3.GASEOUS STATE

Temperature Scale :

$$\frac{C-O}{100-0} = \frac{K-273}{373-273} = \frac{F-32}{212-32} = \frac{R-R(O)}{R(100)-R(O)}$$ where R = Temp. on unknown scale.

Boyle's law and measurement of pressure :

At constant temperature, $V \alpha \frac{1}{P}$

$P_1V_1 = P_2V_2$

Charles law :

At constant pressure, $V \alpha T$ or $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Gay-lussac's law :

At constant volume, $P \alpha T$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\rightarrow$ temp on absolute scale

Ideal gas Equation :

$PV = nRT$

$PV = \frac{w}{m} RT$ or $P = \frac{d}{m} RT$ or $Pm = dRT$

Daltons law of partial pressure :

$P_1 = \frac{n_1 RT}{v}$, $P_2 = \frac{n_2 RT}{v}$, $P_3 = \frac{n_3 RT}{v}$ and so on.

Total pressure = $P_1 + P_2 + P_3 + \ldots\ldots\ldots\ldots$

Partial pressure = mole fraction X Total pressure.

Amagat's law of partial volume :

$$V = V_1 + V_2 + V_3 + ...$$

Average molecular mass of gaseous mixture :

$$M_{mix} = \frac{\text{Total mass of mixture}}{\text{Total no. of moles in mixture}} = \frac{n_1 M_1 + n_2 M_2 + n_3 M_3}{n_1 + n_2 + n_3}$$

Graham's Law :

Rate of diffusion $r \propto \frac{1}{\sqrt{d}}$; d = density of gas

$$\frac{r_1}{r_2} = \frac{\sqrt{d_2}}{\sqrt{d_1}} = \frac{\sqrt{M_2}}{\sqrt{M_1}} = \sqrt{\frac{V.D_2}{V.D_1}}$$

Kinetic Theory of Gases :

$$PV = \frac{1}{3} mN \overline{U^2}$$ Kinetic equation of gases

Average K.E. for one mole = $N_A \left(\frac{1}{2} m \overline{U^2}\right) = \frac{3}{2} K N_A T = \frac{3}{2} RT$

☞ Root mean suqare speed

$$U_{rms} = \sqrt{\frac{3RT}{M}}$$ molar mass must be in kg/mole.

☞ Average speed

$$U_{av} = U_1 + U_2 + U_3 + ... U_N$$

$$U_{avg.} = \sqrt{\frac{8RT}{\pi M}} = \sqrt{\frac{8KT}{\pi m}}$$ K is Boltzmman constant

☞ Most probable speed

$$U_{MPS} = \sqrt{\frac{2RT}{M}} = \sqrt{\frac{2KT}{m}}$$

Vander wall's equation :

$$\left(P + \frac{an^2}{v^2}\right)(v - nb) = nRT$$

☞ **Critical constants :**

$$V_c = 3b, \quad P_C = \frac{a}{27b^2}, \quad T_C = \frac{8a}{27Rb}$$

Vander wall equation in virial form :

$$Z = \left(1 + \frac{b}{V_m} + \frac{b^2}{V_m^2} + \frac{b^3}{V_m^3} + \ldots\ldots\right) - \frac{a}{V_m RT} = 1 + \frac{1}{V_m}\left(b - \frac{a}{RT}\right) + \frac{b^2}{V_m^2} + \frac{b^3}{V_m^3} + \ldots\ldots$$

Reduced Equation of state :

$$\left(P_r + \frac{3}{V_r^2}\right)(3V_r - 1) = 8\,T_r$$