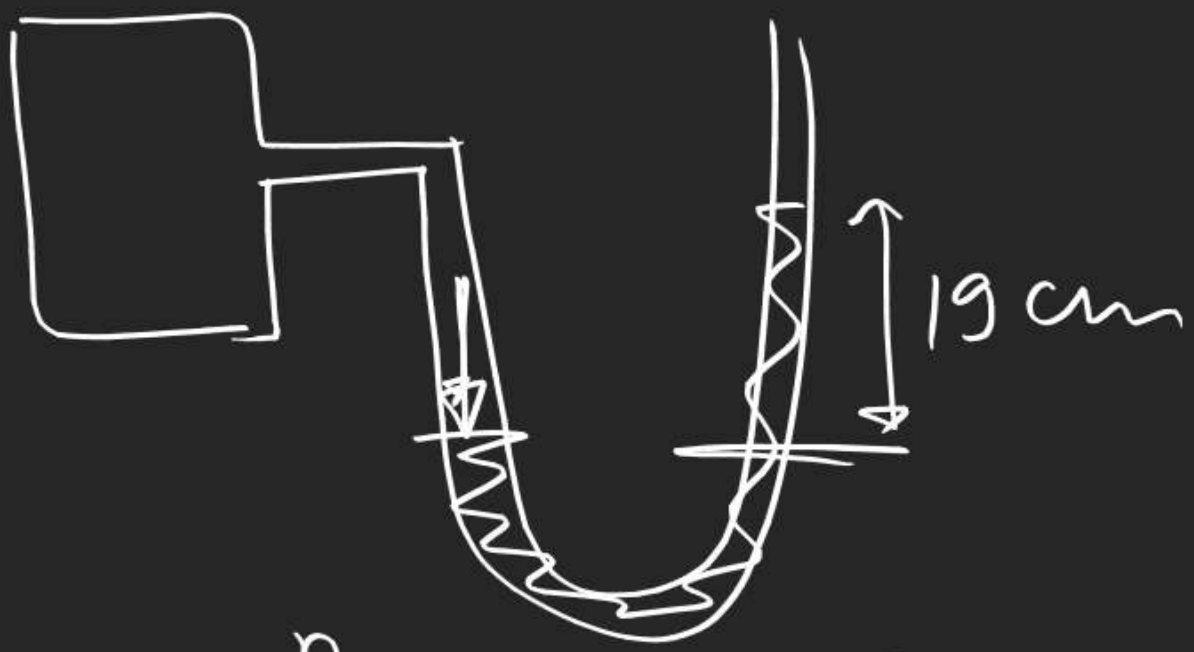
Ideal Gas

18



A_x

$$P_{gas} = 19 + 76$$

$$= 95 \text{ cm of Hg}$$

$$P_{gas} = \frac{95}{76} \text{ atm}$$

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

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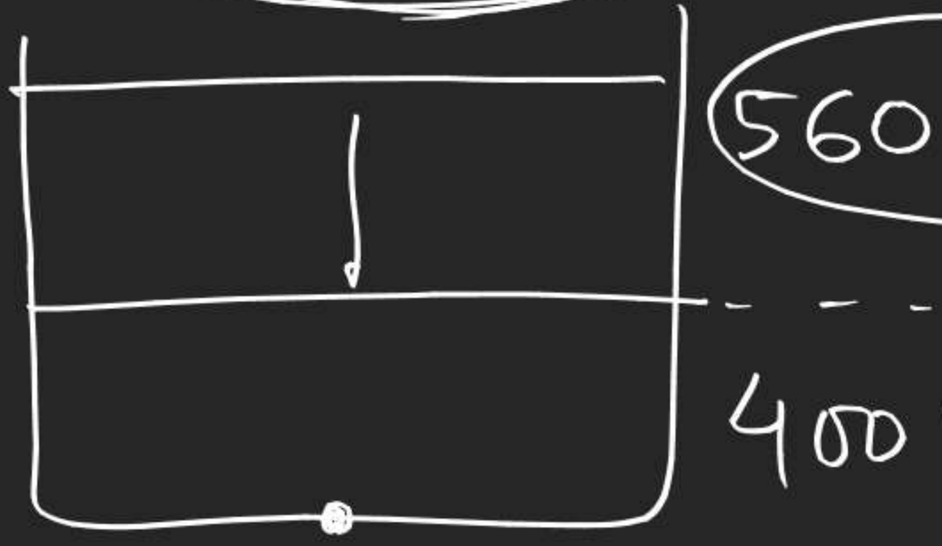
Ideal Gas

17

$P_{air} = 1\,atm$



560 mm

6.8

400 mm

3.4

13.6

280 mm of Hg

160 mm of Hg

380 mm of Hg

$\frac{1}{2}$ atm

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Ideal Gas

(14) $2NH_3 \longrightarrow N_2 + 3H_2$

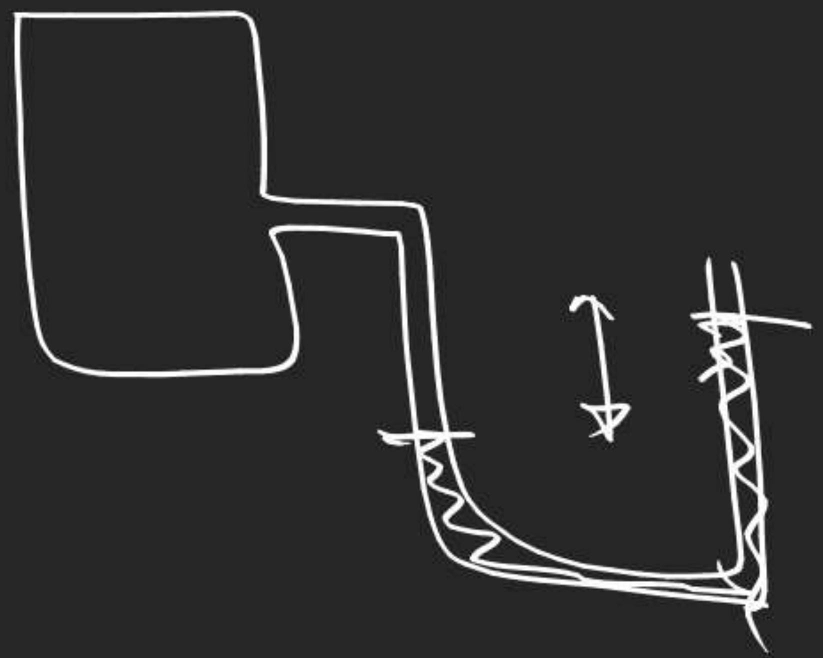
1 atm

$1-x \qquad x/2 \qquad 3x/2$

Total 'P' $= 1 + x = 1.25$

$x = 0.25$

$\frac{19}{76} = \frac{1}{4}$ atm



$P_T = 1.25$ atm

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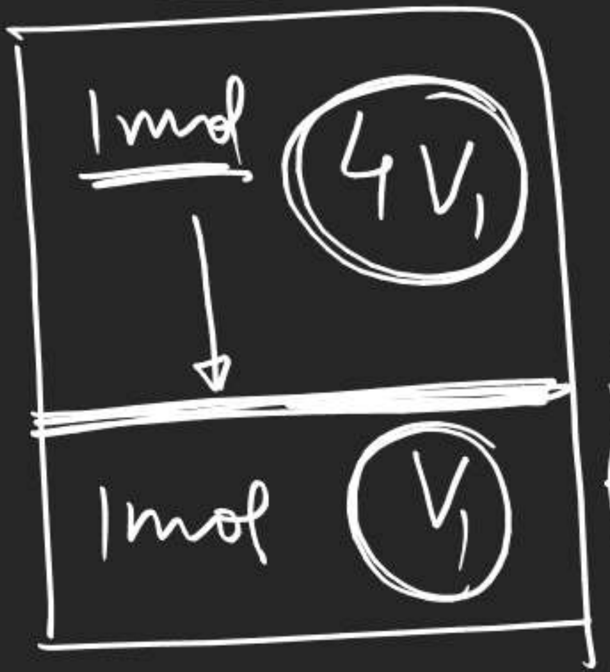
Ideal Gas

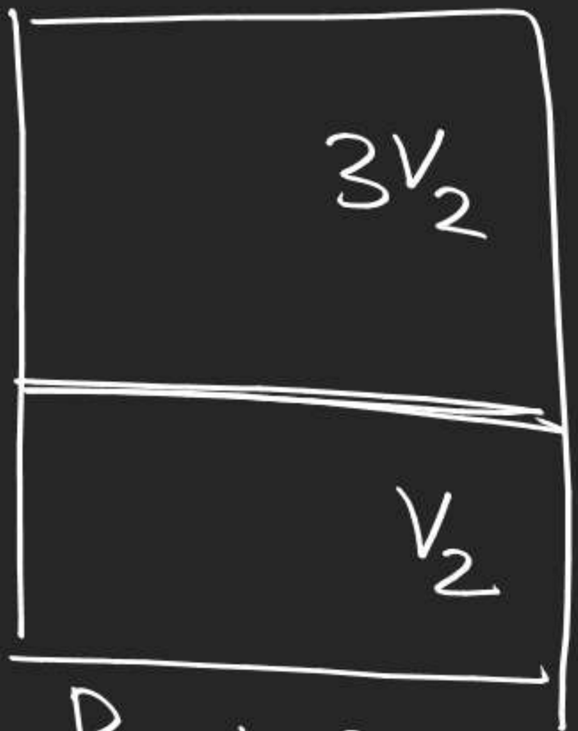
(20)

320K



$T_1 \to T_2$

P_P



$5V_1 = 4V_2$

$$P_U + P_P = P_L$$

$$\frac{RT_1}{4V_1} + \cancel{P_P} = \frac{RT_1}{V_1}$$

$$P_U + P_P + P_L$$

$$\frac{RT_2}{3V_2} + P_P = \frac{RT_2}{V_2}$$

$$\frac{T_1}{4V_1} - \frac{T_2}{3V_2} = \frac{T_1}{V_1} - \frac{T_2}{V_2}$$

Ideal Gas

1—3

16—18

$$P = \frac{nR}{V}\,T$$

(18) $\frac{1}{V^2}$ vs P

$$P = x$$

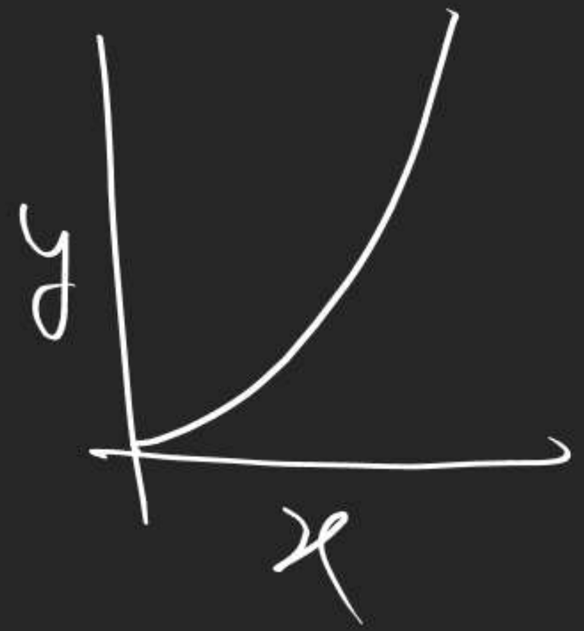
$$\frac{1}{V^2} = y$$

$$V = \frac{1}{\sqrt{y}}$$

$$PV = nRT$$

$$x\,\frac{1}{\sqrt{y}} = nRT$$

$$y = \frac{x^2}{nRT}$$



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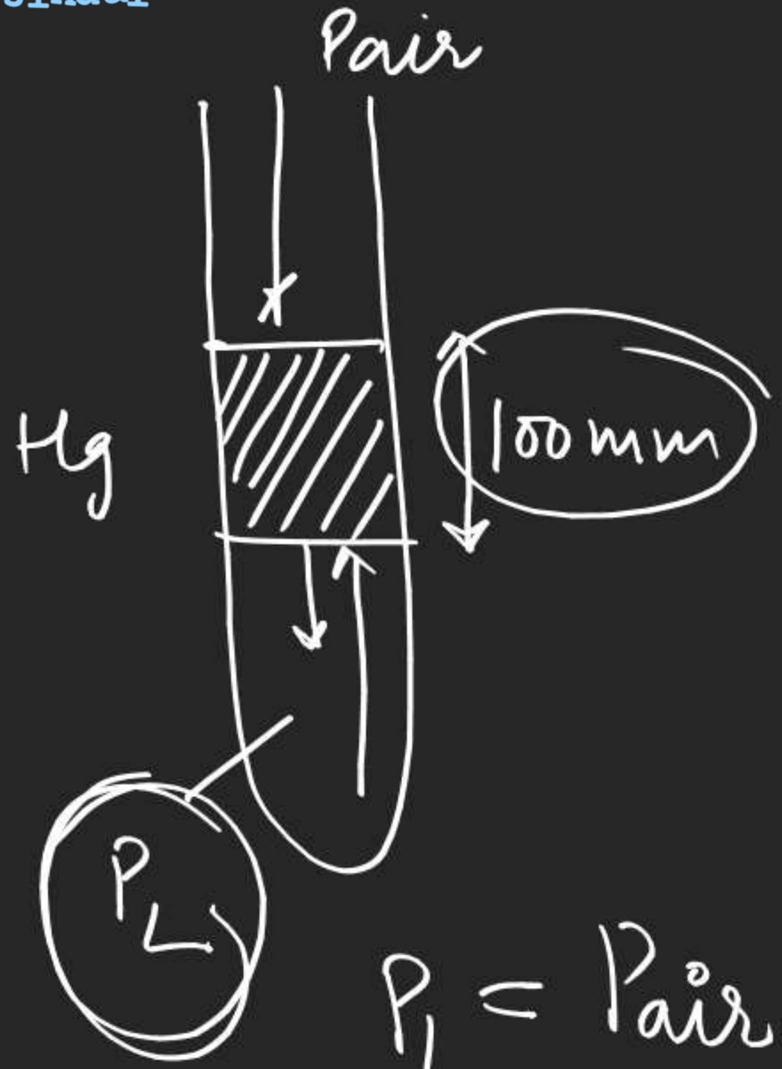

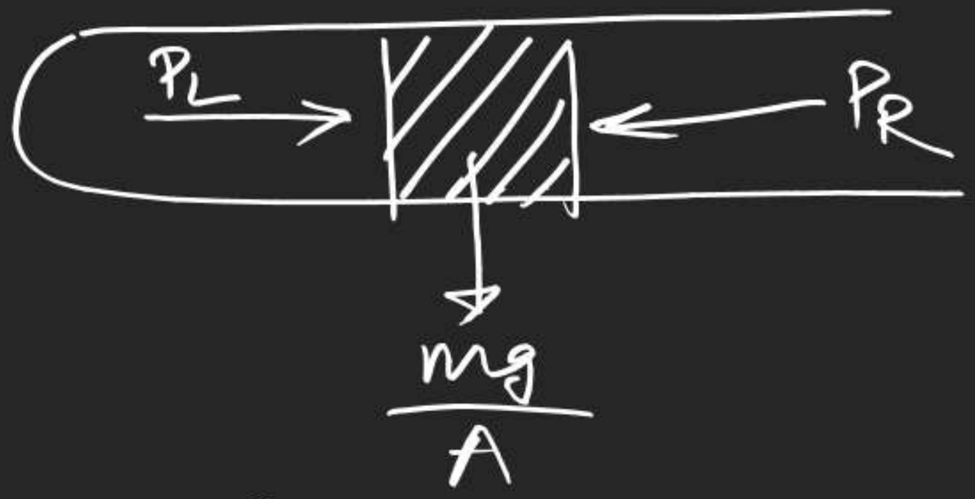

$$P_L = P_R$$

$$P_L = P_{air} + 100\,mm\ of\ Hg$$

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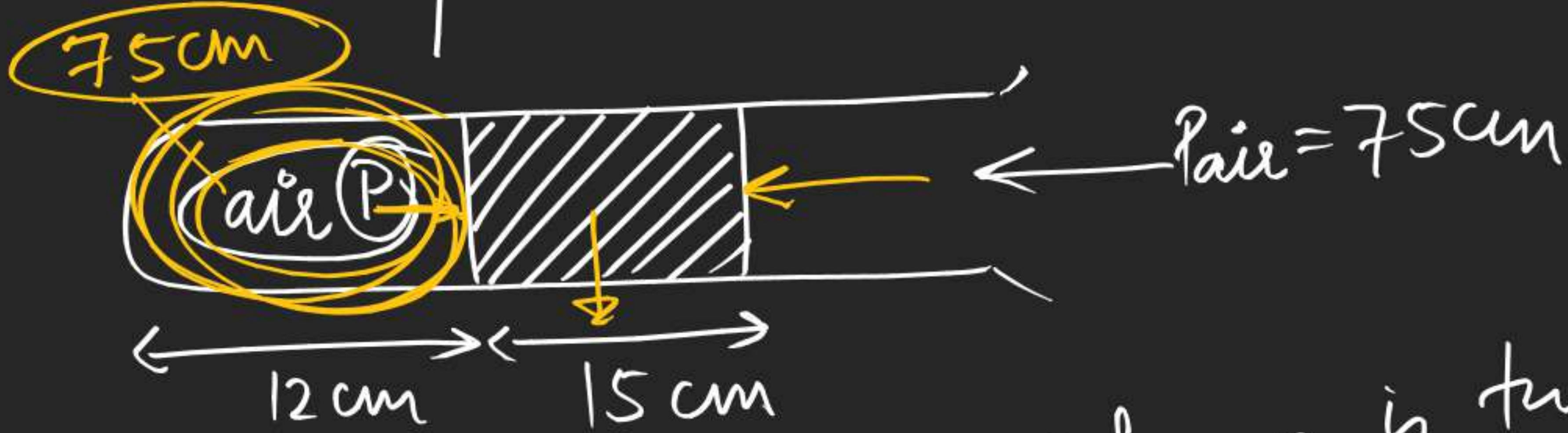
An air column of length 12 cm is trapped by mercury column as shown in diagram.



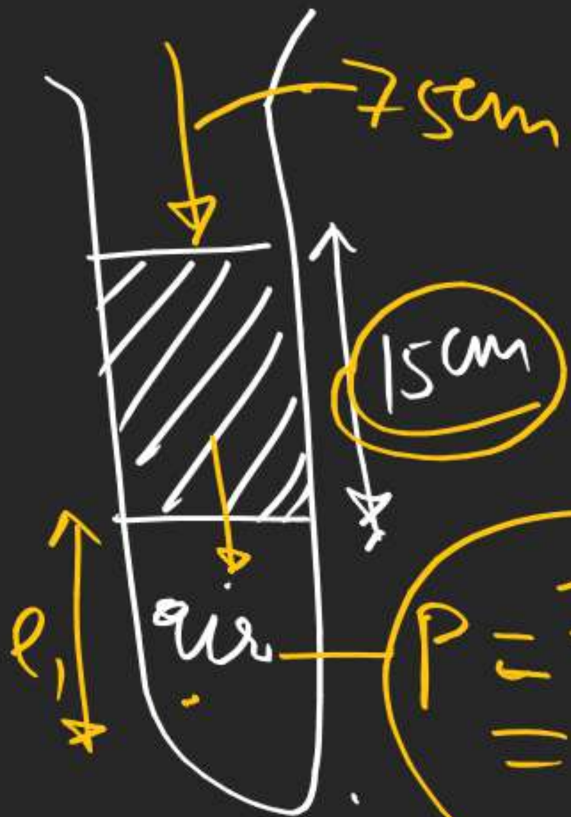
find the length of air column is tube is held

(i) Vertically with open end up (10)

(ii) " " " " down (15)

$$P_1 l_1 = P_2 l_2$$

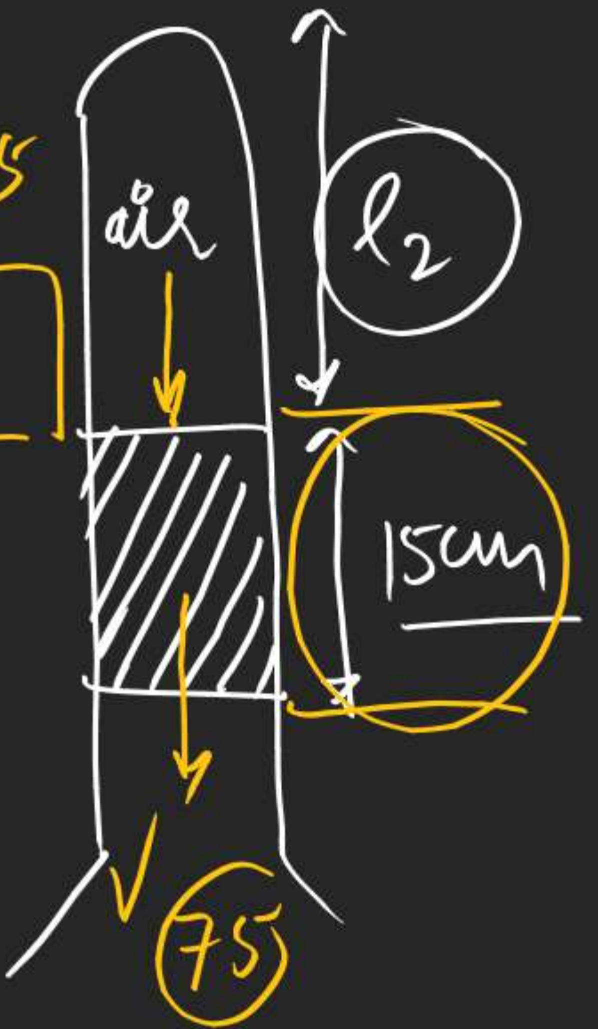
$$75 \times 12 = 90 \times l$$



$$P = 75 + 15 = 90$$

$$P_{air} + 15 = 75$$

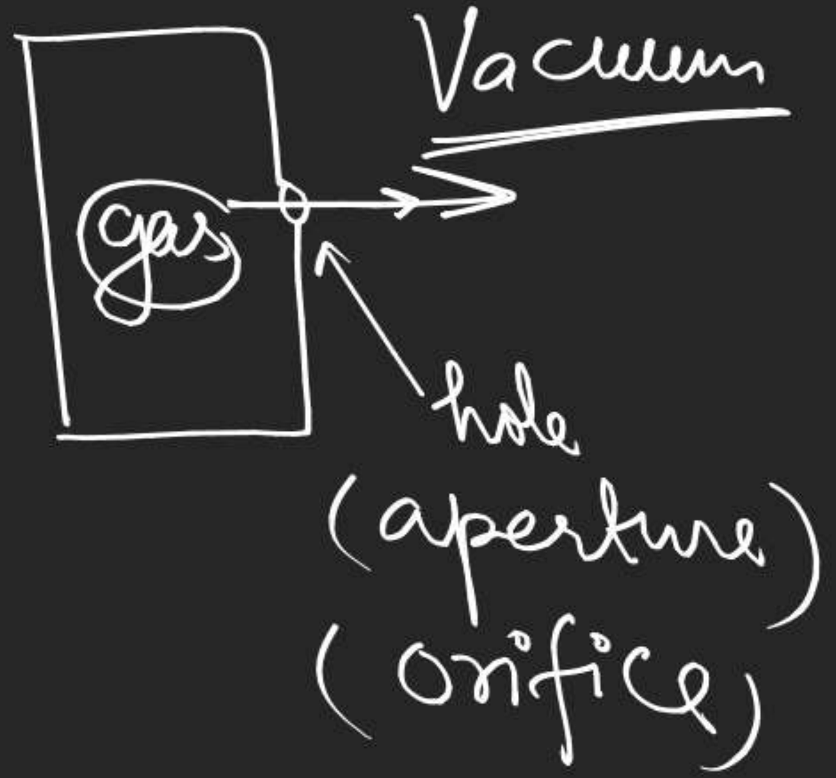
$$\boxed{P_{air} = 60}$$



Graham's law of effusion :→

diffusion → Tendency to mix up

effusion →



$$r = -\frac{dn}{dt} = \frac{PA_0}{(2\pi RTM)^{1/2}}$$

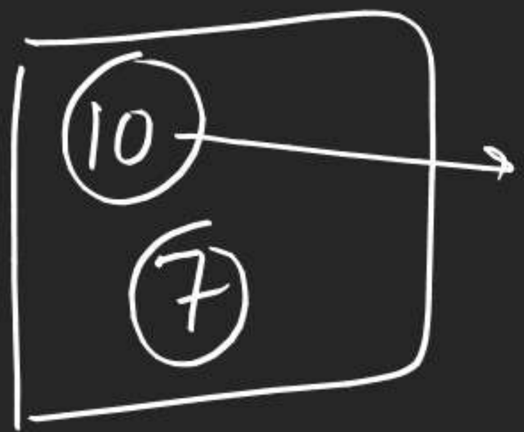
rate of effusion

A_0 = area of aperture

P = Pressure of gas

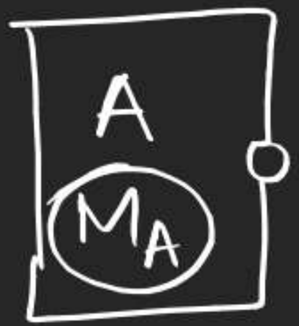
Acc to Graham's Law

rate of effusion is inversely proportional to square root of Molar mass. $r \propto \frac{1}{\sqrt{M}}$



$$\Delta n = n_f - n_i$$
$$= 7 - 10 = -3$$

(1)



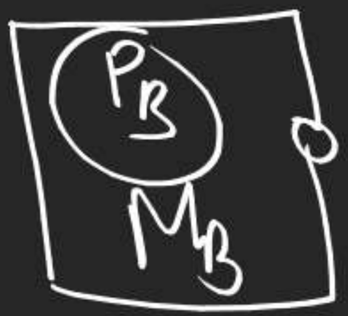
$$r_A \propto \frac{1}{\sqrt{M_A}}$$

$$r_B \propto \frac{1}{\sqrt{M_B}}$$

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

(2)

$$r_A \propto P_A / \sqrt{M_A}$$



$$r_B \propto P_B / \sqrt{M_B}$$

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

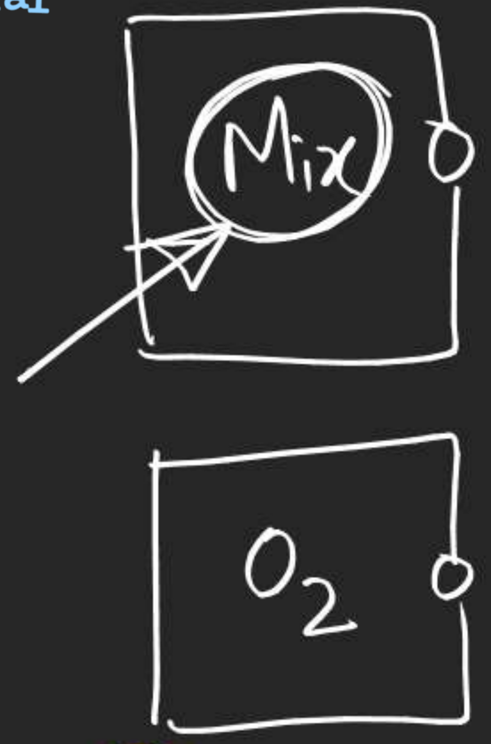
(3)

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

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

(4)

(4)



$$\frac{r_{mix}}{r_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{mix}}}$$

$$M_{mix} = M_{avg}$$

(ii) 16 gm 16 gm

$n_{He} = 4$ $n_{CH_4} = 1$ mol

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

Q find ratio of rate of effusion of He to CH_4 if container contains

(i) Equal moles of each gas

(ii) " mass of " "

(i)
$$\frac{r_{He}}{r_{CH_4}} = \frac{n_{He}}{n_{CH_4}}\sqrt{\frac{16}{4}} = \sqrt{4} = \frac{2}{1}$$

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Q. A mixture containing He and CH_4 in 2 : 1 mol ratio. find ratio of rate of effusion of this mixture w.r.t $O_2(g)$.

He	CH_4
2	1

$$M_{avg} = \frac{2 \times 4 + 1 \times 16}{3} = 8$$

$$\frac{r_{mix}}{r_{O_2}} = \sqrt{\frac{32}{8}} = \frac{2}{1}$$

Assumption: Rate of effusion is constant with time

$$\text{rate of effusion} = \frac{\text{no. of moles effused}}{\text{time taken}} = \frac{n}{t}$$

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

$$\frac{n'_A/t_A}{n'_B/t_B} = \frac{P_A}{P_B}\sqrt{\frac{M_B}{M_A}} = \frac{n_A}{n_B}\sqrt{\frac{M_B}{M_A}}$$

$$\text{rate of effusion} \propto \frac{\text{Vol. of gas effused}}{\text{time taken}}$$

$$\frac{V_A/t_A}{V_B/t_B} = \frac{n_A}{n_B}\sqrt{\frac{M_B}{M_A}}$$

Q. 100 ml CH_4 effused out in 10 sec. find the volume of SO_2 effused in 40 sec. under similar condition.

$$\frac{100/10}{V_{SO_2}/40} = \frac{V_{CH_4}/10}{V_{SO_2}/40} = \sqrt{\frac{64}{16}} = 2$$

$$V_{SO_2} = \frac{40 \times 10}{2} = 200\,ml$$

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rate of effusion $\propto$ speed $= \dfrac{\text{distance travelled}}{\text{time taken}} = \dfrac{d}{t}$

$$\frac{r_A}{r_B} = \frac{d_A/t}{d_B/t} = \frac{x}{y} = \sqrt{\frac{M_B}{M_A}}$$

Q. A classroom consist of 13 equidistant rows of benches. A student from 1^{st} bench releases N_2O (Laughing gas) simultaneously a student from last bench releases weeping gas (Mol mass 176) find the row at which students start laughing and weeping simultaneously

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$\boxed{0 - I \qquad 27 - 36}$

from front 9^{th} Bench