Vessles

Open	Close
P, V } constant	V, n } constant
n variable	P variable.

Q:9 if pressure of a gas available in closed vessel increased by 4% when heated by 1°C at its initial temperature. Find out its initial temperature

250 K

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

$T_1 = t + 273$

$T_2 = t + 274$.

$P_1 = 100$ $P_2 = 100.4$.

$\frac{100}{t+273} = \frac{100.4}{t+274}$

$100 (t+274) = 100.4 (t+273)$

$100t + 274(100) = 100.4t + 273(100.4)$

$100.4t - 100t = 27409.2 - 27400$

$0.4t = 9.2$

$\frac{4}{10}t = \frac{92}{10}$

$40t = 920$

$t = \frac{920}{40} \rightarrow 23$

$$\frac{100}{t} = \frac{100.4}{t+1}$$

$\longrightarrow$ $100t + 100 = 100.4t$

$0.4t = 100$ $\qquad t = \underline{250}$.

$\Rightarrow$ Actual pressure of any gas is calculated by:

P_{obs} or $P_{moist\ gas} = P_{dry\ gas} + P_{water\ vapour}$

$P_{dry\ gas} = P_{moist\ gas} - \text{Aqueous tension}$

$P_{moist\ gas} = P_{dry\ gas} + \text{Aqueous tension}$.

- aqueous tension of water vapour is temperature dependent.

Q:10 Certain amount of nitrogen gas at 27°C temperature show pressure in manometer 800mmHg. If aqueous tension at this temperature is 20mmHg. Then find out mass of N gas, the volume of container is 2ltr.

$\Rightarrow$ $P_{dry\ gas} = 800 - 20$

$= 780\ mmHg$

$PV = nRT$

$\frac{780 \times 2 \times 1}{760 \times 0.0821 \cdot 300} = \frac{N}{28}$

$$W = \frac{78 \times 2 \times 28}{76 \times 300 \times 0.082}$$

$= \frac{43080}{1909 \times 6}$

$= \frac{228410}{9848}$ $\quad \frac{11420}{4924}$ $\quad \frac{5710}{2462}$ $\quad \frac{2853}{1231}$

$\approx$ 2.2gm

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Absolute density of ideal gas:

$PV = nRT$

$PV = \frac{wt}{M} RT.$

$PM = \frac{wt}{V} RT. \quad \frac{PM}{PT} = d$

$$d = \frac{PM}{RT} \text{ gm/ltr.}$$

Q:11 Find density of CO_2 gas at 127°C temperature and 2 atm pressure.

$\Rightarrow d = \frac{2 \times 44}{0.082 \times 400} \Rightarrow \frac{22}{100 \times 0.082}$

$= \frac{22}{8.2} \rightarrow \frac{220}{82} \quad \frac{55}{23} \quad \boxed{2.3}$

Q:12 at 300°C temperature density of gaseous molecule at 2bar is double to that N_2 gas at 4 bar. Find out molar mass of gaseous molecule.

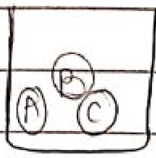
$\Rightarrow d = \frac{4 \times 28}{R \times 300}$

$(2)\left(\frac{4 \times 28}{R \times 300}\right) = \frac{x \times 2}{R \times 300}$

$$\boxed{x = 112 gm}$$

Dalton's law of partial pressure:

- Dalton's law of partial pressure state at a given temperature, the total pressure exerted by two or more non-reactive gases occupying at definite volume is equal to sum of partial pressure of component gases.



at constant V & T

$$P_{total} = P_A + P_B + P_C$$

OR

$$P_{total} = (n_A + n_B + n_C)\frac{RT}{V} \quad \text{— eq(1)}$$

$$P_A = n_A\left(\frac{RT}{V}\right) \text{— eq(2)} \qquad P_B = n_B\left(\frac{RT}{V}\right) \text{— eq(3)}$$

$$P_C = n_C\left(\frac{RT}{V}\right) \text{— eq(4)}$$

for measuring partial pressure of gas then eq(2) compare with eq(1).

$$\frac{P_A}{P_{total}} = \frac{n_A \cancel{(RT/V)}}{(n_A + n_B + n_C)\cancel{(RT/V)}}$$

$$\frac{P_A}{P_{total}} = \frac{n_A}{n_A + n_B + n_C}$$

$$\frac{P_A}{P_{total}} = x_A$$

$$P_A = x_A \cdot P_{total}.$$

Q:13 Equal mass of SO_2, CH_4 and O_2 are mixed in an empty container at 298K where total p is 2.1 atm. Partial pressure of CH_4.

⟹ total moles

$$= x\left[\frac{1}{64} + \frac{1}{16} + \frac{1}{32}\right]$$

$$= x\left[\frac{1+4+2}{64}\right] = x\left(\frac{7}{64}\right)$$

$$P_{CH_4} = \frac{x}{16} \cdot \frac{64}{7}$$

$$= \frac{x\,(64)\times 2.1}{(16)\,(x)(7)} \longrightarrow \boxed{1.2}$$

Q:14 A gaseous mixture by taking equal mole of CO_2 and N_2 if total pressure of mixture was found 1 atm. Partial pressure of N_2 in mixture.

⟹ $P_{N_2} = \frac{x}{2x} \cdot 1$

lets, take total mole of $(N_2) = (CO_2) = x$

$\boxed{= 0.5\text{ atm}}$

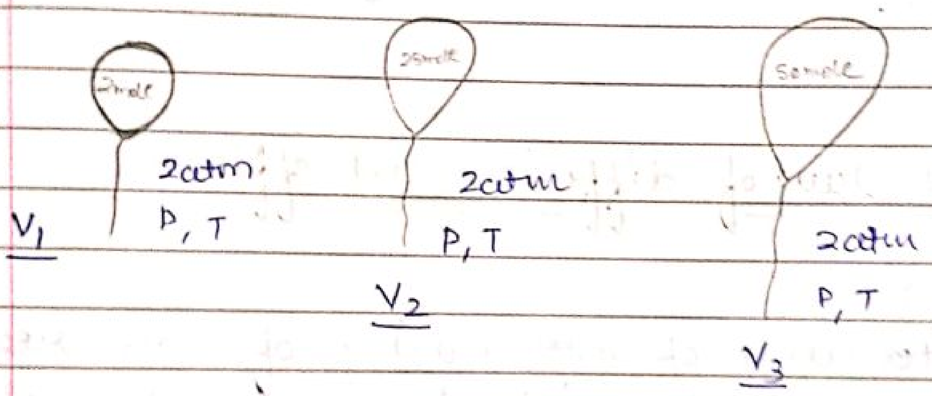
Q:15 A mixture of N_2 and Ar gases in cylinder contains 7gm of N_2 and 8gm of Ar. If total pressure of mix of gases is 27 bar, partial pressure of N_2 is (2020)

⇒

Amagat's laws

- according to this law at constant temperature and pressure, the total volume of mixture of gases which don't react is equal to the sum of partial volumes of each component present in mixture.

$$V_{Total} = V_1 + V_2 + V_3 + \ldots$$



- $V_T = n_1 + n_2 + n_3 \left(\frac{RT}{P}\right)$ —— eq(I)

partial vol. of gas-1

$V_1 = n_1 \left(\frac{RT}{P}\right)$ —— eq(II)

partial vol. of gas-2

$V_2 = n_2 \left(\frac{RT}{P}\right)$ —— eq(III)

compare eq^n (II) with eq^n (I)

$$\frac{V_1}{V_T} = \frac{n_1 \cancel{(RT/p)}}{n_1+n_2+n_3 \cancel{(RT/p)}}$$

$$\boxed{V_1 = X_1 V_T.}$$

- Amagat's law is applicable for flexible conteiners.

Graham's law of diffusion and effusion:

- Diffusion:

→ tendency of inter-mixing of non-reacting gas spontaneously without any external pressure.

Or

→ property of spontaneous flow of gaseous molecules too low concentration from high concentration without external pressure.

here,

$$P_{ext} = \text{constant}.$$

· **Effusion:**

→ property of the flow of gaseous molecules from high concentration to low concentration in a hole with external pressure.

here,

P_{ext} = variable

⇛ Rate of diffusion or effusion:

- represented by 'r'.
- calculated by 3 ways:
  I) mole, II) volume III) distance.

$$r = \frac{\text{no. of mole of gas diffuse}}{\text{time taken (sec)}} = \frac{\text{vol. of dif. gas}}{\text{time (sec)}} = \frac{\text{distance trave}}{\text{time (sec)}}$$

→ according to Graham's law;

∘ at constant pressure, temperature and area rate of diffusion for any gas is inversely proportional to $\sqrt{\text{mol. wt.}}$

$$\text{Rate}(r) \propto \frac{1}{\sqrt{\text{m.wt.}}}$$

· also rate of diffusion is inversely proportional to $\sqrt{\text{density}}$, or $\sqrt{\text{vapour density}}$

$$\text{Rate}(r) \propto \frac{1}{\sqrt{d}} \quad \text{or} \quad \frac{1}{\sqrt{vd}}$$

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• at constant temperature and area but variable pressure than rate of diffusion is directly proportional to pressure. or V (partial pressure)

$$\text{Rate}(r) \propto P \quad \text{or} \propto V$$

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{r_1}{r_2} = \sqrt{\frac{d_2}{d_1}}$$

$$\frac{r_1}{r_2} = \frac{P_1}{P_2}$$

$$\frac{r_1}{r_2} = \frac{P_1}{P_2}\sqrt{\frac{M_2}{M_1}}$$

$$\frac{V_1}{V_2} \times \frac{t_2}{t_1} = \frac{P_1}{P_2}\sqrt{\frac{M_2}{M_1}}$$

$$\frac{V_1}{V_2} = \frac{P_1}{P_2}\sqrt{\frac{M_2}{M_1}}$$ if same time given

$$\frac{V_1}{V_2} \times \frac{t_2}{t_1} = \sqrt{\frac{M_2}{M_1}}$$ if same pressure given

Q:16 50ml of each gas A and of gas B takes 150 and 200 seconds respectively for effusing through pin hole under similar condition. If molecular mass of gas B is 36, molecular mass of gas A will be?

[AIPMT 2012]

⟹ volume = 50 ml for both

hence, $\frac{t_2}{t_1} = \sqrt{\frac{m_2}{m_1}}$

$\frac{200}{150} = \sqrt{\frac{36}{x}} \rightarrow \frac{6}{\sqrt{x}}$

$\sqrt{x} = \frac{18}{4} = \frac{9}{2}$ ∴, $x = \left[\frac{9}{2}\right]^2$

$= \frac{81}{4}$

Q:17 Two gases A and B having same volume diffuse through porous partition in 20 and 10 seconds respectively. Molecular mass of A is 49u. Find molecular mass of B.

[AIPMT 2011]

⟹ volume = same

hence, $\frac{t_2}{t_1} = \sqrt{\frac{m_2}{m_1}}$

$\frac{10}{20} = \sqrt{\frac{x}{49}} \rightarrow \frac{\sqrt{x}}{7}$

$\sqrt{x} = \frac{7}{2}$ ∴, $x = \left[\frac{7}{2}\right]^2 \longrightarrow \frac{49}{4}$ or 12.25