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

$$P_1 V_1 = P_2 V_2$$

Charles law :

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

Gay-lussac's law :

At constant volume, $P \propto T$ $\quad \dfrac{P_1}{T_1} = \dfrac{P_2}{T_2} \rightarrow$ 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 :

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

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

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 $r \propto \dfrac{1}{\sqrt{d}}$; $\qquad$ d = density of gas

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

Kinetic Theory of Gases :

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

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

☞ Root mean suqare speed

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

☞ Average speed

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

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

☞ Most probable speed

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

Van der Waal's equation :

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

☞ Critical constants :

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