STATES OF MATTER

GASES

LONDON DISPERSION FORCES
The weakest intermolecular forces present among non polar atom and molecules.

DIPOLE-DIPOLE FORCES
Forces act between the molecules possessing permanent dipole.

DIPOLE-INDUCED DIPOLE FORCES
The attractive forces operates between polar molecules having permanent dipole.

Intermolecular Forces

Molecules Velocities

RMS Velocity $= \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3PV}{M}} = \sqrt{\frac{3P}{d}}$

Average Velocity $= \sqrt{\frac{8RT}{\pi M}} = \sqrt{\frac{8P}{\pi d}}$

Most Probable Velocity $= \sqrt{\frac{2RT}{M}} = \sqrt{\frac{2P}{d}}$

Physical Properties

- Gases are highly compressible.
- Gases exert pressure equally in all direction.
- Gases have much lower density than liquids.
- Volume and shapes of gases are not fixed
- They mix evenly and completely in all proportions.

Kinetic gas Equation

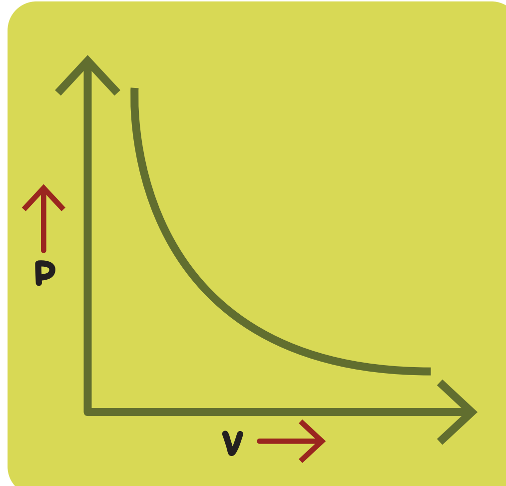
$$PV = \frac{1}{3}mnc^2 \text{ or } PV = \frac{2}{3}K.E$$

Gas Law

BOYLE'S LAW (PRESSURE-VOLUME RELATIONSHIP)
At Constant Temperature.

Volume $\propto \frac{1}{\text{Pressure}} \Rightarrow$ Volume $\times$ Pressure $=$ Constant

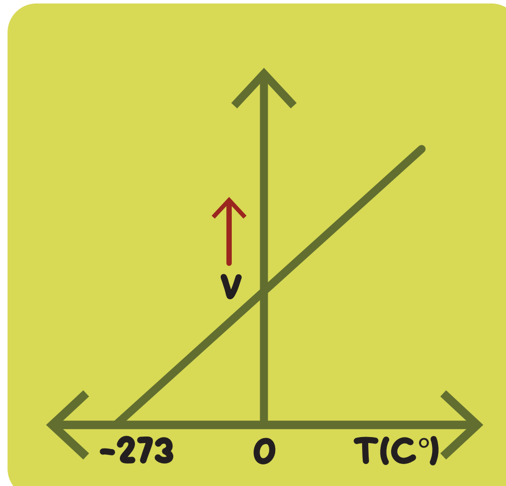
i.e $p_1v_1 = p_2v_2$ or $\frac{p_1}{p_2} = \frac{v_2}{v_1}$



CHARLES LAW (TEMPERATURE-VOLUME RELATIONSHIP)
At Constant Pressure.

Volume $\propto$ Temperature $\Rightarrow \frac{V}{T} =$ Constant

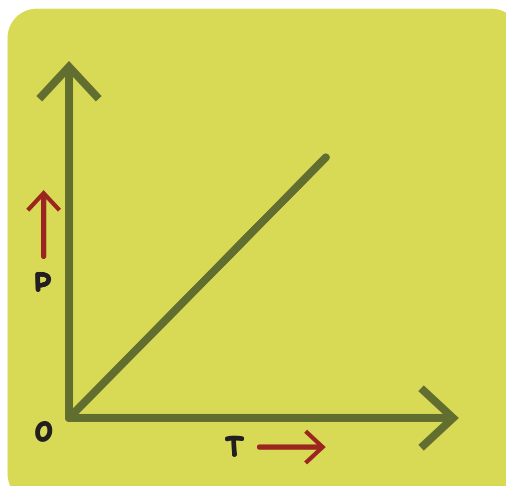
i.e $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ or $V_1T_2 = V_2T_2$



GAY LUSSAC'S LAW (PRESSURE - TEMP RELATIONSHIP)
At Constant volume

Pressure $\propto$ temperature $\rightarrow \frac{P}{T} =$ Constant

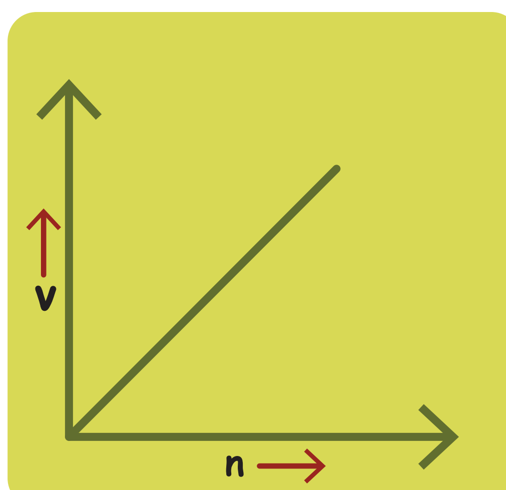
i.e $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ or $P_1T_2 = P_2T_1$



AVAGADRO LAW (VOLUME-AMOUNT RELATIONSHIP)
At Constant Pressure and temperature.

Volume $\propto$ No. of Moles $\Rightarrow \frac{V}{n} =$ Constant

i.e $\frac{V_1}{n_1} = \frac{V_1}{n_2}$ or $V_1n_2 = V_2n_1$



IDEAL GAS EQUATION
Combining above all.

$V \propto \frac{1}{P} \times T \times n \Rightarrow PV \propto nT \Rightarrow \boxed{PV = nRT}$

Here 'R' is gas constant

$R = 8.31\ JK^{-1}mol^{-1}$

$R = 0.08\ L\ atm\ k^{-1}\ mol^{-1}$

$R = 2\times 10^{-3}\ K\ cal\ K^{-1}mol^{-1}$

gas equation (Real gases) Deviation from ideal
Real gases show deviations from ideal gas law because molecules interact with each other.

Pressure exerted by the gas is lower than the pressure exerted by the ideal gas.

$$\boxed{P_{Ideal} = P_{real} + \frac{an^2}{v^2}}$$

Compressibility factor (z) $= \frac{Pv}{nRT}$

$$Z = \frac{V_m,real}{22.4L}$$

Dalton's Law of Partial Pressure
Total pressure exerted by the mixture of non-reactive gases is equals to the sum of partial pressures of individual gases.

$$\boxed{P_{Total} = P_1 + P_2 + P_3 \text{(At constant T, v)}}$$

Pressure Correction factor -

$$\Delta P = \frac{an^2}{V^2}$$

Volume Correction factor -

$$\Delta V = nb \Rightarrow b = N_A \times 4 \times \frac{4}{3}\pi R^3$$

Kinetic-Molecular Theory of Gases
A gas contains a long no of small particles called molecules.

Size and mass of all molecules of each gas are identical

Particles of a gas are always in constant and random motion.

Particles of a gas move in all possible directions in straight line.

Collisions of gas molecules are perfectly elastic.

LIQUID

Liquification of gases
Volume of one mole of gas at critical temperature is called critical volume (V_c) and pressure at this temperature is called critical pressure (P_c)

Surface Tension
It the force acting per unit length is perpendicular to the line drawn on the surface of liquid denoted by gamma (γ) unit: Nm-1

Viscosity
Viscosity coefficient (N) is the force when velocity gradient is unity and the area of contact is unit area. SI Unit: Newton second per square metre

$$F = \eta A\frac{dv}{dx}$$