Expansion of gas

Boyle's Law

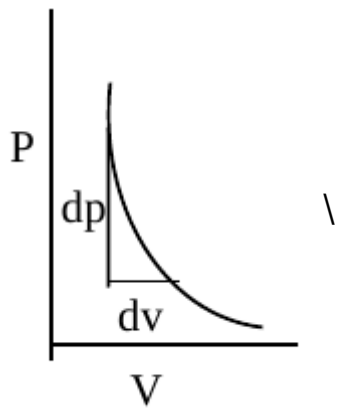
At constant temperature of given mass of gas the pressure of gas is inversely proportional to volume

$$\mathrm{P} \propto \frac{1}{V}$$

$$\text{or, } \mathrm{PV} = \text{ constant}$$

$$\text{or, } \mathrm{P_1V_1} = \mathrm{P_2V_2}$$

- Graph between pressure and volume is



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- Slope of curve \(\cfrac{dp}{dV} = \cfrac{-p}{V}\

Charle's Law

For Volume

At constant pressure of given mass of gas volume is directly proportional to absolutetemperature

$$\mathrm{V} \propto \mathrm{T}$$

$$\text{or, } \frac{V}{T} = \text{constant}$$

$$\text{or, } \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Volume coefficient (γ_p)

Change in volume per unit original volume per degree change in temperature at constant pressure is same for all gases. Value is $\frac{1}{273}/^oC$ for all gases.

Volume coefficient $(\gamma_p) = \frac{\Delta V}{V\Delta T}$

For Pressure

At constant volume of given mass of gas, pressure is directly proportional to absolute temperature

$P \propto T$

or, $\frac{P}{T} = costant$

or, $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

Pressure Coefficient (γ_v)

Change in pressure per unit original pressure per degree change in temperature at constant volume is same for all gases. Value is $\frac{1}{273}/^oC$ for all gases.

Pressure coefficient $(\gamma_v) = \frac{\Delta P}{P\Delta T}$

Combined gas equation or equation of state

For given mass of gas,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

or, $\frac{PV}{T} =$ constant

For 1 move of gas at STP,

$P = 1.01 \times 10^5 N/m^2$

V = 22.4lts = 22.4 × 10-3m3, T = 273 K so

$V = 22.4lts = 22.4 \times 10^{-3} m^3, T = 273K$ so

$$\frac{PV}{T} = R$$

Where $R = 8.31 Jmol^{-1}K^{-1}$ is called universal molar gas constant.

- For 1 mole of gas PV = RT
- For n moles of gas PV = nRT
- $n = \frac{m}{M} \qquad so, PV = mrT$

  Where $r = \frac{R}{M}$ is called gas constant per unit mass
- $r = \frac{PV}{mT} = \frac{P}{\rho T}$

Dalton's law of partial pressure

Total pressure due to mixture of non reacting gases is equal to the sum of their partial pressure.

Partial Pressure (Pi):

Pressure due to any gas if it occupy whole volume of mixture alone.