Liquifaction (Tc, Pc, Vc)

Course on States of Matter for Class XI

akhilesh • Lesson 19 • Aug 13, 2021

2(b)

$$\left[P + \frac{363.76 \times 10^{3} \times 10^{-6}\, m^{6} \times \cancel{\tfrac{1}{4}}}{(0.5 \times 10^{-3})^{2}}\right] \times \left[0.5 \times 10^{-3} - \frac{1}{2} \times 42.67 \times 10^{-6}\right]$$

$$\boxed{0.5 \times} = \frac{1}{2} \times 8.314 \times 298.15$$

$$dm^{3} = lit = 10^{-3} m^{3}$$

$$(dm)^{6} = lit^{2} = 10^{-6} m^{6}$$

(4)

$$P(V-b) = RT$$

100 atm

1 atm

$$\frac{V_1}{V_2} = \frac{RT/P_1 + b}{RT/P_2 + b}$$

$$0.011075 = \frac{RT/100 + b}{RT/1 + b}$$

$$\frac{4}{3}\pi r^3 \times N_A$$

$$b = 4 \times \left(\frac{4}{3}\pi r^3 \times N_A \right)$$

(6)

$$CaCO_3 \longrightarrow CaO + CO_2$$

$1/4$ $1/4$ mol $1/4$ mol

500ml

$1/4 \times 56$

$= 14$ gm

$= \frac{14}{3.3} =$ 4.2 ml

$$\left[P + \frac{4 \times \left(\frac{1}{4}\right)^2}{\left(\frac{1}{2}\right)^2} \right] \left[\frac{1}{2} - \frac{1}{4} \times 0.04 \right]$$

$$= \frac{1}{4} \times R \times 1500$$

8

$$1 \text{ mol } Hg(l) \equiv 200 \text{ gm}$$

$$\text{Vol. of } 1 \text{ mol} = \frac{200}{13.6} \text{ ml} = \frac{4}{3}\pi r^3 \times N_A$$

7 hold

14

$$Z = 1 + \frac{b}{RT} P$$

$$b = 0.01 \times RT = 0.2$$

$$\frac{b}{RT} = 0.01 =$$

$$nRT = 40$$

$$RT = 20$$

$$\frac{PV}{nRT} = 1 + \frac{bP}{RT}$$

$$PV = nRT + nb.P$$

Excluded volume $= nb$

Question
from Alok

Please take my doubt . My doubt was missed out in last class . Please sir take it

Ex.15 One litre flask contains air, water vapour and a small amount of liquid water at a pressure of 200 mmHg. If this is connected to another one litre evacuated flask, what will be the final pressure of the gas mixture at equilibrium ? Assume the temperature to be 50°C. Aqueous tension at 50°C = 93 mmHg.

Does it mean that there was already Aq. tension?

Ans. 3.0513 atm

Sol. The aqueous tension remains same in both the flask. Also flask are at same temperature

$V_1 = 1$ litre

$\therefore \quad P_1V_1 = P_2V_2$

Where $P_1 = 200 - 93 = 107$ mm

$V_2 = 2$ litre

$\therefore \quad 107 \quad 1 = P \quad 2$

$P = 53.5$ mm

Doubt : If second container was evacuated . how did Aq. tension came ?

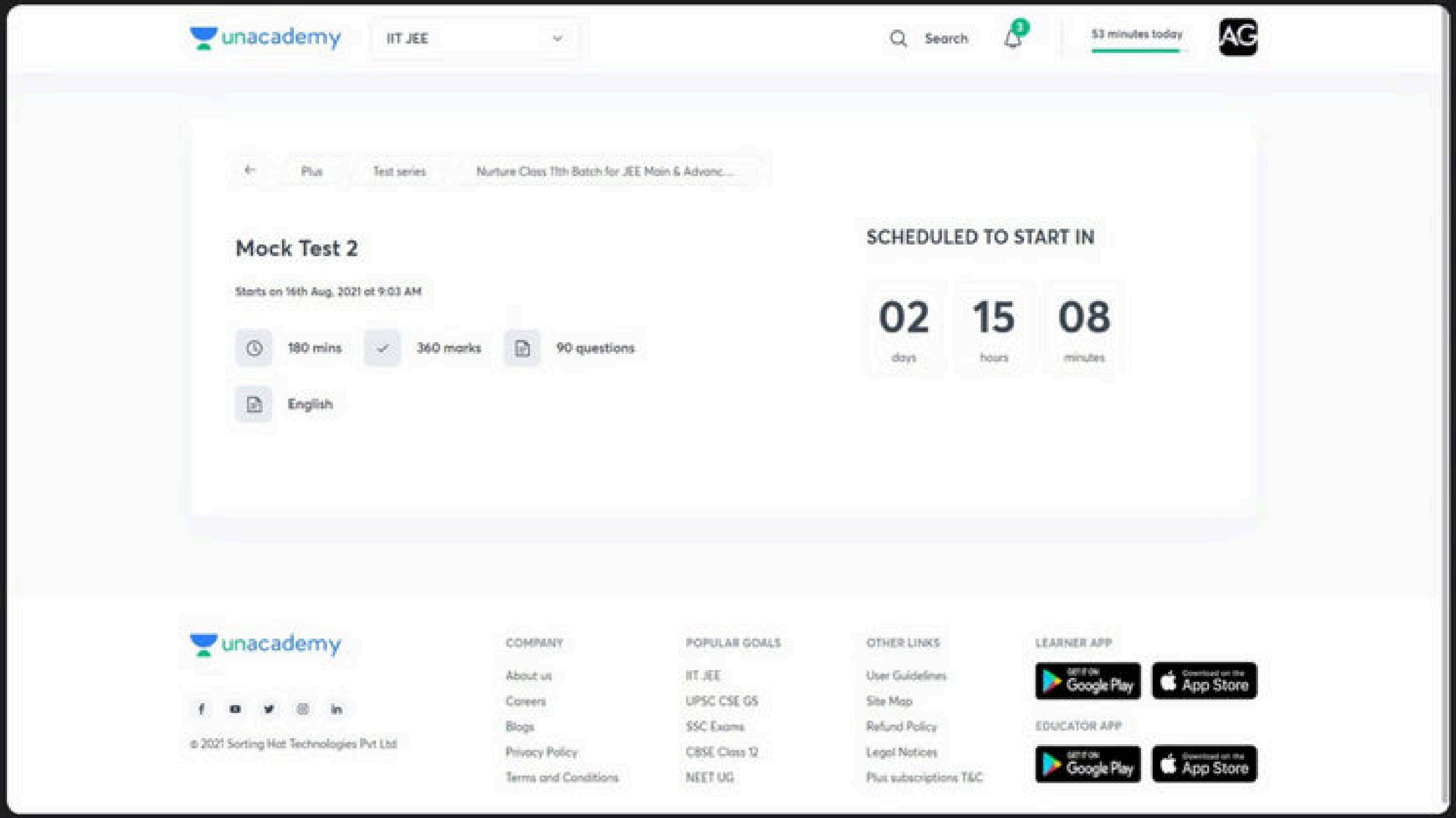
Since aqueous tension is also present in flask, equivalent to 93 mm.

$\therefore$ pressure of gaseous mixture = 93 + 53.5 = 146.5 mmHg.

Ex.16 A sample of butane gas C_4H_{10} of unknown mass is contained in a vessel of unknown volume V at 25°C and a pressure of 760 mmHg. To this vessel 8.6787 g of neon gas is added in such a way that no butane is lost from the vessel. The final pressure in the vessel is 1920 mm Hg at the same temperature. Calculate the volume of the vessel and the mass of butane.

Question
from Akshit

360 marks !!!!!



$PV = nRT$

Effusion

KTG

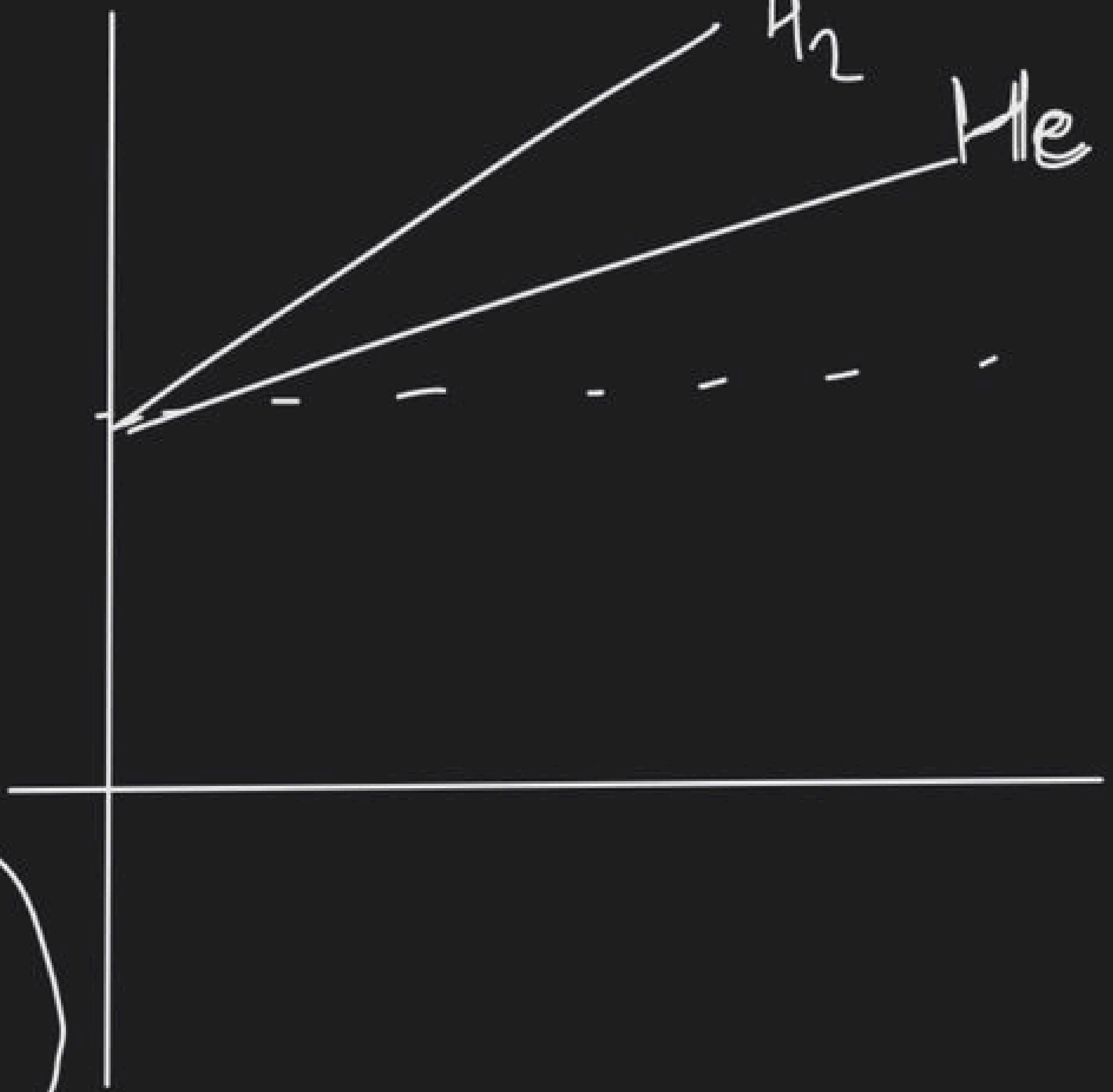
Maxwell

Collision

Case-3 for H_2 & He

VanderWaal's force $\propto$ polarity

$\propto$ Molecular mass



$\overset{\delta+}{H} — \overset{\delta-}{Cl}$ $\quad$ $\overset{\delta+}{H} — \overset{\delta-}{Cl}$

dipole

H — H $\quad$ H — H

London - dispersion forces $\propto$ Molecular mass

(for non-polar Molecule)

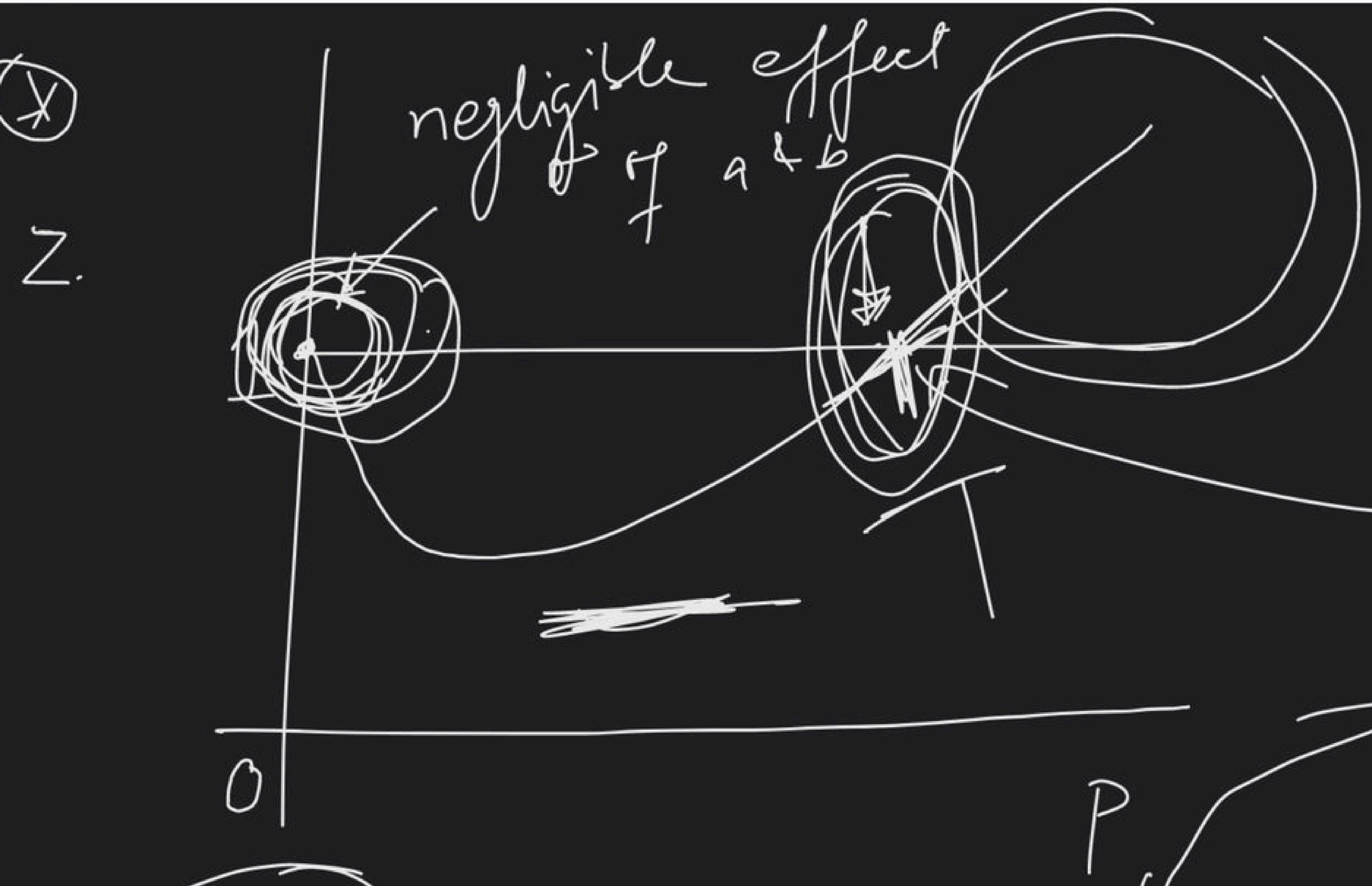
$$N_2 < O_2 < I_2(s)$$

for H_2 & , He attraction $(a) \simeq 0$

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

$$PV_m - Pb = RT$$

$$\boxed{Z = 1 + \frac{Pb}{RT}}$$



$$Z = 1 = \frac{PV}{nRT}$$

a & b nullify effect of each other

$P \longrightarrow 0$

$V \longrightarrow \infty$ (very large volume)

a & b can be neglected

Graph →

$PV = nRT$ (Dalton law)

Container open, closed, connected

piston, spm, mercury tube

Q.12 A container fitted with frictionless massless piston consist of five **valves–I, II, III, IV** and **V.** These valves open automatically if pressure exceed over **1.5, 2.2, 2.5, 4.4** and **4.8 atm** respectively. Under the given initial conditions (mentioned in given diagram) system is in state of equilibrium. Piston is now pressed in downward direction very slowly.

[Note: Consider the diameter of valve tube negligible and temperature remain constant.]

$n =$

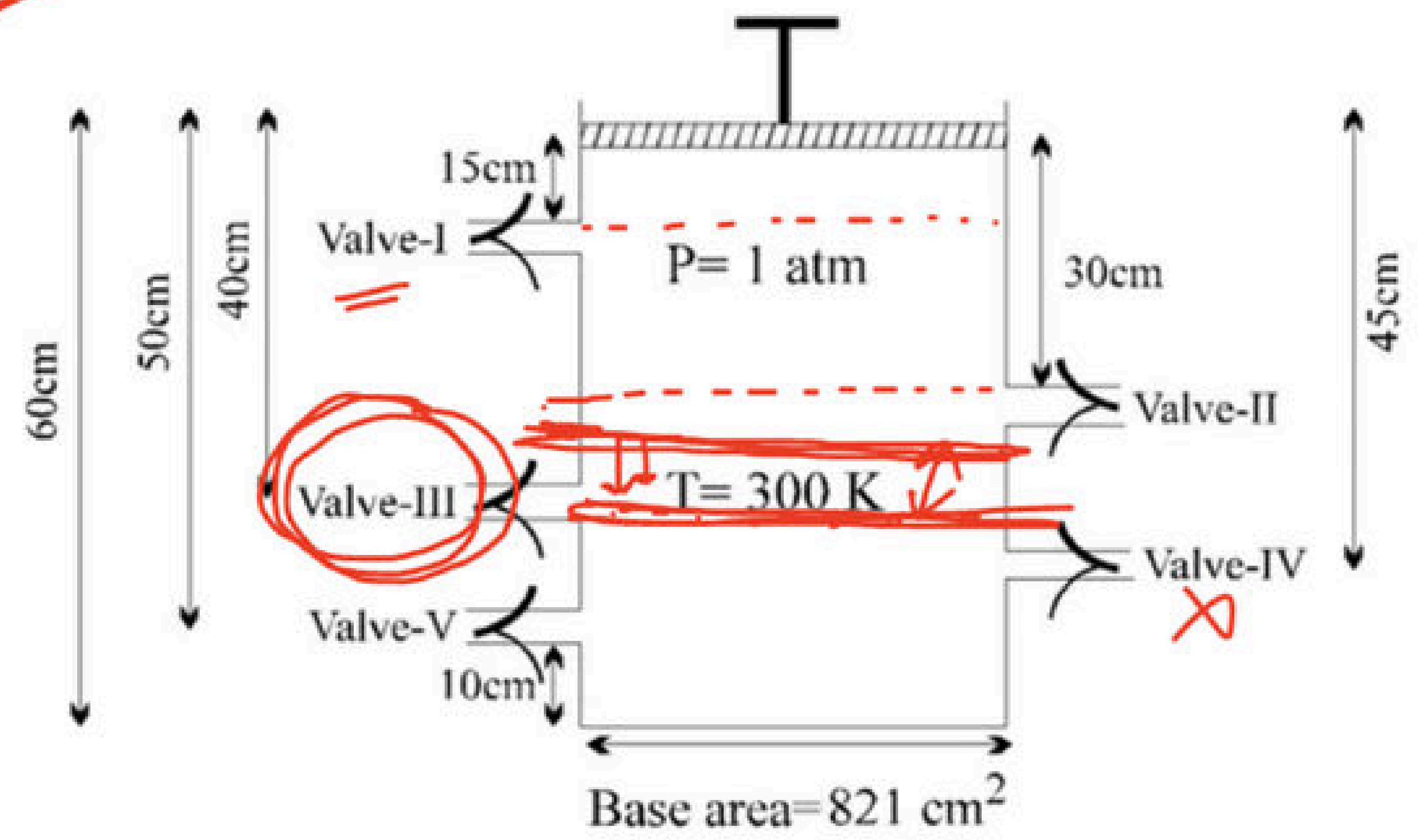
I

II

III

IV

V



$P_1 l_1 = P_2 l_2$

$1 \times 60 = P \times 45$

$1.33 = P$

$1 \times 60 = P \times 20$

$3 = P$

Select the correct option(s):

(A) **Valve –II** will be opened first

(B) As the piston crosses the valve which will be opened first, the remaining number of moles in container are $\frac{5}{3}$.

(C) **Valve–V** will be the second valve which open

(D) Number of moles will zero as piston crosses **Valve–V**

(A) AB C

(B) A C

(C) B C

(D) AB

(E) B

Q.11 Select the correct option(s).

(A) Fraction of molecule in the range $U_{avg} \pm f\,U_{avg}$ is same for SO_2 and O_2 at same Temperature $(0 < f < 1)$.

(B) Fraction of molecule in the range $U_{mps} \pm 100$ (m/sec) is same for SO_2 and O_2 at same Temperature.

(C) Fraction of molecule in the range $U_{avg} \pm f\,U_{avg}$ is same for O_2 at 300 K and at 200 K $(0 < f < 1)$.

~~(D) None of these~~

Question
from Vaibhav

Sir, what is the mistake here?

I. On differentiating,

$$\frac{1}{dE}\cdot\frac{dN}{N} = \frac{2}{\sqrt{\pi}}\left(\frac{1}{KT}\right)^{3/2}\sqrt{E}\,e^{-\frac{E}{KT}}$$

we found, $\boxed{\text{most probable K.E.} = \frac{1}{2}KT}$

II. We know that,
most particles are moving with speed $u_{mps} = \sqrt{\frac{2RT}{M}}$

$\because$ masses of all particles are same
$\Rightarrow$ their speed is the only differentiating factor in their K.E.
and $\because$ most of the particle move with $u = \sqrt{\frac{2RT}{M}}$

$\Rightarrow$ most probable K.E. $= \frac{1}{2}\times m\times(u_{mps})^2$

$= \frac{1}{\cancel{2}}\times \cancel{m}\times\frac{\cancel{2}RT}{\cancel{M}N_A}$

$= \underline{\underline{KT}}$

→ Sir, where is this method going wrong ??

$\frac{1}{2}KT$

$\frac{1}{2}mu^2 \quad \frac{1}{2}mu^2 \quad \ldots$

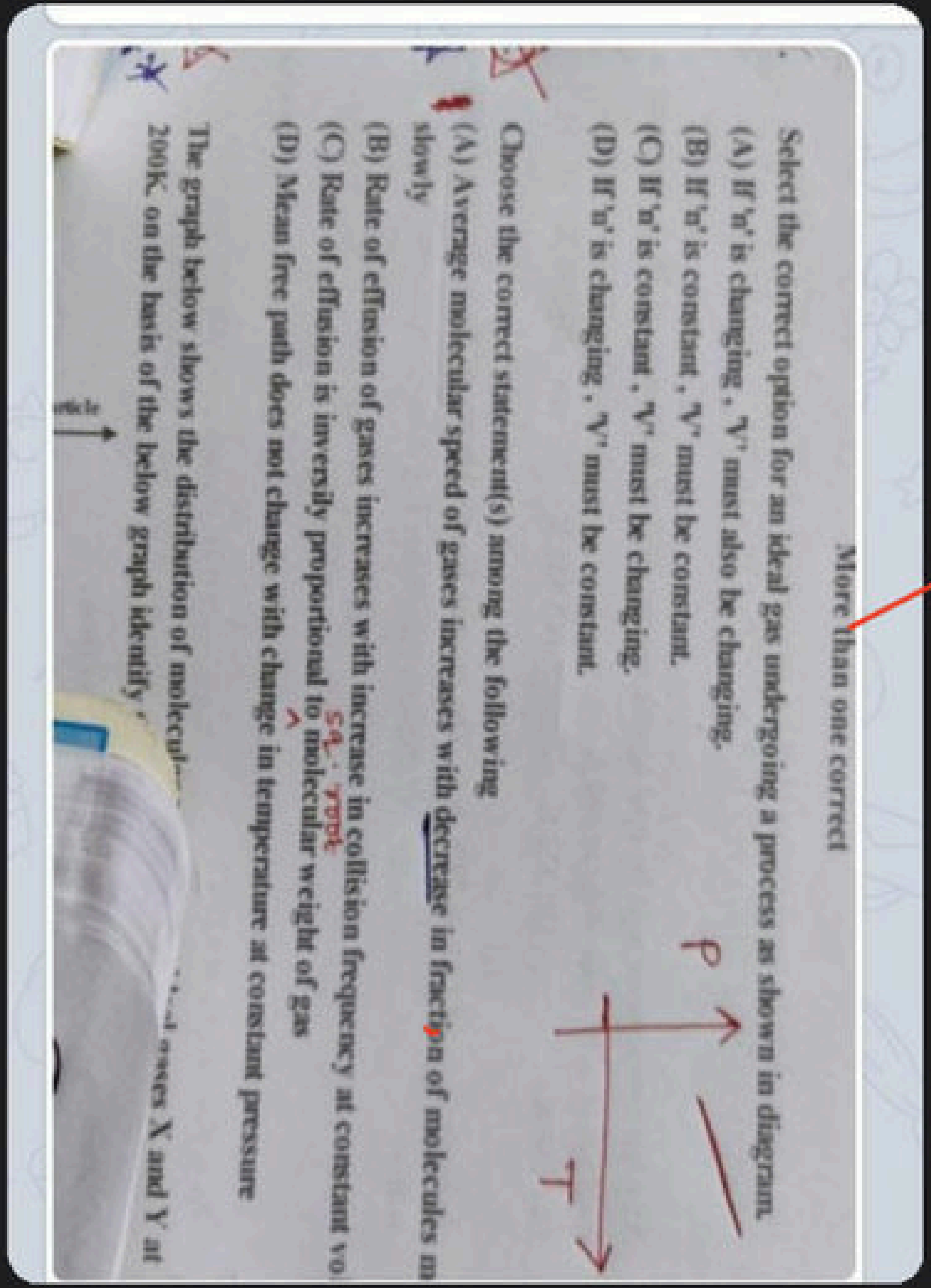
$KE_1 \quad KE_2 \quad KE_3$

$\frac{1}{2}m\,u^2_{mps}$

Question

from ASESH RAKS...

Isme sir 2nd qn me Aritra ko doubt aa raha hai ki B option shi hai. Ki. Nhi...?? Plz sir can you give the explanation of it plz why b option is correct or if not then why??



More than one correct

Select the correct option for an ideal gas undergoing a process as shown in diagram.

(A) If 'n' is changing, 'V' must also be changing.
(B) If 'n' is constant, 'V' must be constant.
(C) If 'n' is constant, 'V' must be changing.
(D) If 'n' is changing, 'V' must be constant.

Choose the correct statement(s) among the following

(A) Average molecular speed of gases increases with decrease in fraction of molecules m... slowly
(B) Rate of effusion of gases increases with increase in collision frequency at constant vo...
(C) Rate of effusion is inversely proportional to sq. root molecular weight of gas
(D) Mean free path does not change with change in temperature at constant pressure

The graph below shows the distribution of molecul... gases X and Y at 200K on the basis of the below graph identify...

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$$\left(\frac{2^2 + 3^2 + 4^2}{3}\right)^{1/2}$$

$$\frac{2+3+4}{3}.$$

$$\frac{1 \times \cancel{60}^{3}}{2} = \frac{2.5 \times \cancel{20}}{n}$$

$$\boxed{n = 5/3}$$

$$1/3$$

$$1 \times \frac{\cancel{821} \times 6\cancel{0}}{\cancel{1000}} = n \times \frac{0.\cancel{0821} \times 3\cancel{00}}{\cancel{1000}}$$

$$\boxed{2 = n}$$

At $P \to 0$

$V \to \infty$

$V \to$ very large Volume

A Real gas behaves like an ideal gas.

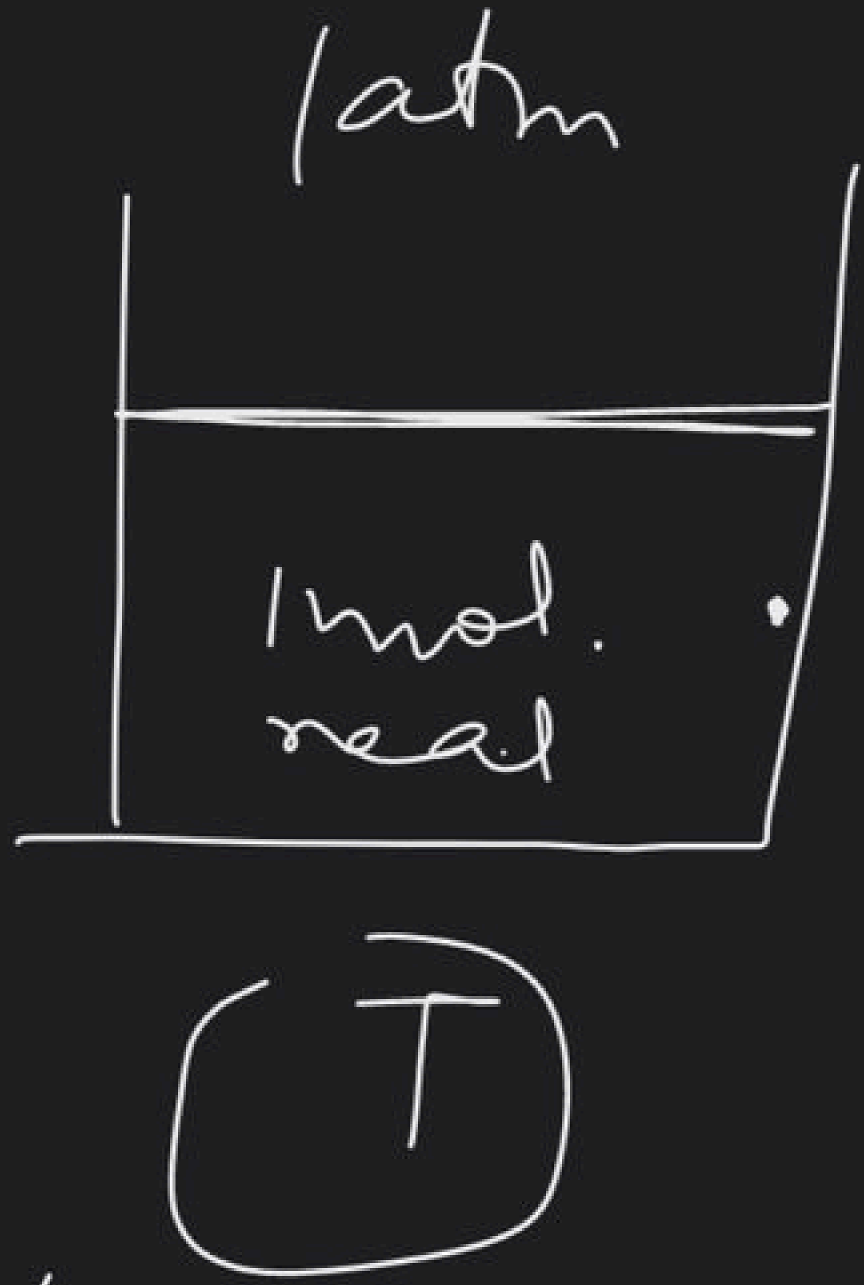
At low pressure $Z = 1 - \frac{a}{V_m RT}$ 'b' is neglected Attraction dominates

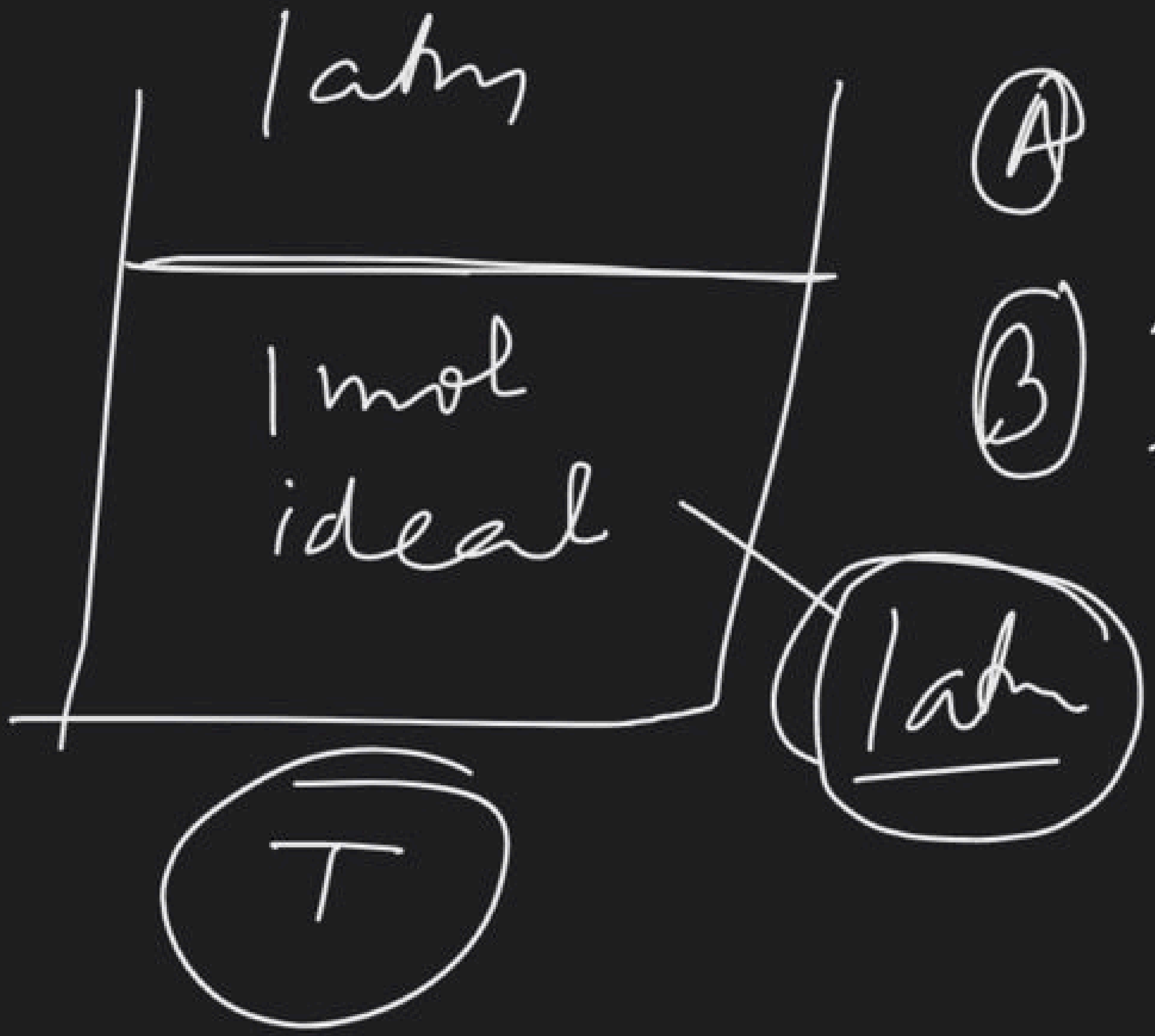
At very high p $Z = 1 + \frac{pb}{RT}$ 'a' is neglected Repulsion dominates

$Z < 1$ effect of 'a' dominates ~~...~~ 'b'

$Z > 1$ effect of b dominates effect of a

Attraction dominates





(A) Real

(B) Ideal

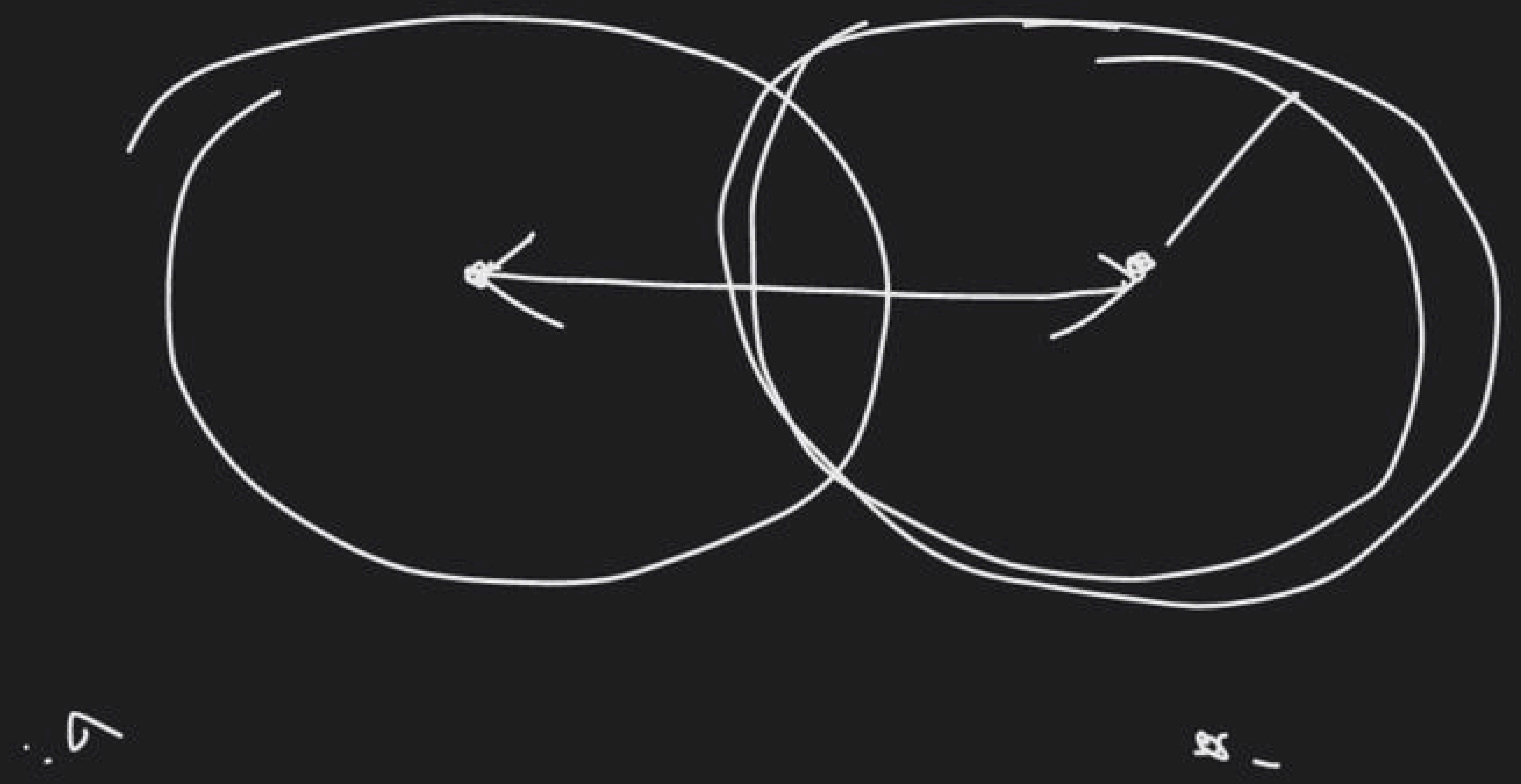
$$Z = \frac{V_{real}}{V_{ideal}} < 1$$

Repulsion dominate → $Z > 1$

'a' represents attraction

b " repulsion as well as

size of molecule.



$$\left(P + P_{cor} - P'_{cor}\right) V = nRT$$

$$\left(P + \underline{P_{cor}}\right)\left(V - V_{cor}\right) = nRT$$

$$\left(V - nb\right)$$

$$PV = RT$$

$$P'(V-b) = RT$$