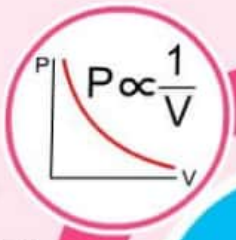
PVT GAS LAWS

Boyle's law



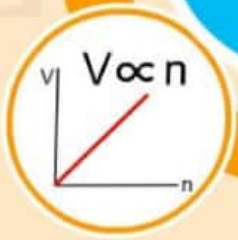
As water bubble rises its size increases because pressure decreases.

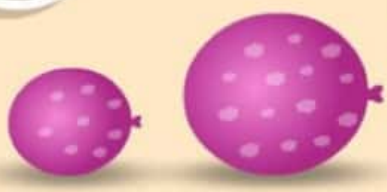
Charle's Law

As temperature increases, volume increases

$PV = nRT$

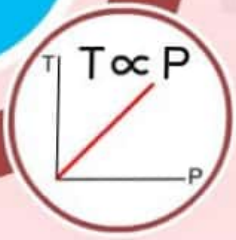
Avogadro's Law

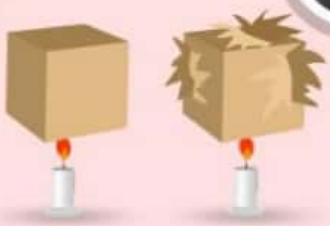




As number of moles increase, volume increases

Gay Lussac's law





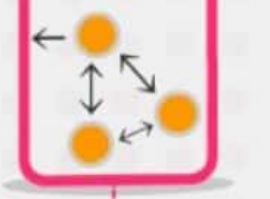
As temperature increases pressure inside the container increases and it explodes

WHAT MAKES GASES REAL

DEVIATION FROM IDEAL GAS

Pressure Correction

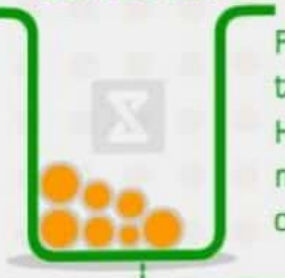
Pressure is one force applied by an ideal gas on one container. In real gas, molecules have attraction between them, thus reducing the force applied on container



$$P_{real} = P_{ideal} - \frac{an^2}{V^2}$$

Volume Correction

For ideal gas, V is equal to volume of container. However in real gases molecules occupy considerable volume



$$V_{real} = V_{ideal} + nb$$

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

Vander Waal Equation

IS Z A REAL DETECTOR ?

Z < 1

- Deviates from ideal gas behaviour
- Attractive forces dominate repulsive forces

Z > 1

- Deviates from ideal gas behaviour
- Repulsive forces dominate attractive forces

Z = 1 ⟹ ideal gas

AT LOW PRESSURE & HIGH TEMPRATURE real gas acts as ideal gas

HELIUM & HYDROGEN

They are lighter gases. So force of attraction is less. therefore they have always

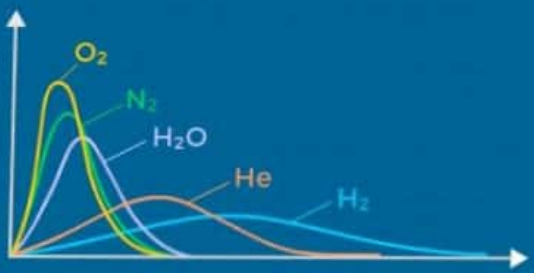
Z > 1

VANDER WAAL'S CONSTANT

a - measure of average attraction of gas molecules

b - proper volume of gas molecules . It is actually 4 times volume of single molecule.

DISTRIBUTION OF MOLECULAR VELOCITIES



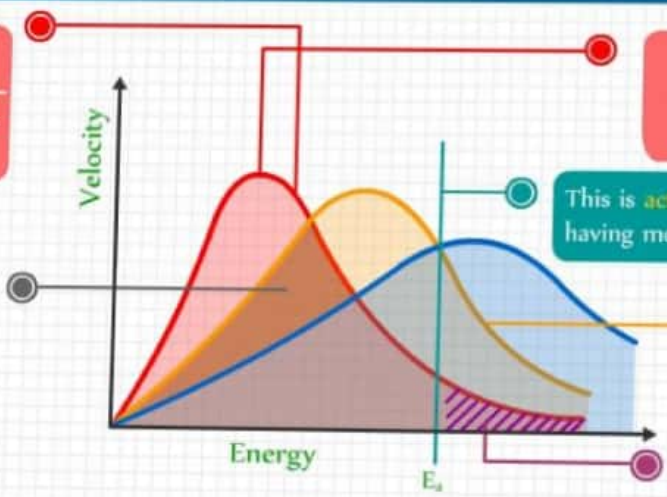
Maxwell Boltzmann stated, all molecules don't have similar velocity. Each molecule moves with different velocity.

AVERAGE VELOCITY

Average of all the velocities of gas molecules : $A.V. = \sqrt{\frac{8RT}{\pi M}}$

MOST PROBABLE VELOCITY

Velocity of Maximum number of molecules : $M.P.V. = \sqrt{\frac{2RT}{M}}$



This is activation energy (E_a) barrier, Molecules having more energy than this participate in reaction.

As temperature increases, fraction of molecules having more energy than Activation energy (E_a) increases.

Fraction of molecules having more Kinetic energy than Activation energy (E_a).

AREA

Area under these graphs gives total kinetic energy of gas molecules

$A = \int F.dv$

F = fraction of molecules

ROOT MEAN SQUARE VELOCITY

Average velocity may be zero, because velocity is vector, RMS = $\sqrt{\frac{3RT}{M}}$ so we use root mean square velocity.