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, $V \propto \frac{1}{P}$

$$P_1V_1 = P_2V_2$$

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 :

$$PV = nRT$$

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

Daltons law of partial pressure :

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

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 :

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

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

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

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

☞ Most probable speed

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

Van der Waal's equation :

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

☞ Critical constants :

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