States of Matter

$\boxed{\text{Ideal Gas}}$

$C + 273 = K$

Ideal gas equation

$pv = nRT$

p = pressure in pascals, Pa

T = Temperature in Kelvin

R = Ideal gas constant ($8 \cdot 31\ JK^{-1}\ mol^{-1}$)

V = volume in m^3

n = number of moles of gas

$n = \dfrac{m}{Mr}$ $pv = \dfrac{n}{Mr} RT$

The basic assumptions of the kinetic theory as applied to an ideal gas

1. The molecules behave as a rigid sphere.
2. There are no/negligible intermolecular forces between the molecules.
3. Collisions between the molecules are perfectly elastic.

- The molecules have no/negligible volume.
- The volume of the gas molecules or atoms is insignificant compared with the volume of the vessel.
- The molecules move in straight lines.
- The kinetic energy of the molecules is directly proportional to the temperature.
- The pressure exerted by the gas is due to the collisions between the gas molecules and the walls of the container.

$$\boxed{P_1 V_1 = P_2 V_2}$$

Temperature Constant

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Example - 1

Calculate the volume occupied by 0.5 mol of CO_2 at a pressure of 150 kPa and a temperature of 19°C.

$Pv = nRT$

$150000 \times v = 0.5 \times 292 \times 8.31$

$v = 8.09 \times 10^{-3}\ m^3$

Example - 2

A flask of volume $5.00\ dm^3$ contained $4.00g$ of oxygen. Calculate the pressure exerted by the gas at temp $127°C$.

$Pv = nRt$

$$\frac{0.125 \times 8.31 \times 400}{0.005}$$

$\Rightarrow 83100$

Example - 3

When an evacuated glass tube of volume $200\ cm^3$ is filled with a gas at $300\ K$ and $100\ kpa$ the mass of the tube increases by $0.06g$.

Identify the gas.

$pV = nRT$

$$\frac{100000 \times 0.0002}{8.31 \times 300} = 0.00802$$

$M_r = 132$

Example-4

M contains helium at 20°C at a pressure of 1×10^5 Pa.

N has been evacuated and has three times the volume of M

In an experiment the value is opened and the temperature of the whole apparatus is raised to 100°C

$PV = nRT$

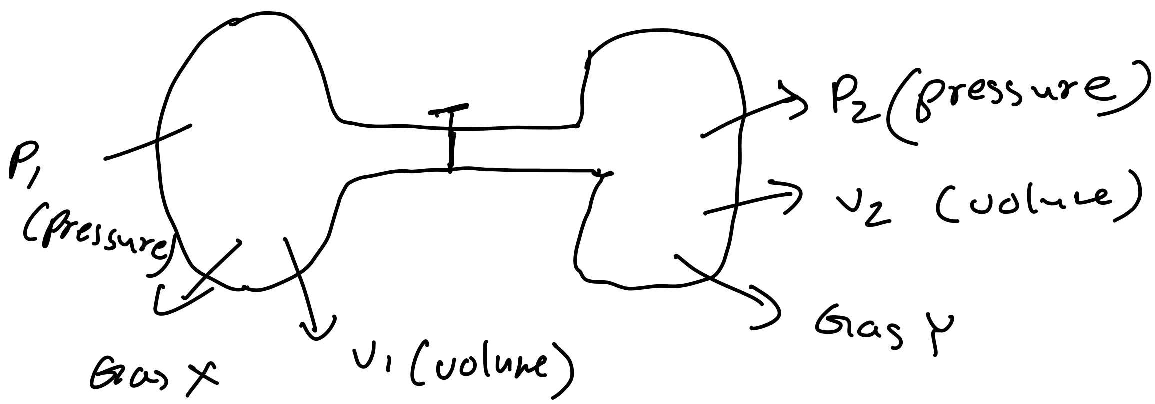
Final pressure?

25000

$$\frac{100000 \times 1}{293} = \frac{x \times 4}{373}$$

$$x = 31826$$

Overall pressure calculation



$$\boxed{P = \frac{P_1V_1 + P_2V_2}{V_1 + V_2}}$$

Example-1

Flask (X) contains $5\,dm^3$ of helium at 12 kPa pressure and flask (Y) contains $10\,dm^3$ of Neon at 6 kPa presure.

If the flask are connected at constant temperature, what is the final pressure?

$$\frac{5 \times 12 + 10 \times 6}{10 + 5} = 8\ kPa$$

Ideal behaviour

Neon Nitrogen Ammonia $\longrightarrow$

Ideal behaviour decreases

- Nitrogen has stronger van der waal's forces than neon.
- Ammonia has hydrogen bonding as well as van der waal's forces.

Two conditions under which the behaviour of a real gas approaches that of an ideal gas

1. High temperature
2. Low pressure