Maxwell Distribution of Molecular Speed

Course on States of Matter for Class XI

akhilesh • Lesson 11 • July 28, 2021

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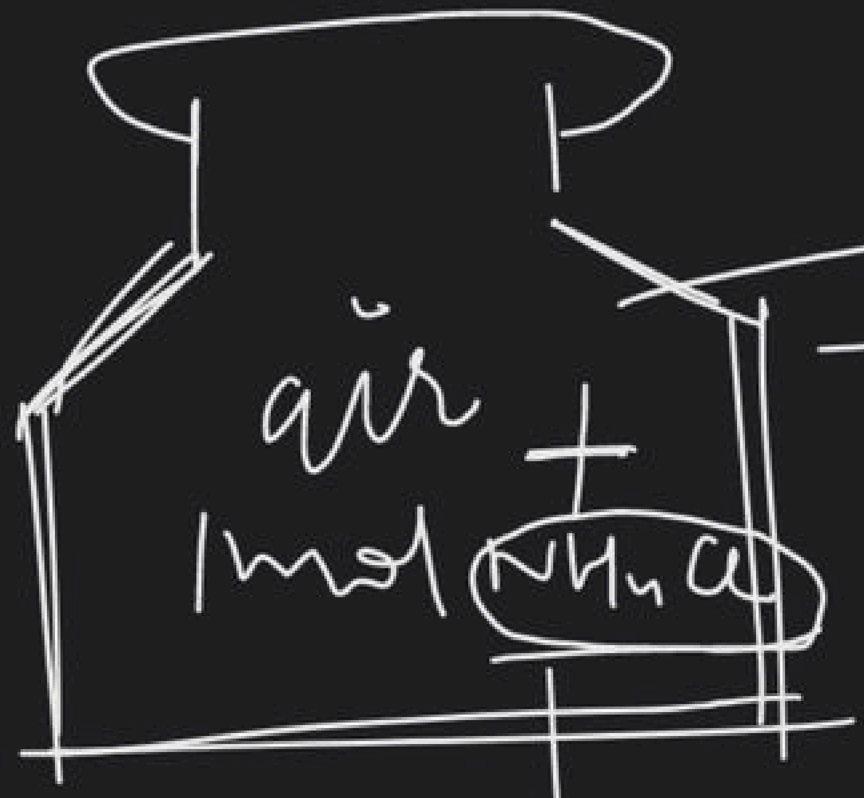
$2A \longrightarrow A_2$ $\quad T = 546\,K$

$\cancel{96\,gm}$ $\quad \cancel{96\,gm}$

$\cancel{2\,mol}$ $\quad \cancel{1\,mol}$

$1\,mol$ $\quad \frac{1}{2}\,mol$

(5)



300K

$NH_3 + HCl$

5.5

$P_{air} = 2 \text{ atm}$

$P \times 24.63 = 2 \times 0.0821 \times 600$

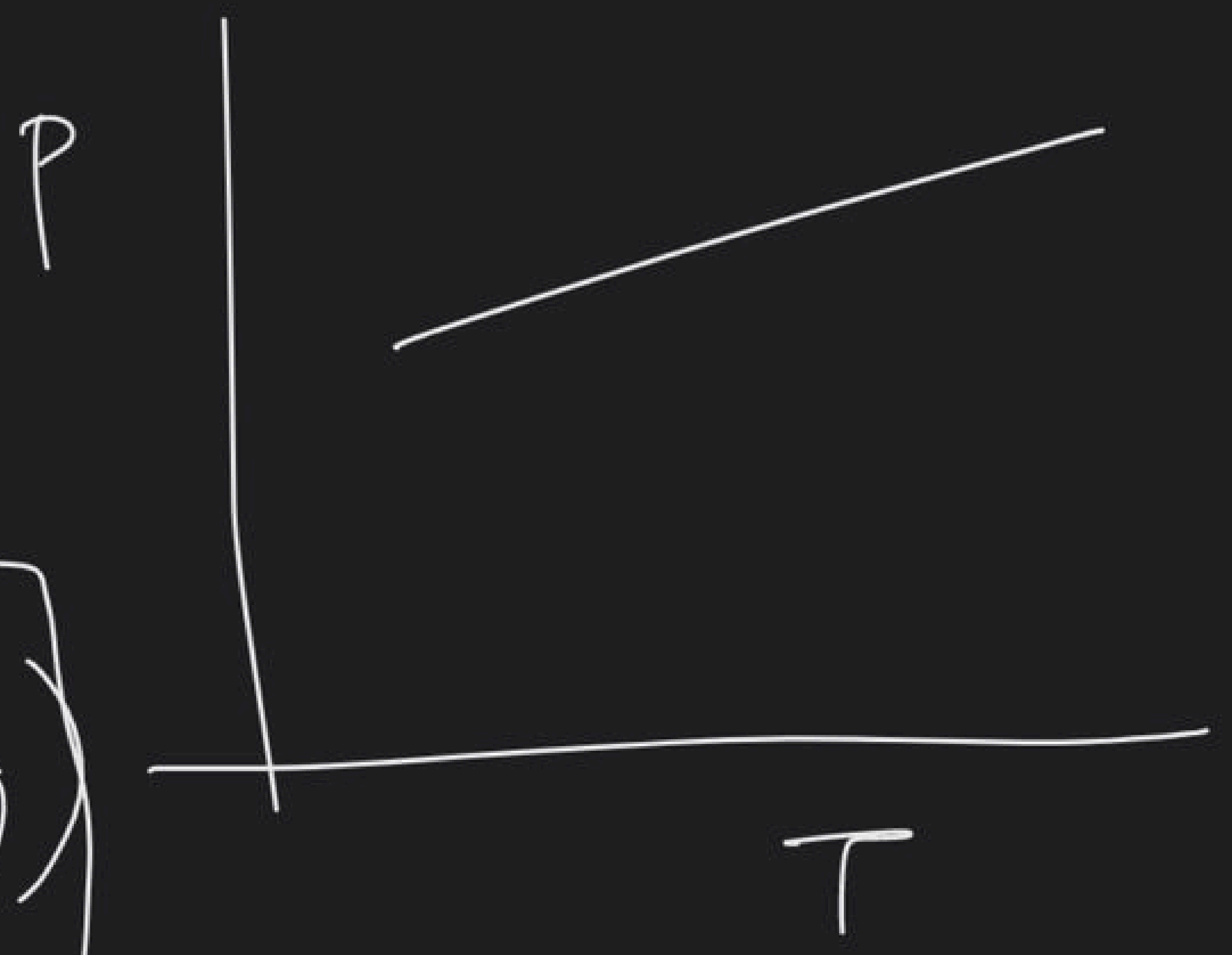
$P = 4 \text{ atm}$

$$P = \frac{1}{8.21} \times V$$

$$\underline{V = 8.21\,P}$$

$$P \times 8.21\,P = n R \underline{T}$$

$n = 3 = \frac{PV_1}{RT_1} + \frac{PV_2}{RT_2}$



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$\boxed{\begin{matrix} 2A(g) \longrightarrow & 3B(g) & + 2c(g) \\ 1-0.2 & 0.3 & 0.2 \\ =0.8 & & \end{matrix}}$

$= \frac{1.3}{2}$

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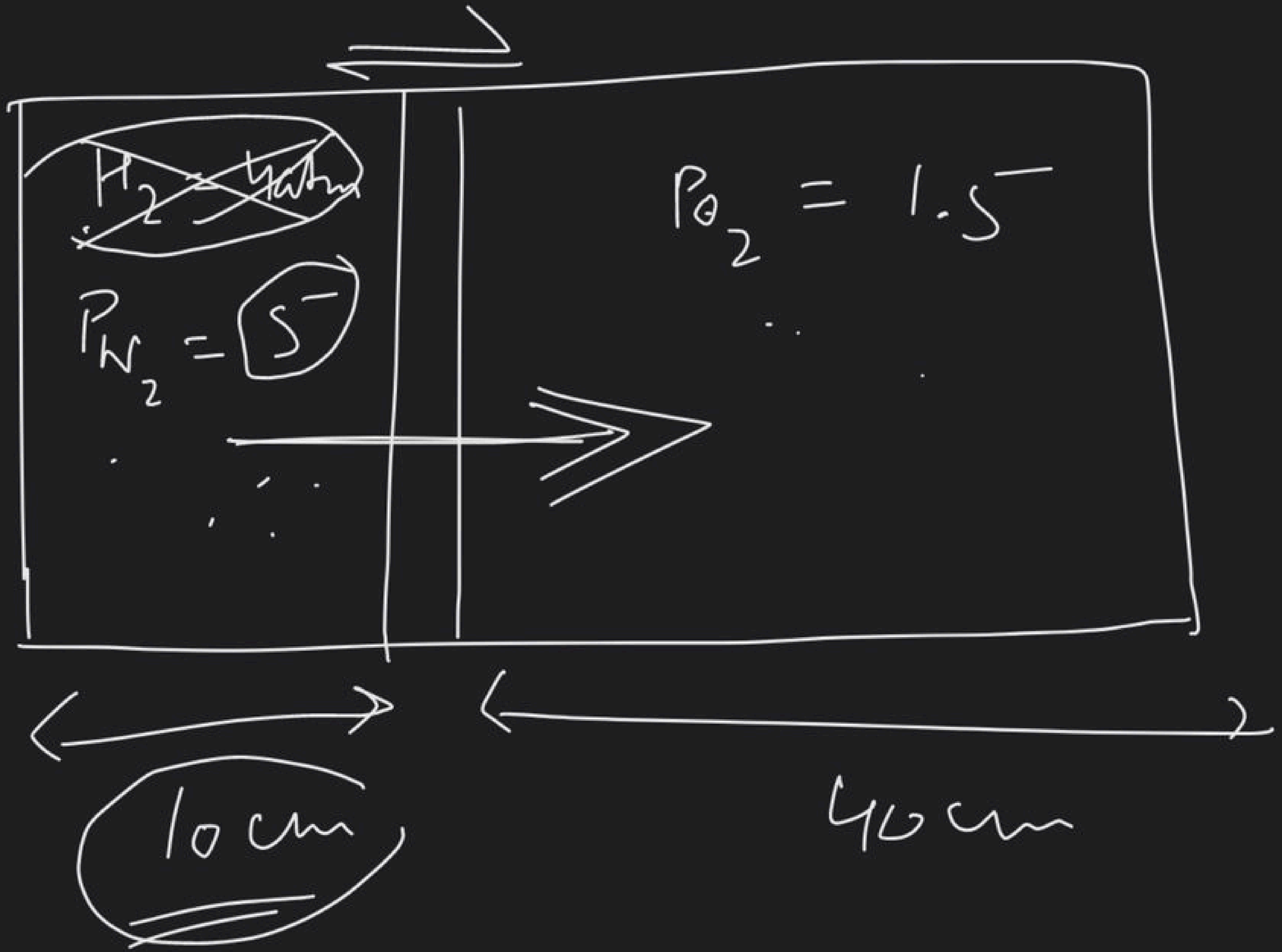
$\frac{2}{1000\,e}$



$$4 \times 10 = P_{H_2} \times 50$$

$$\boxed{0.8 = P_{H_2}}$$

$$P_{Total} = 3$$

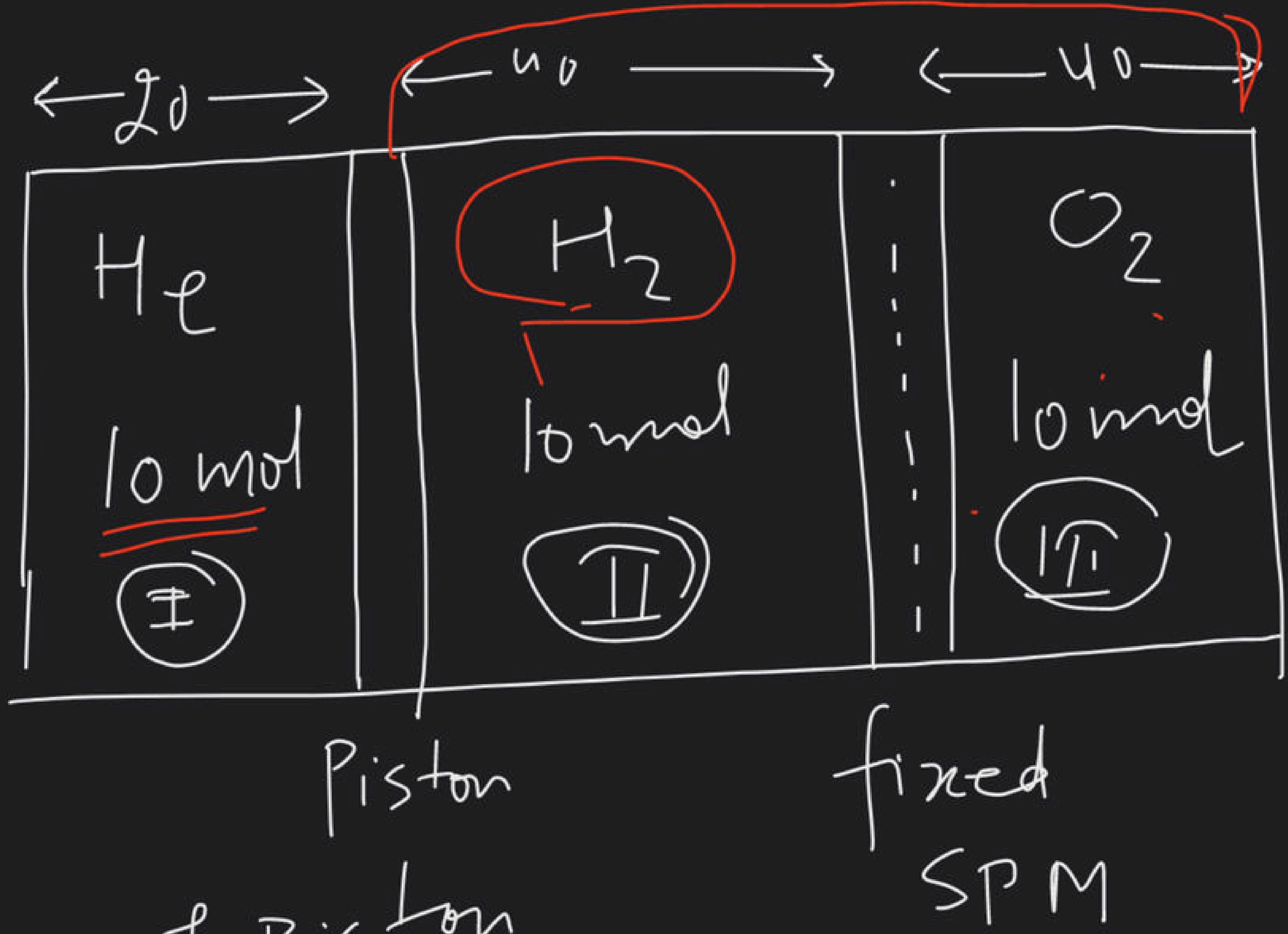
$$4 \times 10 + 5 \times 10 + 1.5 \times 40 = P \times 50$$

$$40 + 50 + 60 = P \times 50$$

$$5 \times 10 + 1.5 \times 40 = P \times l_1 + P \times l_2$$

$$= P(l_1 + l_2)$$

$$= P \times 50$$



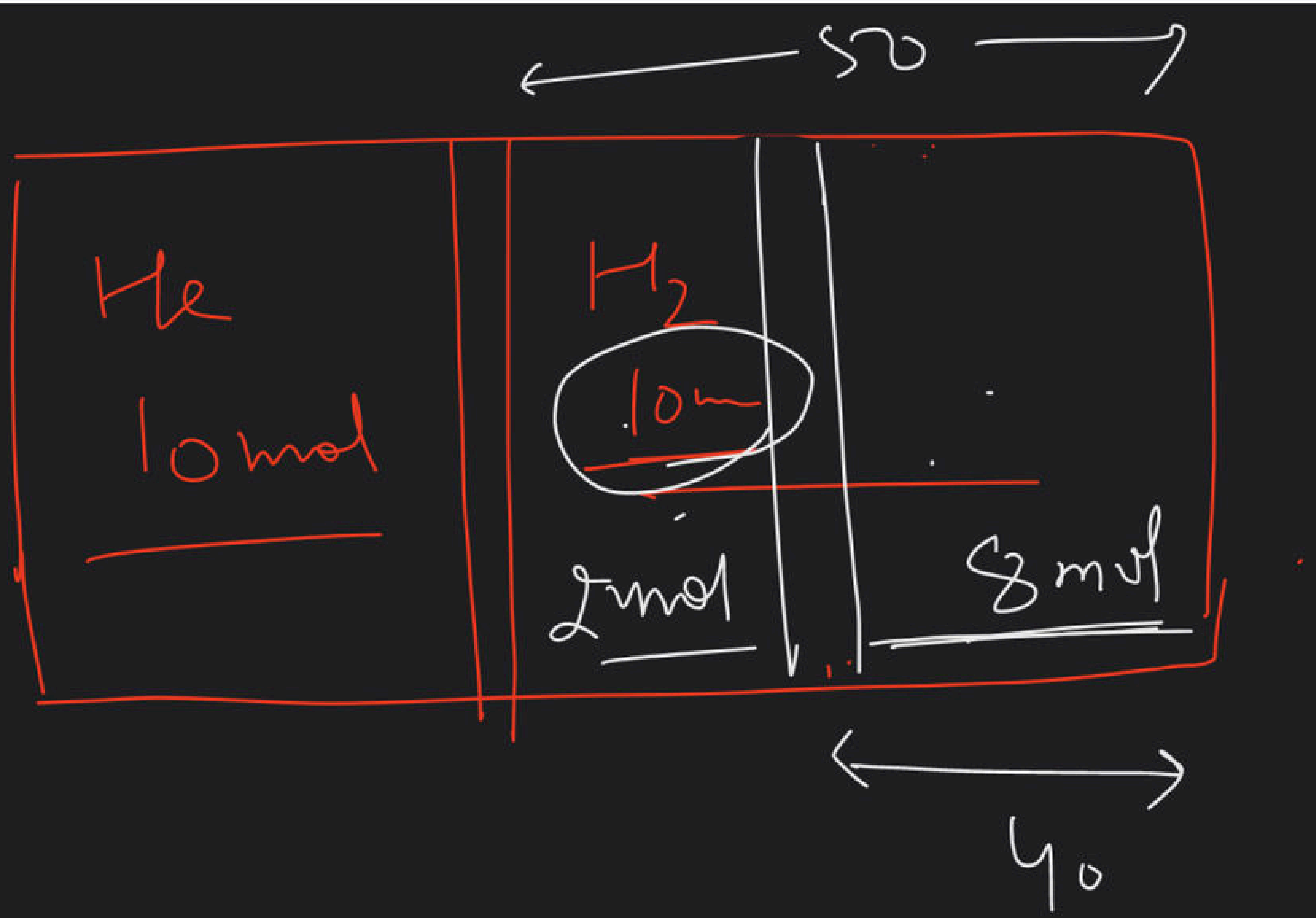
$\rightleftharpoons$

H_2

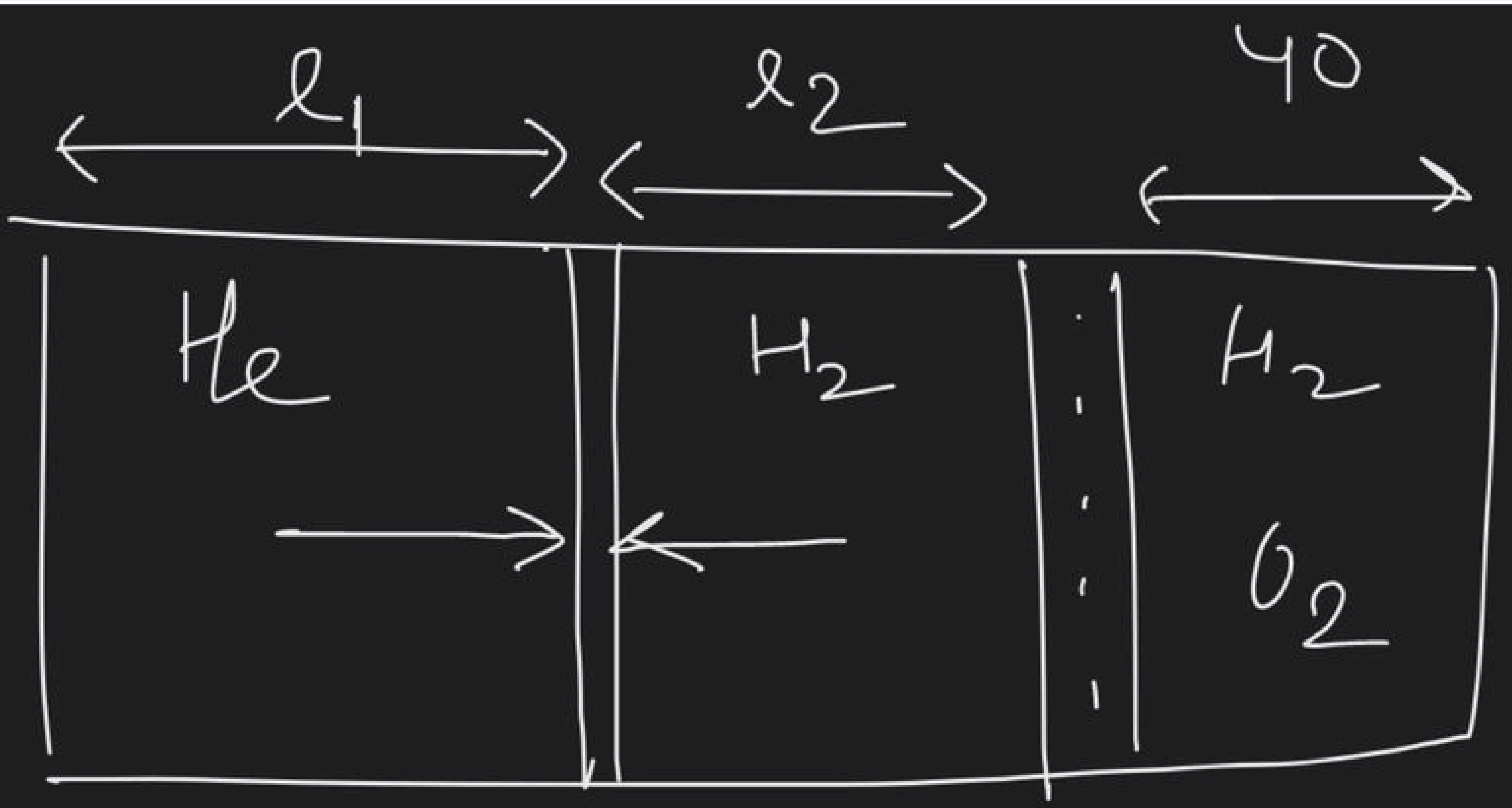
1. moles of H_2 in Compartment II & III
2. Position of Piston from left

Position of Piston

A) 35
B) 60
C) 50
D) None



520
He
10 mol
H2
10 m
2 mol
8 mol
40



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

$$\cancel{\propto}\ \frac{n}{\ell}$$

$$\ell_1 + \ell_2 + \cancel{40} = \cancel{100}\ 60 \quad —(1)$$

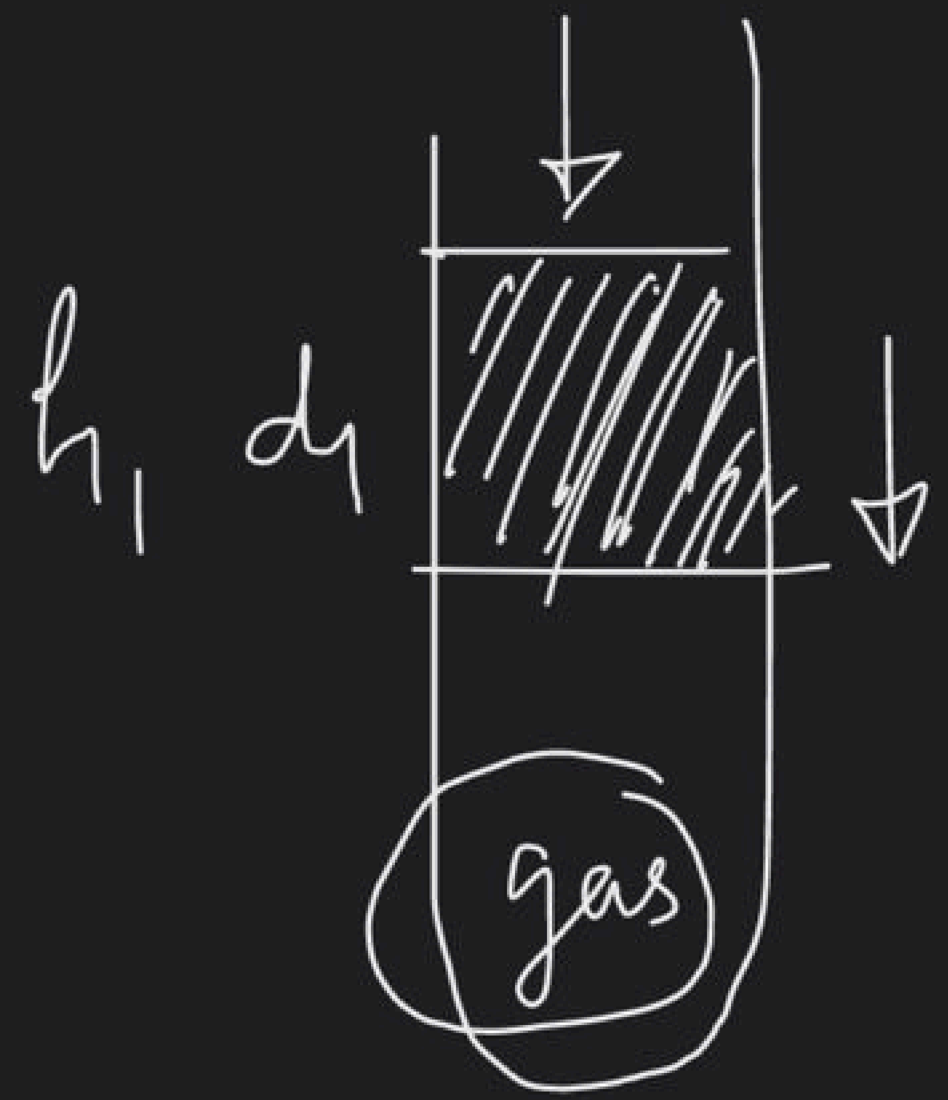
$$P_{He} = P_{H_2}$$

$$\frac{10}{\ell_1} = \frac{10}{\ell_2 + 40} \quad —(2)$$

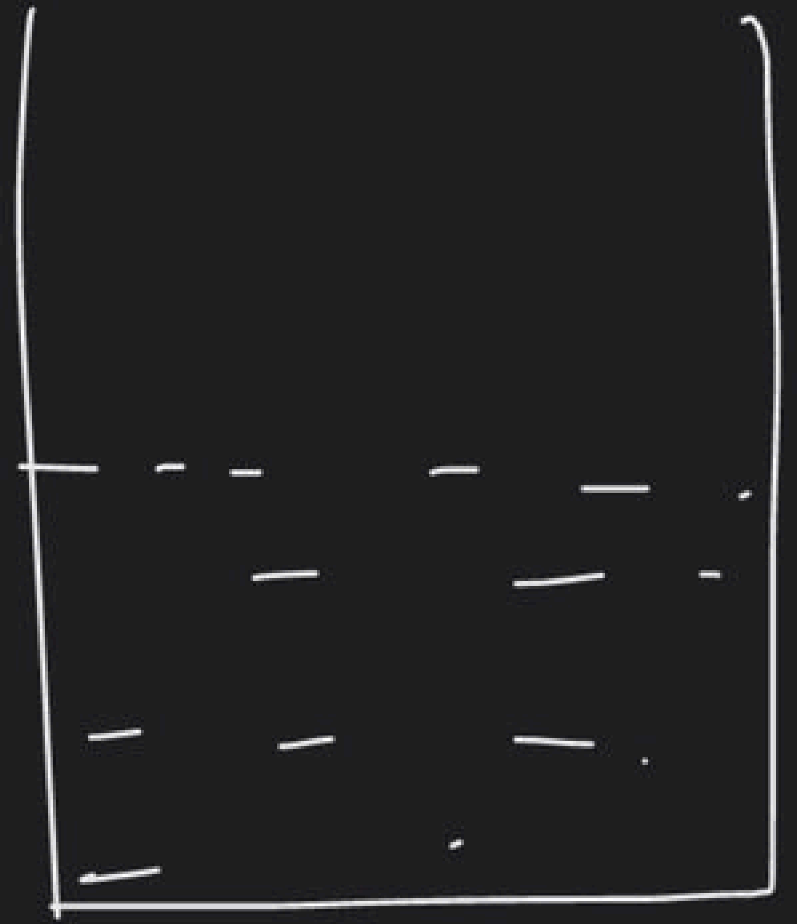
$$\ell_2 = 10$$

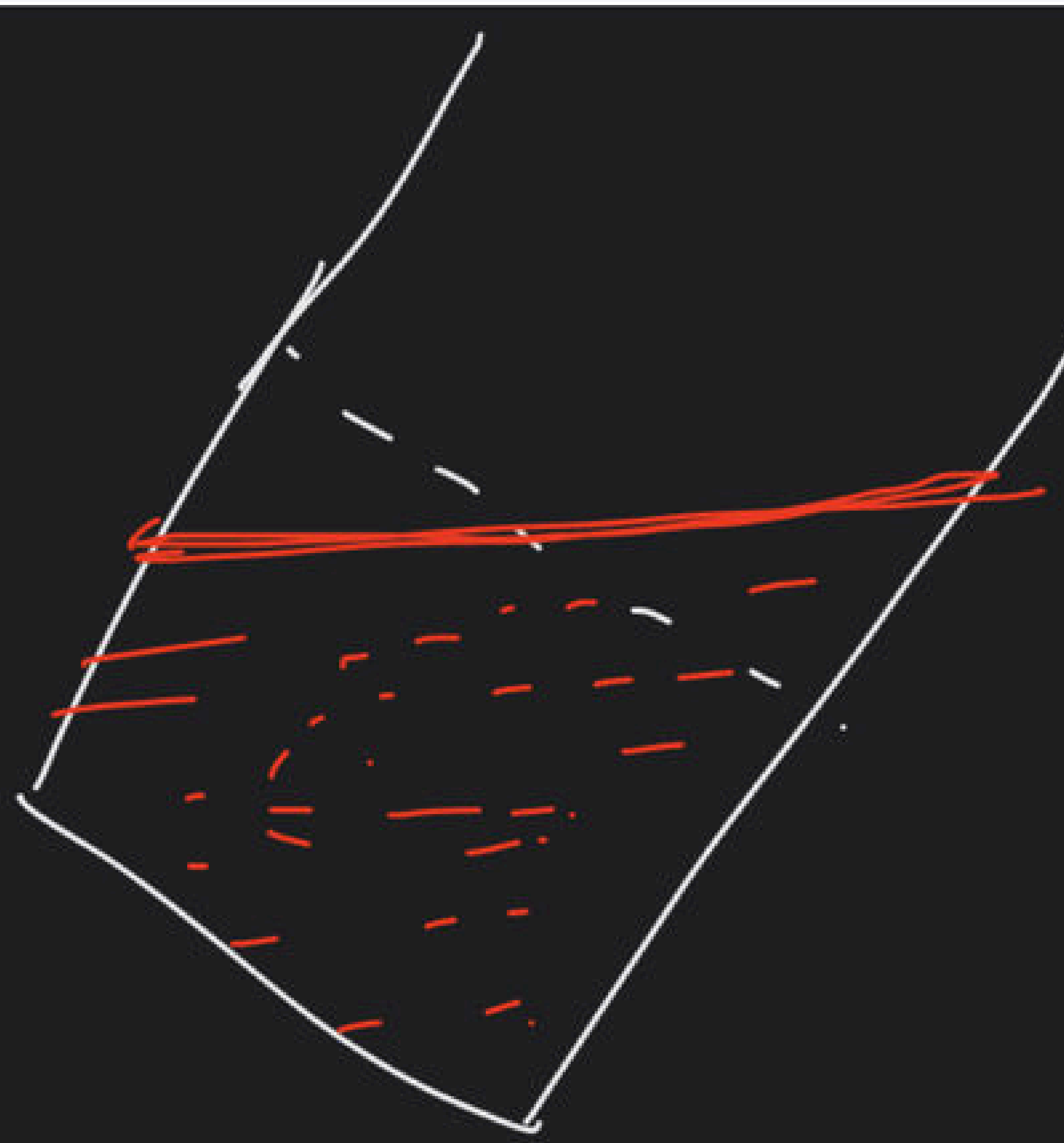
$$\ell_2 + 40 = \ell_1 = 60 - \ell_2$$

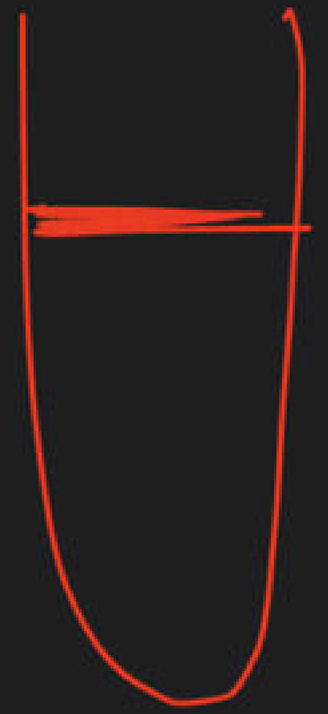
Problems related with Mercury tube

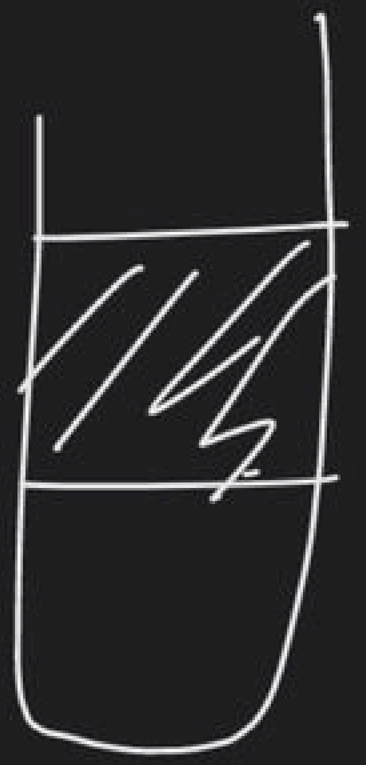


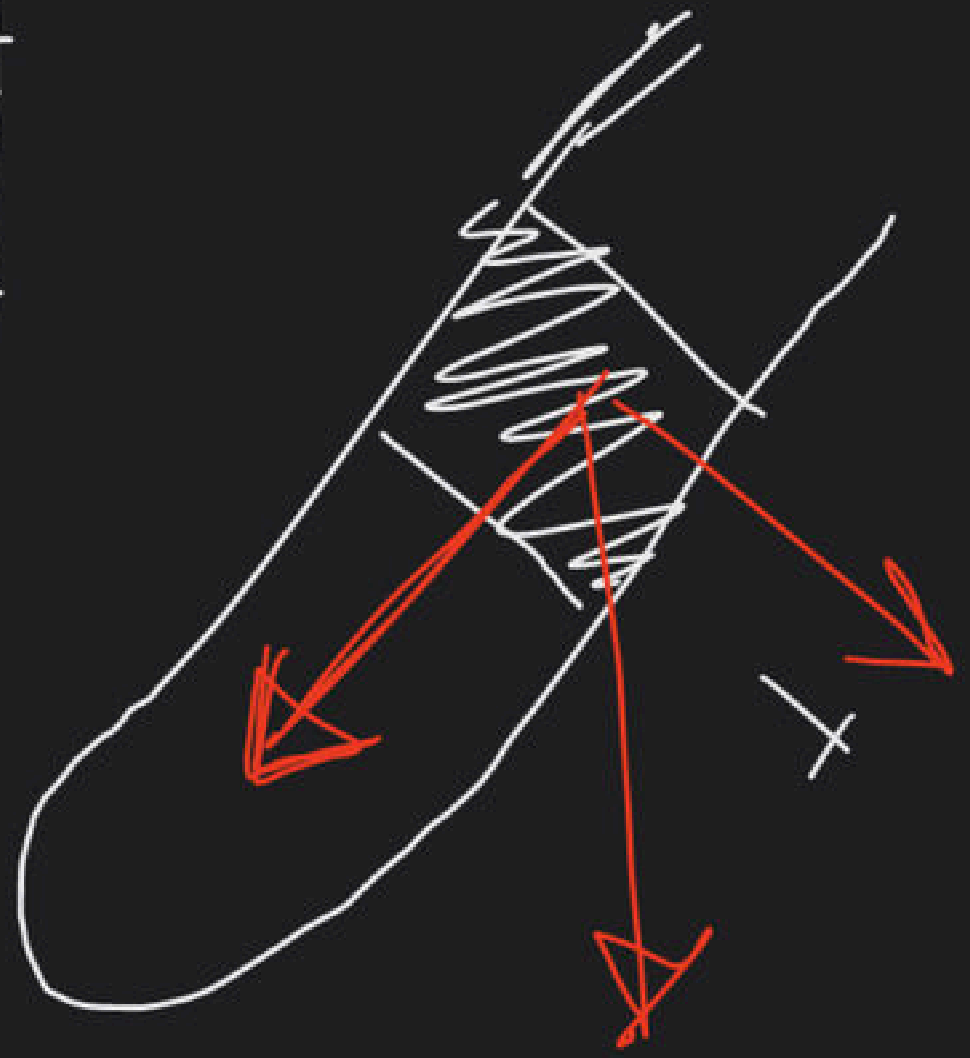
$$P_{gas} = h_1 d_1 g + P_{air}$$

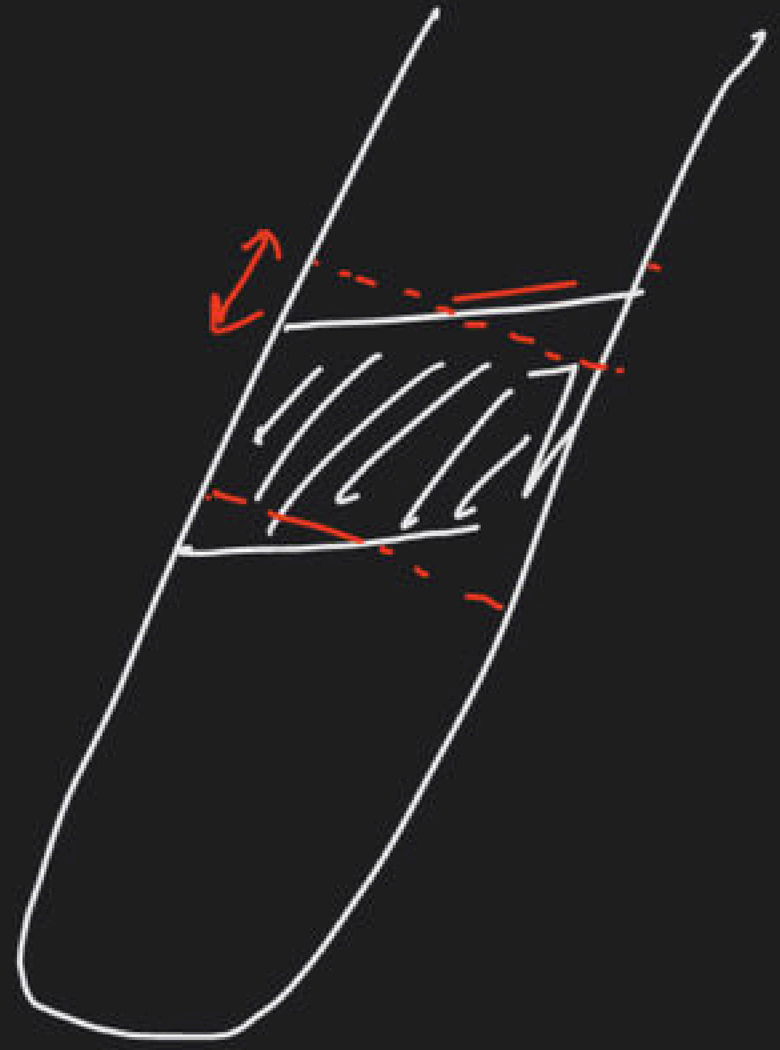




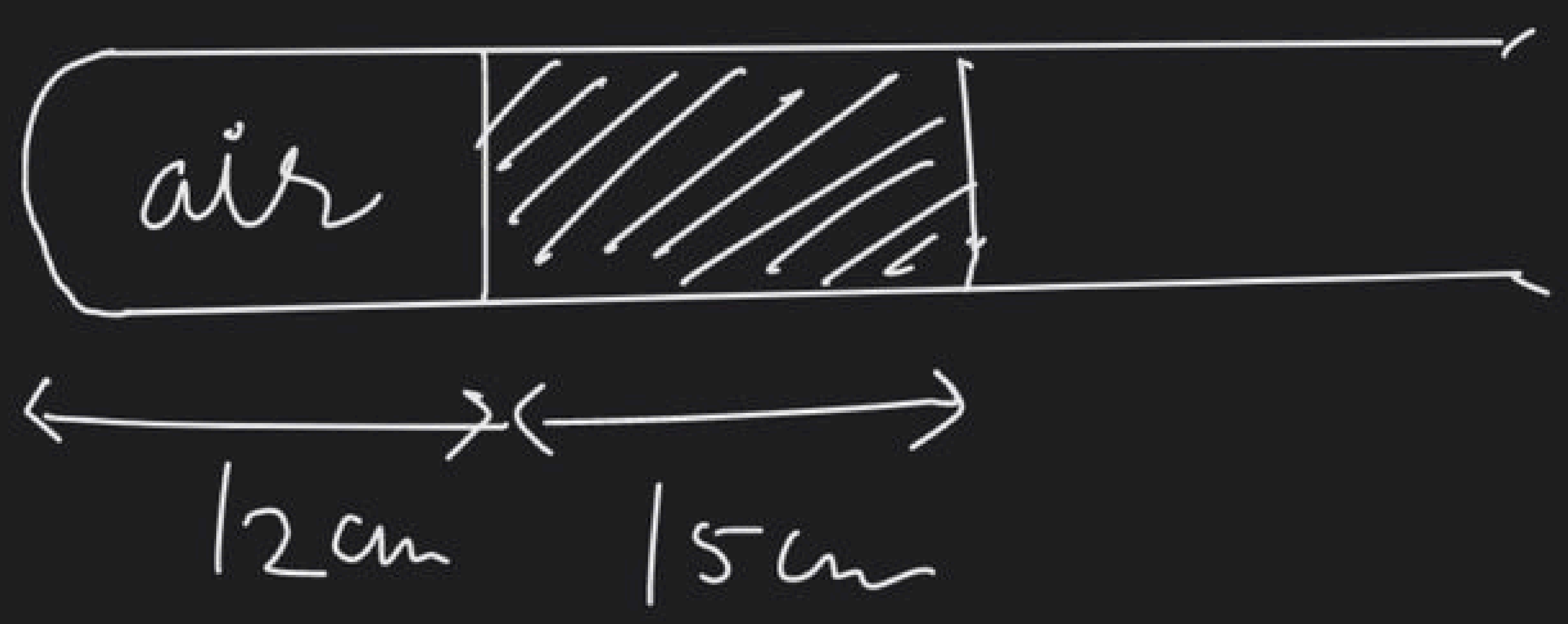








An air column of 12 cm length is trapped by a 15 cm mercury column in a tube as shown



$\underline{\underline{P_{air} = 75\,cm}}$

find the length of air column if tube is held

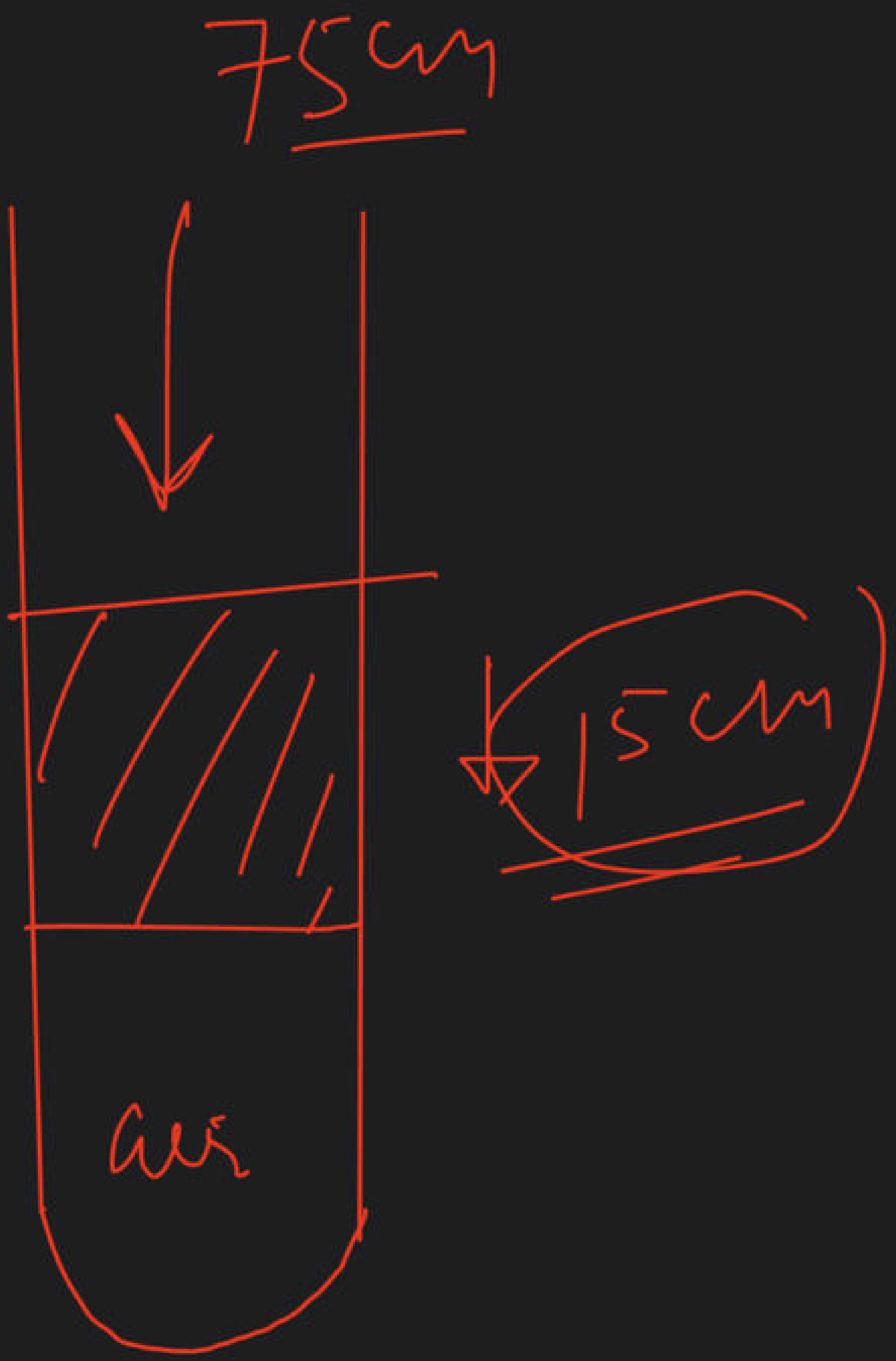
(1) Vertically with open end up

(2) " " open end down

(3) At angle 45° with open end up.

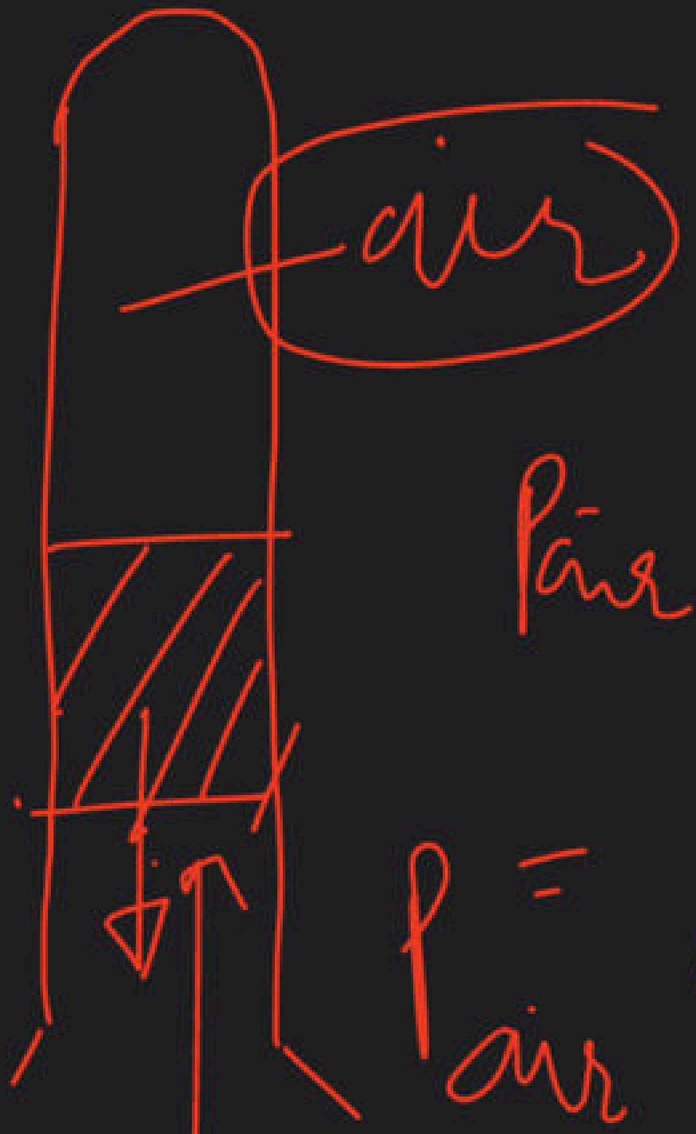
(A) 12 cm (B) 15 cm

(C) 10 cm (D) 18 cm.



$$75 \times 12 = 90 \times l_2$$

$$10 = l_2$$

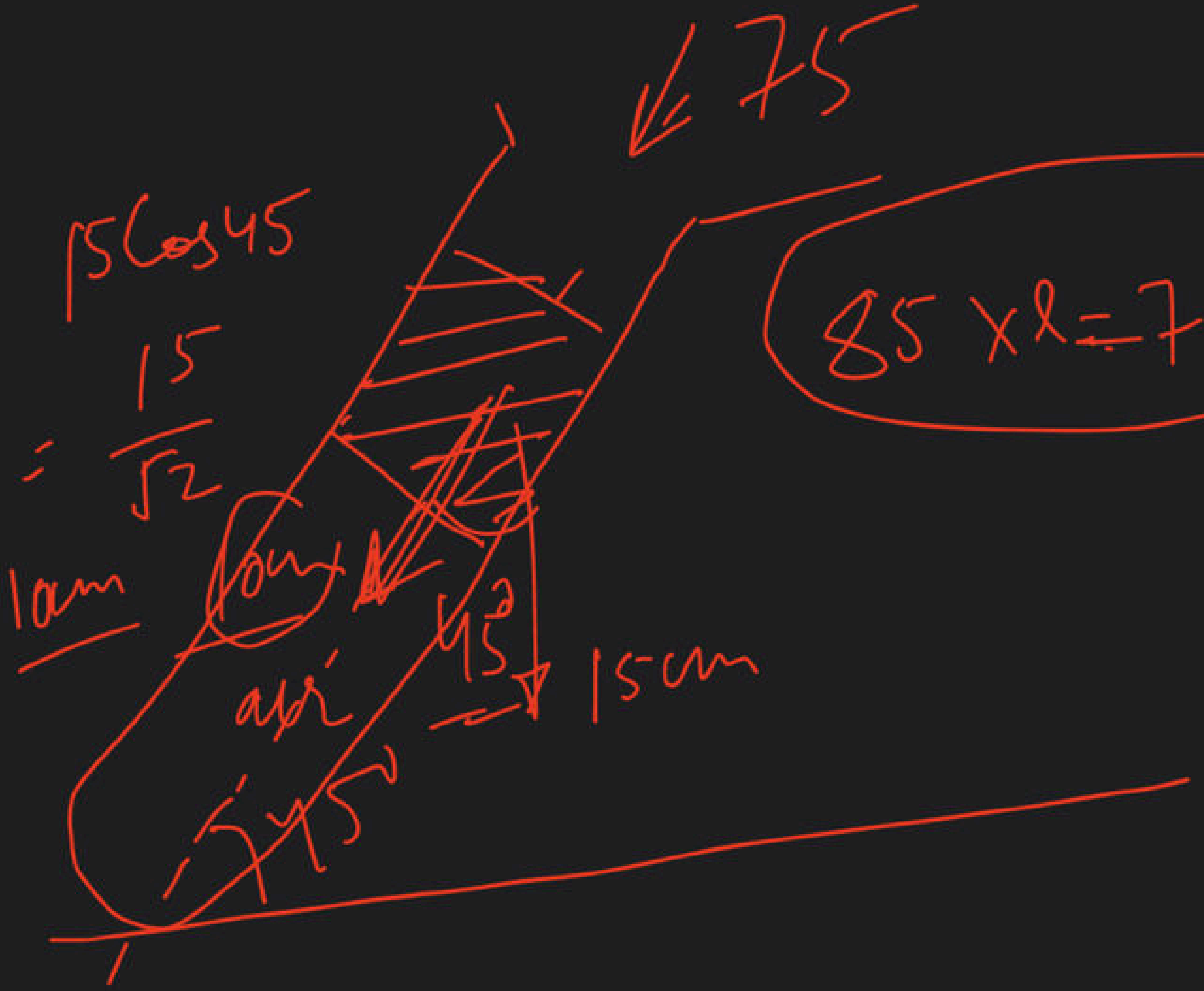


$$P_{air} + 15\,cm = 75\,cm$$

$$P_{air} = 60$$

$$75 \times 12 = 60 \times l$$

10cm



$$85 \times l = 75 \times 12$$

$$\sqrt{2} = 1.5$$

A 10—11

B 11—12

C 9—10

D 12—13

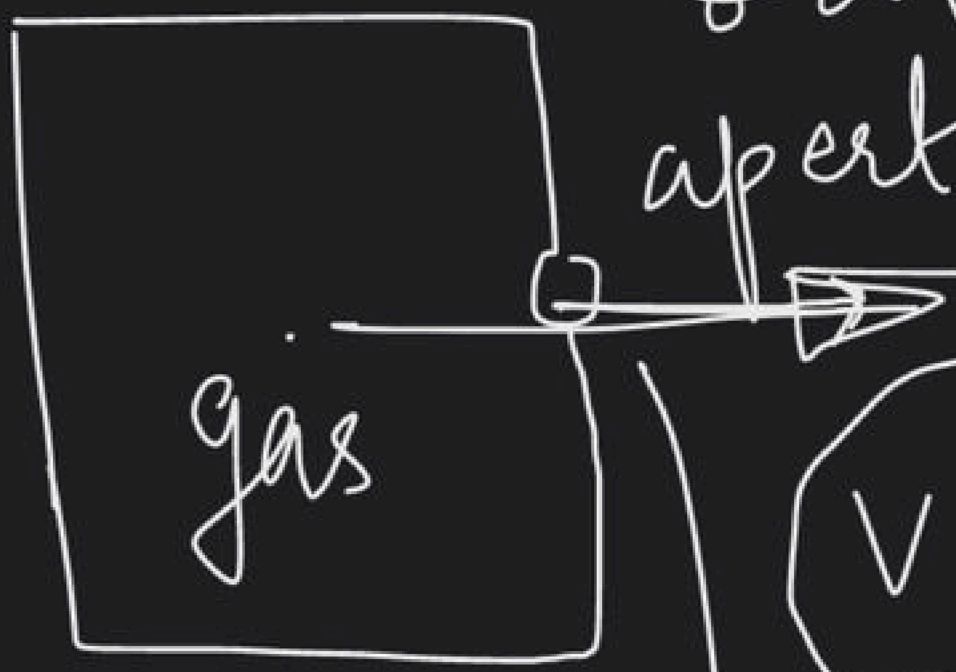
Graham's law of effusion :→

effusion

diffusion → Tendency to mix

orifice

aperture



Vacuum

small hole

$$-\underbrace{\frac{dn}{dt}}_{\substack{\text{rate of effusion} \\ \text{(no. of moles effused per unit time)}}} = \frac{PA_0}{(2\pi RTM)^{1/2}}$$

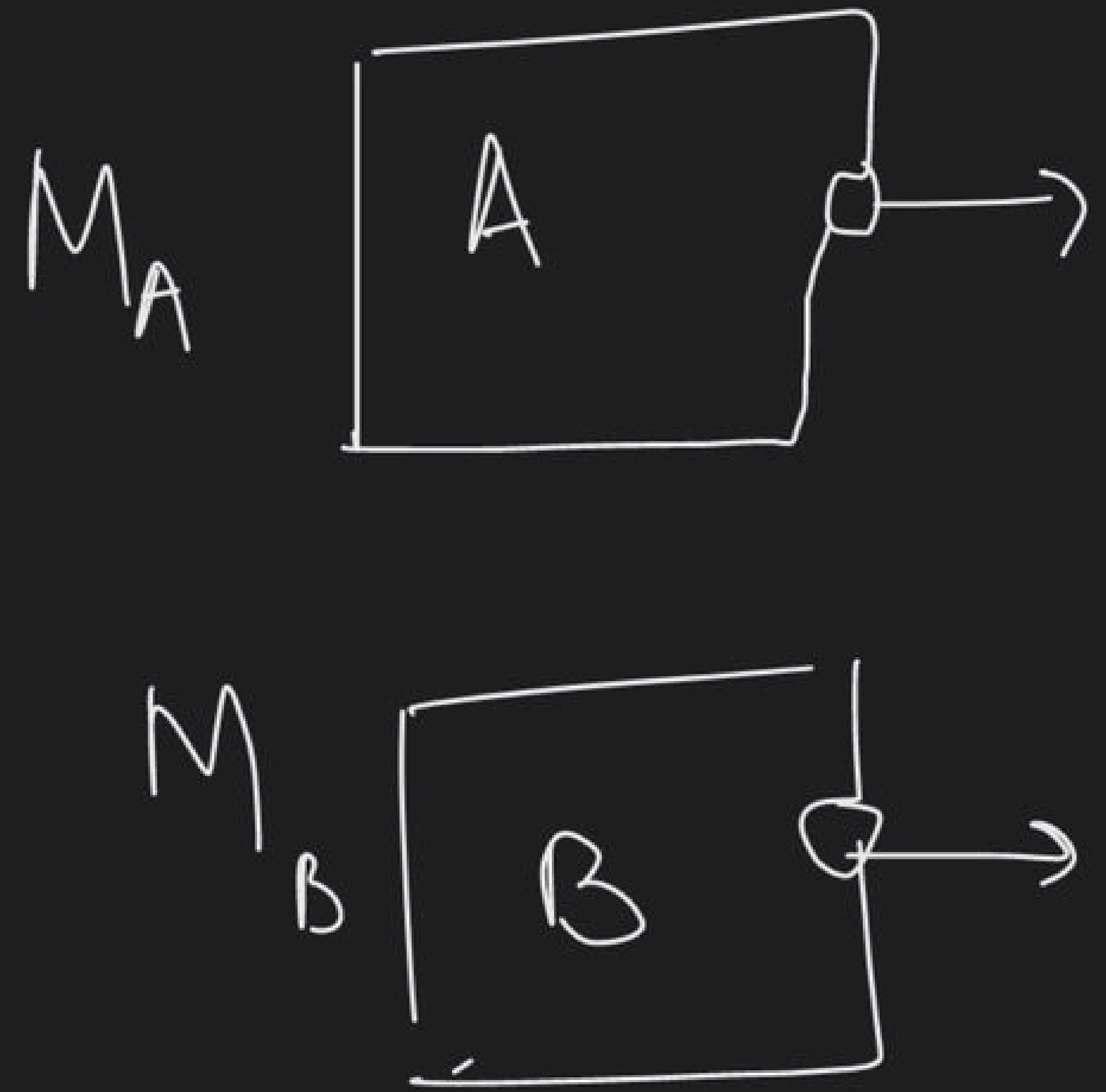
A_0 = Area of aperture

P = Pressure

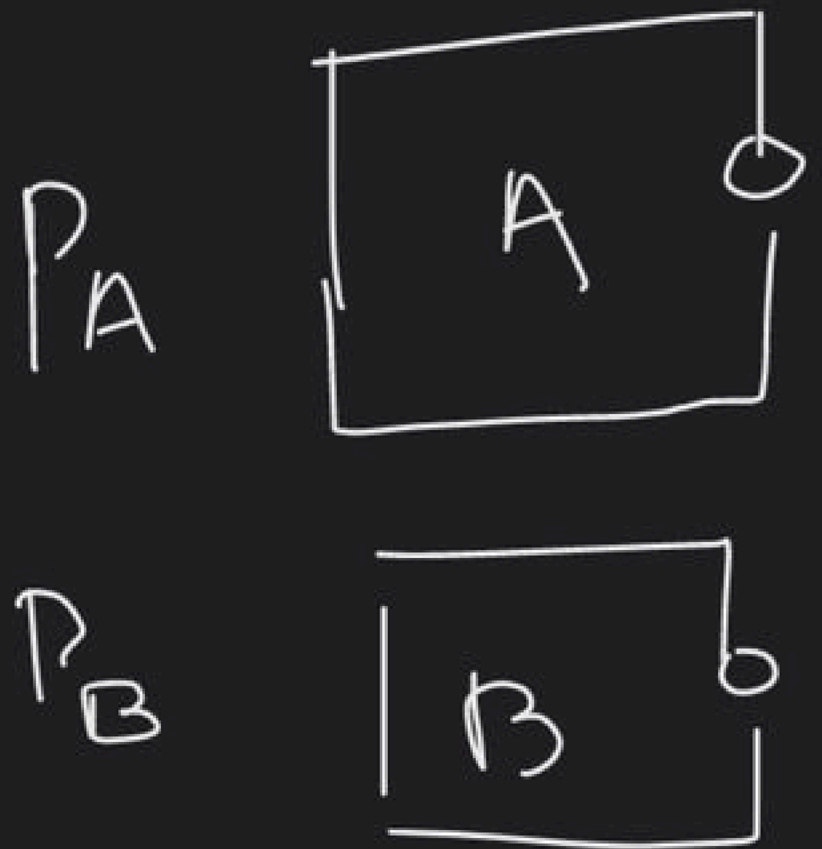
M = Mol. mass

rate of effusion $\left(-\frac{dn}{dt}\right) \propto \frac{1}{\sqrt{M}}$

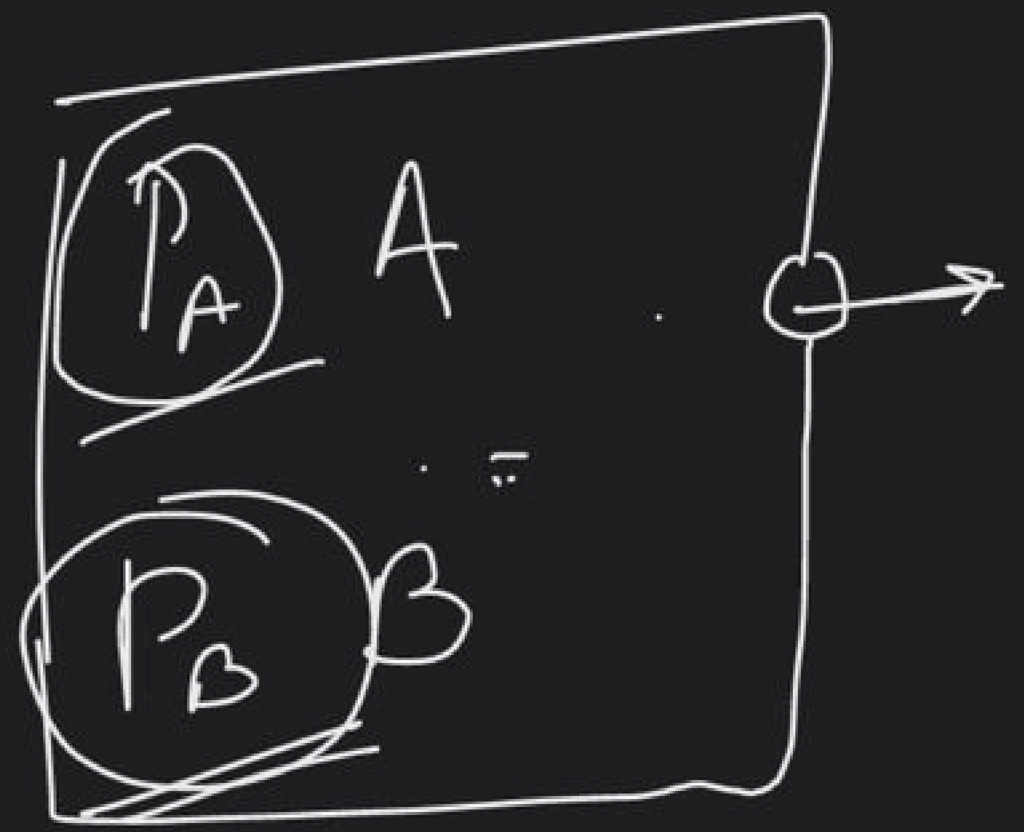
Graham's law :→ rate of effusion is inversely proportional to the square root of molecular mass.



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



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



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

Calculate ratio of rate of effusion of H_2 to O_2.

$$\frac{r_{H_2}}{r_{O_2}} = \sqrt{\frac{32}{2}} = 4$$

Calculate ratio of rate of effusion of He to CH_4 if container contains equal mass of both gases.

16 gm 16 gm

4 mol 1 mol

A 8

B 2

$$\frac{r_{He}}{r_{CH_4}} = \frac{4}{1}\sqrt{\frac{16}{4}} = 8$$

2. According to Graham's law, at a given temperature the ratio of the rates of diffusion $\frac{r_A}{r_B}$ of gases A and B is given by : **[JEE 1998]**

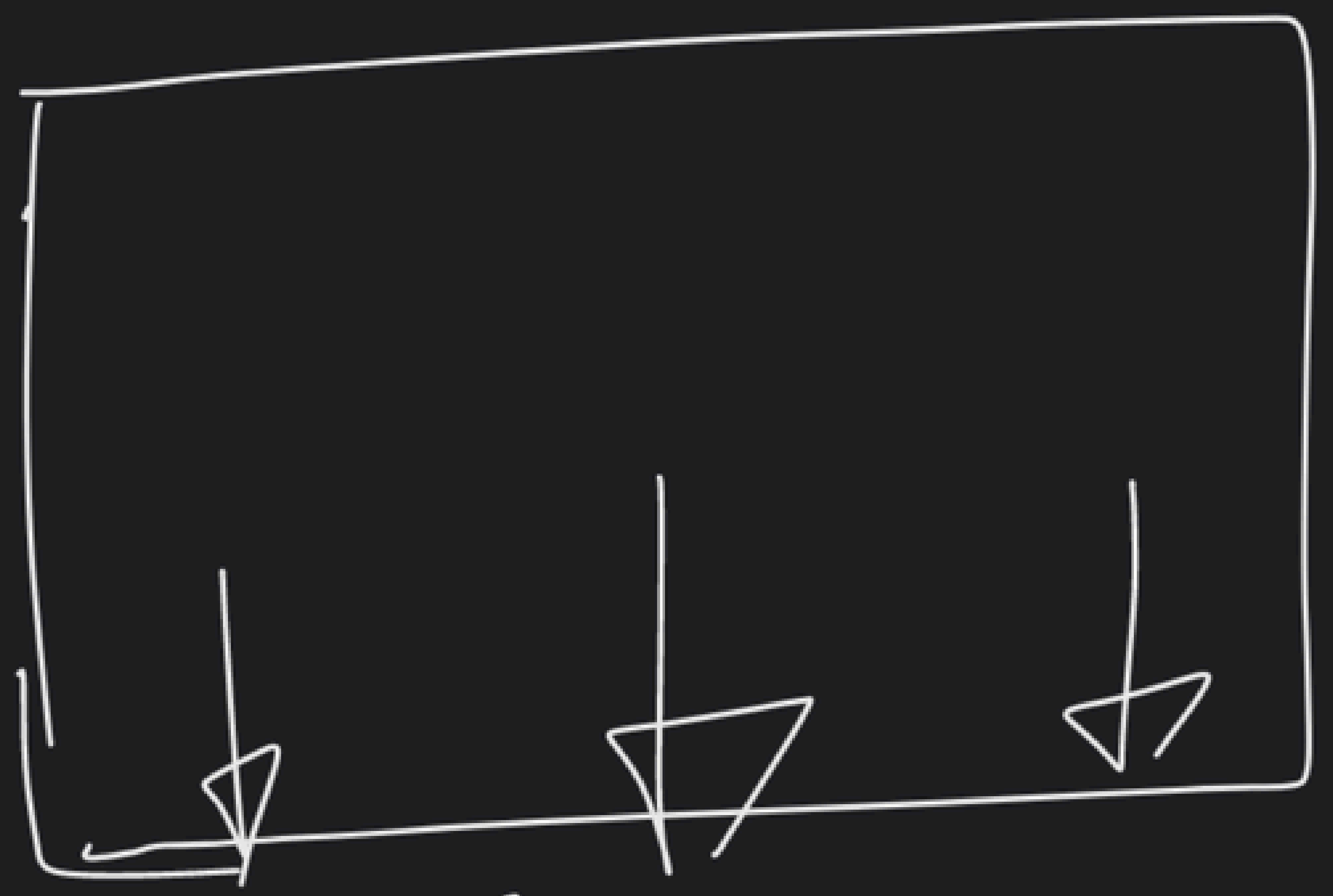
(A) $\frac{P_A}{P_B}\left(\frac{M_A}{M_B}\right)^{1/2}$ (B) $\left(\frac{M_A}{M_B}\right)\left(\frac{P_A}{P_B}\right)^{1/2}$ (C) $\frac{P_A}{P_B}\left(\frac{M_B}{M_A}\right)^{1/2}$ (D) $\frac{M_A}{M_B}\left(\frac{P_B}{P_A}\right)^{1/2}$

~~S-1 15, 16, 17, 18,~~

NCERT

12. The ratio of the rate of diffusion of helium and methane under identical condition of pressure and temperature will be **[JEE 2005]**

(A) 4 (B) 2 (C) 1 (D) 0.5



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$$PV = nRT$$

$T = 570$ $\quad$ $n = 2$

$V = 0$ $\quad$ $P = 1$

$$Pe^{V/2} = nCT$$

$$2 \times 2 =$$