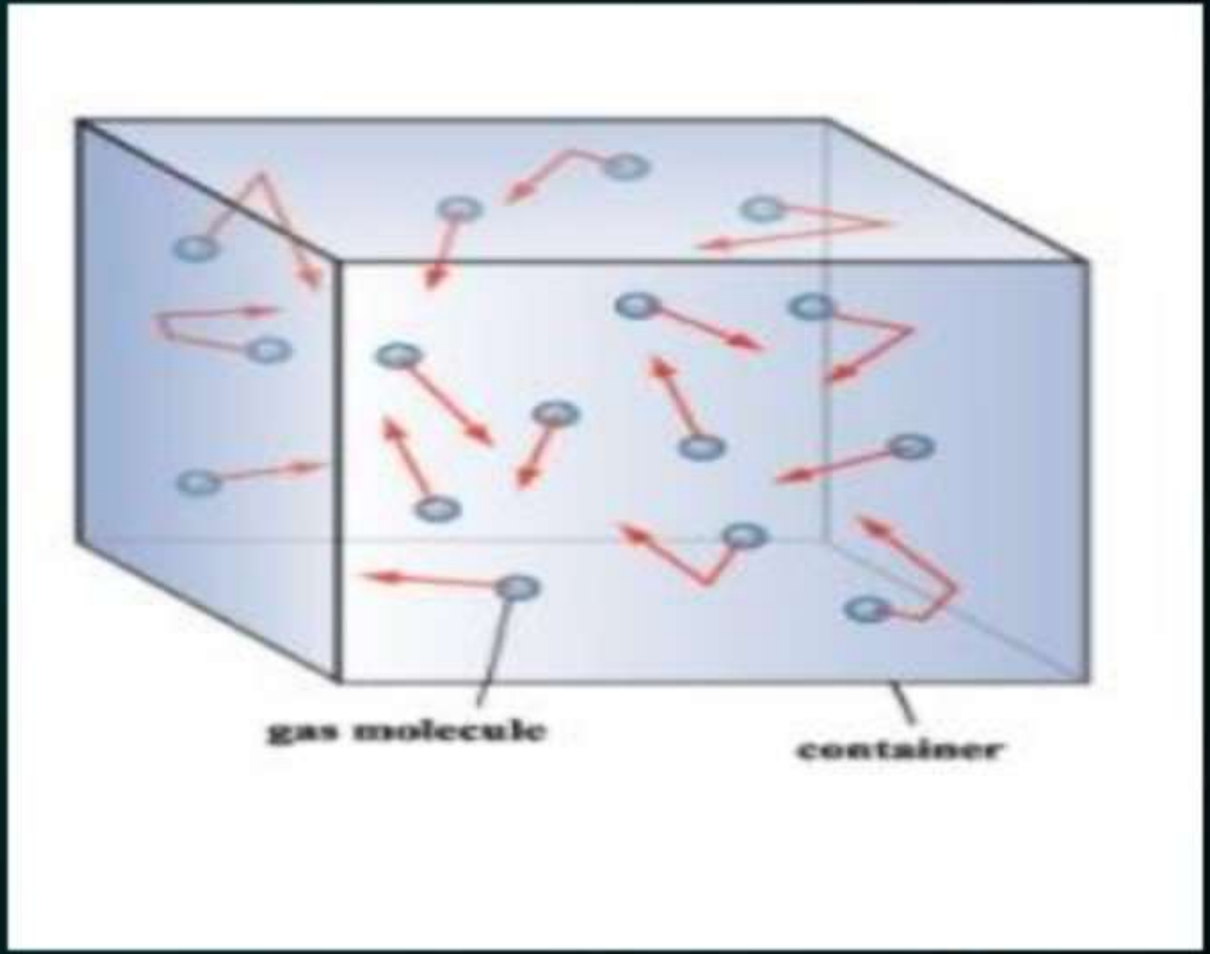
(d) $r^t \propto TM$

Kinetic Theory of Gases



- Every gas is made up of a large number of extremely small particles called molecules. All the molecules of a particular gas are identical in mass and size and differ in these from gas to gas.





- The molecules of a gas are separated from each other by large distances so that the actual volume of the molecules is negligible as compared to the total volume of the gas.

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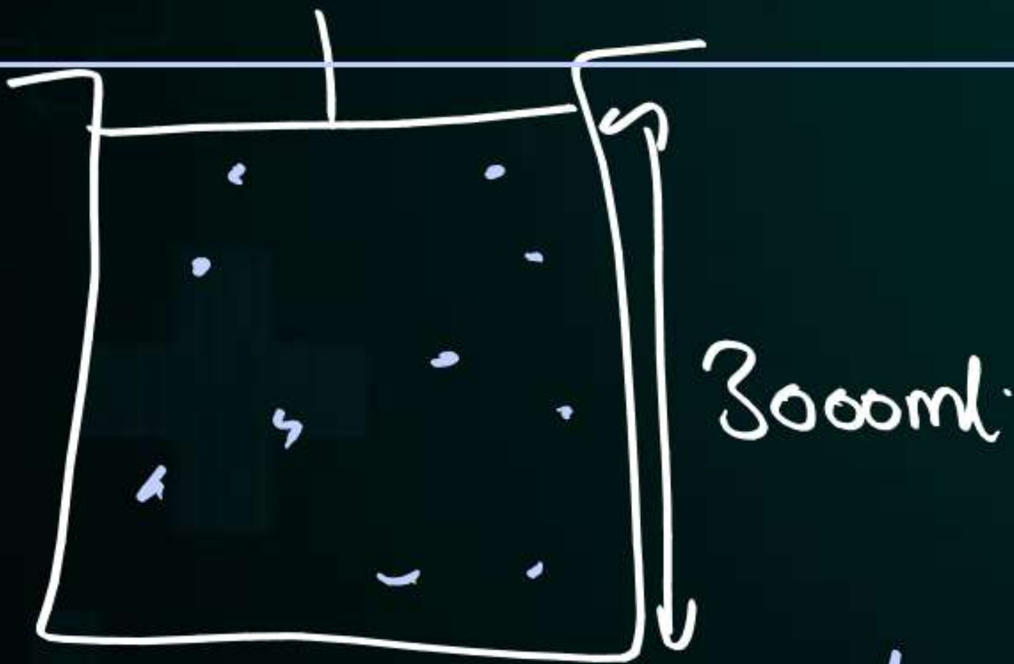
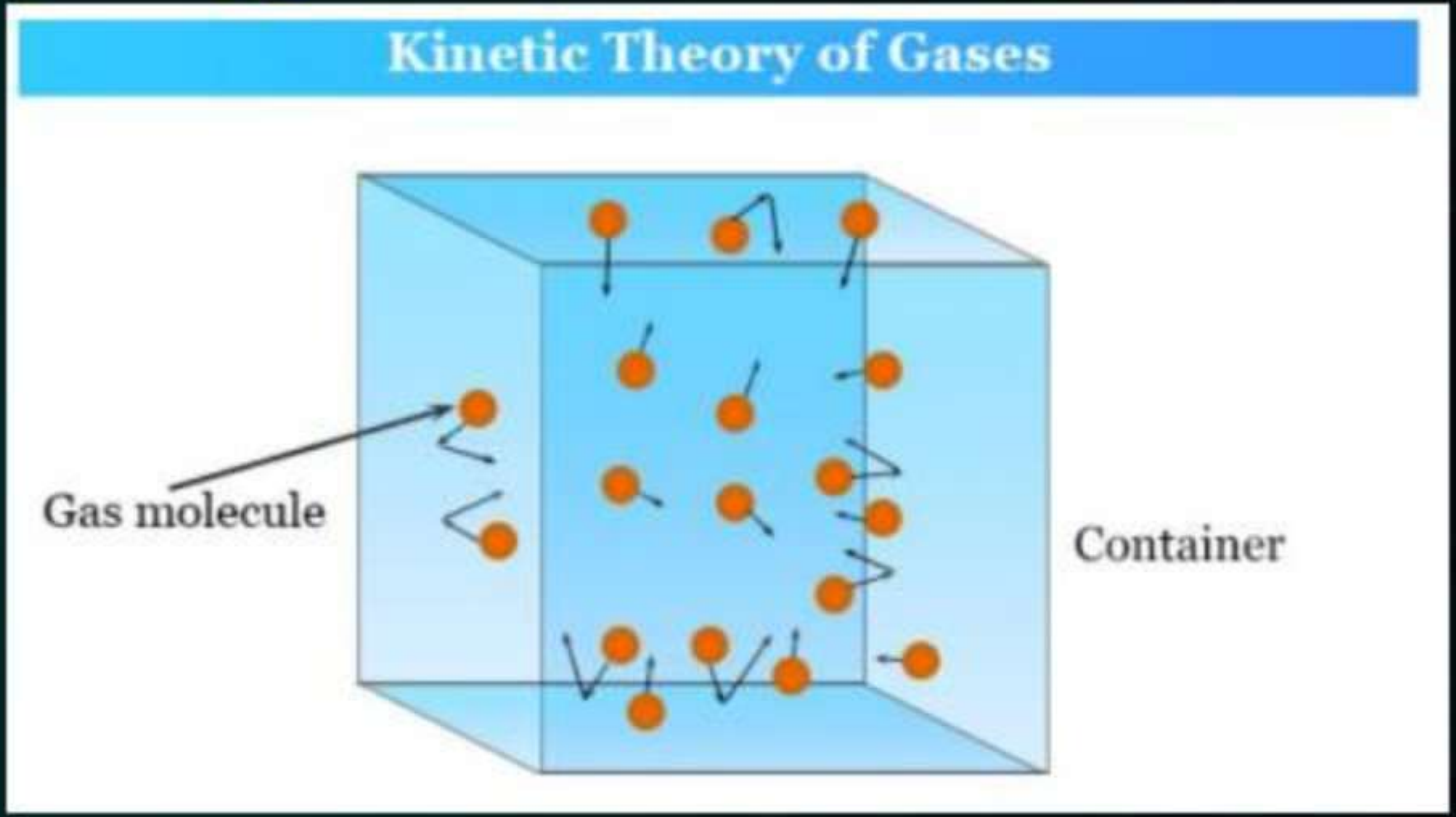
Volume of gas molecule is negligible Compared to total Volume of gas



V of 10 gas molecules = 0.1 ml



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- Distances of separation between the molecules are so large that the forces of attraction or repulsion between them are negligible.
- Force of gravitation on the molecules is also negligible.
- Molecules are supposed to be moving continuously in different directions with different velocities. Hence, they keep on colliding with one another (called molecular collisions) as well as on the walls of the containing vessel.
- Pressure exerted on the walls of the containing vessel is due to the bombardment of the molecules on the walls of the containing vessel.
- Molecules are supposed to be perfect By elastic hard spheres so that no energy is wasted when the molecules collide with one another or with the walls of the vessel. The energy may, however, be transferred from some molecules to the other on collision.

Question

A container contains CH_4 and SO_3 in 3 : 5 weight ratio. Calculate ratio of $P_{CH_4} : P_{SO_3}$?

Ans

$$\frac{w_{CH_4}}{w_{SO_3}} = \frac{3}{5}$$

$$M_{CH_4} = 16g$$

$$M_{SO_3} = 80g$$

$$\frac{P_{CH_4}}{P_{SO_3}} = \frac{x_{CH_4} \cancel{P_T}}{x_{SO_3} \cancel{P_T}} = \frac{n_{CH_4}}{n_{SO_3}} = \frac{w_{CH_4} \times M_{SO_3}}{M_{CH_4} \times w_{SO_3}} = \frac{3 \times 80}{16 \times 5}$$

$$= \frac{3 \times \cancel{80}}{\cancel{16} \times 5} = \frac{3}{1}$$

Question

An open flask contains air at 27°C. Calculate temperature which it should be heated so that 1/3rd of air measured at 27°C escapes out?

Ans

$T_1 = 27°C = 300K$.

Let $n_1 = n$

$T_2 = ?$

$n_2 = n - \frac{1}{3}n = \frac{2}{3}n$.

$n_1 T_1 = n_2 T_2$

$T_2 = \frac{n_1 T_1}{n_2}$

$= \frac{\cancel{n} \times \cancel{300}^{150} \times 3}{2\cancel{n}}$

$= 450K$.

$= 177°C$.

Question

At which of the following four conditions, the density of an ideal gas will be maximum?

A. 0°C and 0.1 atm.

B. 0°C and 0.2 atm.

C. 273°C and 0.1 atm.

D. 273°C and 0.2 atm.

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

Question

The molar volume of CO_2 is maximum at

A. 273 K and 1 atm

B. 546 K and 1 atm

C. 273 K and 2 atm

D. 546 K and 2 atm

$V = \frac{nRT}{P}$

$n = 1$

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

$\frac{T}{P}$ more $\Rightarrow$ V more

Question

The ratio of universal gas constant and molar mass of gas is called molar gas constant. The t value of molar gas constant is greater for

(A) He $\rightarrow M_{He} = 4g$

(B) $N_2 \Rightarrow M_{N_2} = 28g$

(C) $H_2 \Rightarrow M_{H_2} = 2g$

(D) Same for all

$\frac{R}{M} \Rightarrow$ min

Molar gas constt - max

Question

H. W.

Two gases A and B having the same volume diffuse through a porous partition in 20 and 10 seconds respectively. The molecular mass of A is 49u. Molecular mass of B will be:

A. $50.00\ u$

B. $12.25\ u$

C. $6.50\ u$

D. $25.00\ u$

Question

H.W.

A balloon of diameter 20 m weighs 100 kg. Calculate pay load if it is filled with He at 1 atm and 27°C. Density of air is 1.2 kg/m^3. (R = 0.082 dm^3 atm K^{-1} mol^{-1})

Question

H.W.

If 25 ml of CO_2 diffuse out of vessel in 75 sec. What volume of SO_2 could diffuse out in same time in same condition.

$M_{CO_2} = 44g$, $M_{SO_2} = 64g$.

Question

H.W.

A quantity of 2 g of hydrogen diffuses from a container is 10 minutes. How many grams of oxygen would diffuse through the same container in the same time under similar conditions?

$M_{H_2} = 2g$, $M_{O_2} = 32g$.

(A) 0.5 g

(B) 4 g

(C) 6 g

(D) 8 g

Question

H.W.

Equal moles of hydrogen and oxygen gases are placed in a container with pin-hole from which gases can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape?

A 3/8

B 1/2

C 1/8

D 1/4

How to increase Your Focus ?

- Use Pen Technique - Discussed in chapter 1 Lecture 2
- Use Ear Plugs while Studying - Discussed in chapter 1 Lecture 3

How to increase Your Efficiency ?

- Use Pomodoro technique - Discussed in chapter 1 Lecture 5
- Join a Library – Discussed in Chapter 2 Lecture 6

How to stop Overthinking ?

- Use Appointment method - Discussed in chapter 1 Lecture 10

How to get Confidence in Physical Chemistry

- Make formula sheets & write each formula in rough copy 10 times after remembering it & practice a variety of questions after revising & doing each question discussed in your copy by yourself - Discussed in Chapter 1 Lecture 12

How to Restrict Screentime ?

- Use Lock or Delete - Discussed in chapter states of Matter Lecture 3

Thank You