MIND MAP

States of Matter

Pressure Unit Conversion

1 N/m^2 = 1 Pascal (Pa)

1 atm = 101325 Pa or 101.325 kPa

1 bar = 100000 Pa or 100 kPa

1 torr = 133.322 Pa

1 atm = 760 mm Hg

Barometer

$P = h \times d \times g = P_{atm}$

d = Density of fluid (Mercury)

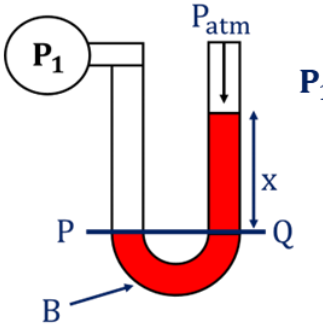
h = Vertical height

g = Acceleration due to gravity

For mercury: h = 76 cm or 760 mm

P_{atm} = 0.76 x 13593 x 9.8
= 101325 Pascal (Pa)
= 1 atm = 1.01325 bar

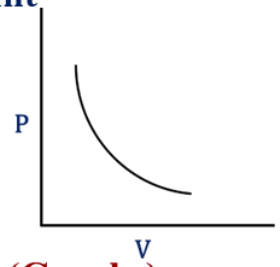
Manometer



$P_1 = P_{atm} + d_B . g . x$

Boyle's Law

$PV =$ Constant

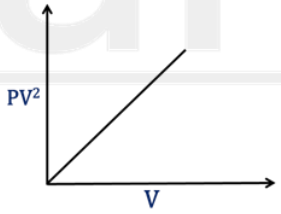


Boyle's Law (Graphs)

PV^2 vs V.

$PV^2 = kV$

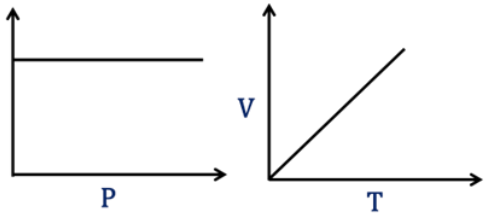
Y = mX (straight line)

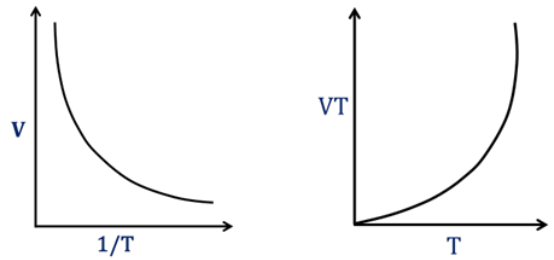


Charles Law

V = kT

$V \propto T$



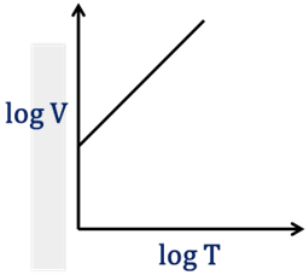


According to Charle's Law

V = kT

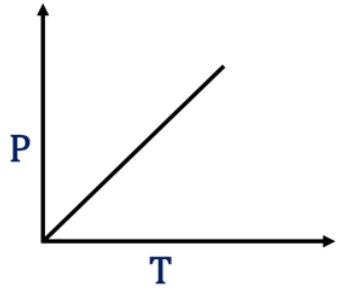
log V = log T + log k

Y = mX + c (Straight line)



Gay-Lussac's Law

$P \propto T \Rightarrow P = kT$



MIND MAP

States of Matter

Avogadro's Law

$V \propto n \Rightarrow$ (P & T = constant)

Value of R

R = 0.0821 lit-atm/K-mol

= 0.0831 lit-bar/K-mol

= 8.314 J/K-mol

= 2 cal/K-mol

Ideal Gas Equation in Terms of Density

PV = nRT

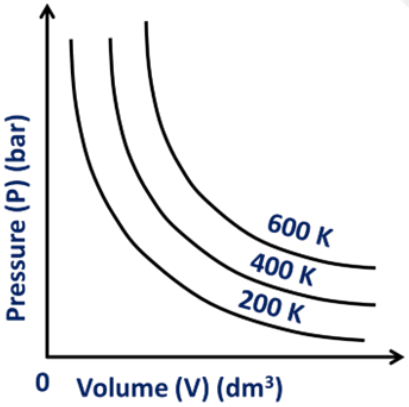
PM = dRT

M = Molar mass of the gas

d = density of the gas

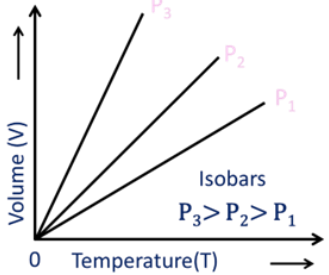
Isotherms

PV Isotherms Graph between P and V at Constant temperature.



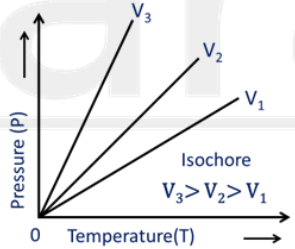
Isobar

Graph at constant pressure.



Isochore

Graph plotted at constant volume.



Partial Pressure & Total Pressure relationship

Partial pressure of gas A= mole fraction of gas A× total Pressure of gaseous mixture

$P_A = X_A P_T$

Graham's Law

$$r \propto \frac{1}{\sqrt{d}}$$

Under identical condition, the rate of diffusion or effusion of gas is inversely proportional to square root of their density.

$$\frac{r_1}{r_2} = \frac{\text{constant}/\sqrt{d_1}}{\text{constant}/\sqrt{d_2}} = \sqrt{\frac{d_2}{d_1}}$$

$$\sqrt{\frac{d_2/d_{H_2}}{d_1/d_{H_2}}} = \sqrt{\frac{VD_2}{VD_1}} = \sqrt{\frac{M_2}{M_1}}$$

Kinetic Gas Equation

$$PV = \frac{1}{3} mNu^2$$

P = Pressure of gas

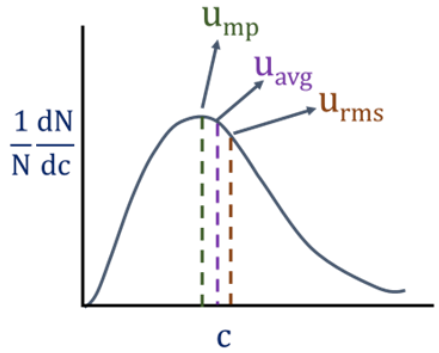
V = Volume of container

m = Molecular mass of gas molecule

N = number of molecules

u = Root mean square velocity (U_{rms})

Maxwell's Distribution



$$u_{avg} = \sqrt{\frac{8RT}{\pi m}} \quad u_{rms} = \sqrt{\frac{3RT}{m}}$$

$$u_{mp} = \sqrt{\frac{2RT}{m}}$$

$$U_{rms} : U_{avg} : U_{mp} = 1 : 0.92 : 0.816$$

$$U_{rms} > U_{avg} > U_{mp}$$

Mean Free Path

$$\lambda = \frac{\text{Average distance travelled per unit time}}{\text{No. of collsions made by single molecule per unit time}}$$

$$\lambda = \frac{1}{\sqrt{2}\pi\sigma^2 N^*}$$

MIND MAP

States of Matter

Van Der Waals Equation

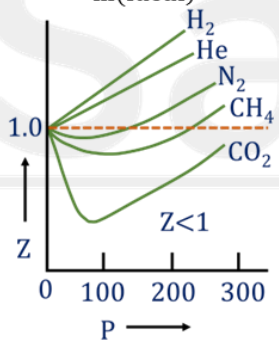
$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

This is called the Van der Waals Equation.

Compressibility Factor (Z)

$PV_{real} = ZnRT$

$$Z = \frac{V_m}{V_{m(ideal)}} = \frac{PV_m}{RT}$$



Ideal gas Z=1

Effect of Pressure

At very low P, PV≈RT i.e. Z ≈ 1

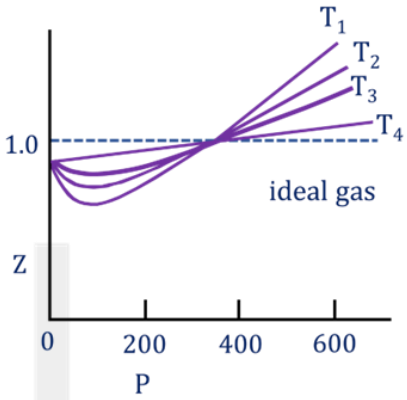
At low P, PV < RT i.e. Z < 1

At moderate P, PV ≈ RT i.e. Z ≈ 1

At high P, PV > RT i.e. Z > 1

Effect of Temperature

An increase in temperature shows a decrease in deviation from ideal behaviours i.e. PV approaches unity or Z approaches unity with increase in temperature.



At low pressure and very high temperature V_m will be very large. Hence 'b' can be neglected and a/V_m^2 can also be neglected.
Then, $PV_m = RT$ (ideal gas condition).

Critical Phenomenon: CriticalTemp(T_C),Criticalpressure(P_C),Criticalvolume(V_C)

$$T_c = \frac{8a}{27Rb}; \quad P_c = \frac{a}{27\,b^2}; \quad V_c = 3\,b$$