

GASEOUS STATE

Temperature Scale :

$$\frac{C - 0}{100 - 0} = \frac{K - 273}{373 - 273} = \frac{F - 32}{212 - 32} = \frac{R - R(O)}{R(100) - R(O)}$$

where R = Temp. on unknown scale.

Boyle's law and measurement of pressure :

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

$$P_1 V_1 = P_2 V_2$$

Charles law :

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

Gay-lussac's law :

At constant volume, $P \propto T$ $\frac{P_1}{T_1} = \frac{P_2}{T_2} \rightarrow$ temp on absolute scale

Ideal gas Equation :

$$PV = nRT$$

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

Dalton's law of partial pressure :

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

$$\text{Total pressure} = P_1 + P_2 + P_3 + \dots\dots\dots$$

$$\text{Partial pressure} = \text{mole fraction} \times \text{Total pressure.}$$

Amagat's law of partial volume :

$$V = V_1 + V_2 + V_3 + \dots\dots\dots$$

Average molecular mass of gaseous mixture :

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

Graham's Law :

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

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

Kinetic Theory of Gases :

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

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



Root mean square speed

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



Average speed

$$U_{\text{av}} = U_1 + U_2 + U_3 + \dots\dots\dots U_N$$

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



Most probable speed

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

Van der Waal's equation :

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



Critical constants :

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