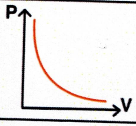
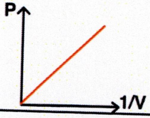
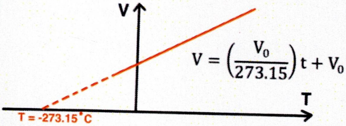
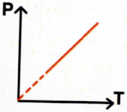
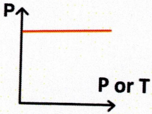
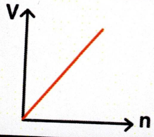
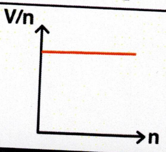
GASEOUS STATE

Boyle's law	$P \propto \frac{1}{V}$	$P_1V_1 = P_2V_2$
Graphs		
Charle's law	$V \propto T$	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$
Graphs		
Gay Lussac's law	$P \propto T$	$\frac{P_1}{T_1} = \frac{P_2}{T_2}$
Graphs		

Avogadro's law	$V \propto n$	$\frac{V_1}{n_1} = \frac{V_2}{n_2}$
Graphs		

Ideal Gas Equation

Ideal Gas Equation	$PV = nRT$
Combined Gas Law	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
Density Relation	$PM = dRT$

Dalton's Law of Partial Pressure

For a mixture of Gases	$P_{total} = p_1 + p_2 + p_3 + \cdots$
Relation between p & Mole fraction	$p = x \times P_{total}$ p=partial pressure

Graham's Law of Diffusion

At constant T & P If, r=Rate of diffusion of a gas d = Density of Gas M = Molecular Mass	$\frac{r_1}{r_2} = \sqrt{\frac{d_2}{d_1}} = \sqrt{\frac{M_2}{M_1}}$

Speed of Sound in Gas	$v = \sqrt{\frac{rRT}{M}}$

Collision Frequency

$f = \frac{V}{\lambda} = \sqrt{2}\pi d^2 vn$	v = avg. velocity of molecules n = number density

Number of Moles

$n = \frac{M}{M_0} = \frac{N}{N_A}$	**M** = mass of gas **N** = molecule of gas **M_0** = molar mass **N_a** = avogadro's no.

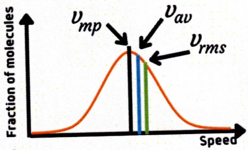
Kinetic Theory of Gases

Kinetic Gas equation	$pV = \frac{1}{3} mnu_{rms}^2$
Average Kinetic Energy	$KE = \frac{3}{2} RT(\text{per mole})$ $KE = \frac{3}{2} k_b T(\text{per molecule})$

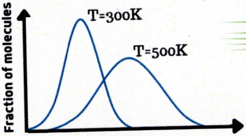
Different Molecular velocities

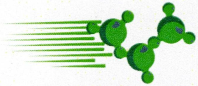
Root Mean Square	$v_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{v_1^2 + v_2^2 + \cdots + v_n^2}{N}}$
Average	$v_{avg} = \sqrt{\frac{8RT}{\pi M}} = \frac{(\lvert v_1 \rvert + \lvert v_2 \rvert + \lvert v_3 \rvert \ldots)}{N}$ $< v_{avg} >= 0$
Most Probable	$v_{mp} = \sqrt{2RT/M}$

Relation ($v_{mp} < v_{av} < v_{rms}$)	$(v_{mp} < v_{av} < v_{rms}) = 1 : 1.128 : 1.224$



Distribution of Molecular Velocities





Maxwell Boltzmann Distribution of speeds

v_{rms} & v_{avg} Relation	$v_{rms} = \left[1 + \frac{5}{x}\right]^{1/2} v_{avg}$
Graham's law of diffusion	Rate of diffusion $\propto \frac{1}{\sqrt{\text{Molecular Mass}}}$
Equivalent degree of freedom	$f_{eq} = \frac{n_1 f_1 + n_2 f_2}{n_1 + n_2}$

Van Der Waal's Equation

$\left(p + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$	a = Force of attraction measure (atm L^2 mol^{-2} b = Excluded volume (L mol^{-1})

Degree of Freedom

Degree of Freedom A = Number of Particles in System	$f = 3A - R$
Specific heat at constant volume	$C_v = \frac{f}{2}R$
Specific heat at constant Pressure	$C_P = \left(\frac{f}{2} + 1\right)R$

Nature of Gas	$U = \frac{f}{2}RT$	$C_v = \frac{dU}{dT} = \frac{f}{2}R$	$C_P = C_v + R$	$\gamma = \frac{C_P}{C_v} = 1 + \frac{2}{F}$
Mono-atomic	$\frac{3}{2}RT$	$\frac{3}{2}R$	$\frac{5}{2}R$	1.67
Polyatomic Linear	$\frac{5}{2}RT$	$\frac{5}{2}R$	$\frac{7}{2}R$	1.4
Polyatomic Non-linear	3RT	3R	4R	1.33

Change in Diameter	$\Delta D = D \propto \Delta T$
Law of Equipartition of Energy This law states that, for a dynamic system in thermal equilibrium, the total energy is distributed equally amongst all the degree of freedom	Energy associated with each molecule per degree of freedom is, $E = \frac{1}{2}k_BT$ $k_B = 1.38 \times 10^{-23} JK^{-1}$ (Boltzmann constant)

Mean Free Path (λ or l)	
The avg. distance travelled by a molecule between two successive collisions.	$\lambda = \frac{1}{\sqrt{2} n \pi d^2}$ n = number density d = diameter of the molecule
$\lambda = \frac{1}{p} \propto T$	

Liquefication of Gases	
Critical Temperature	$T_c = \frac{8a}{27Rb}$
Critical Pressure	$P_c = \frac{a}{27b^2}$
Critical Volume	$V_c = 3b$
Compressibility factor (Zc)	$\frac{P_c V_c}{RT_c} = \frac{3}{8}$