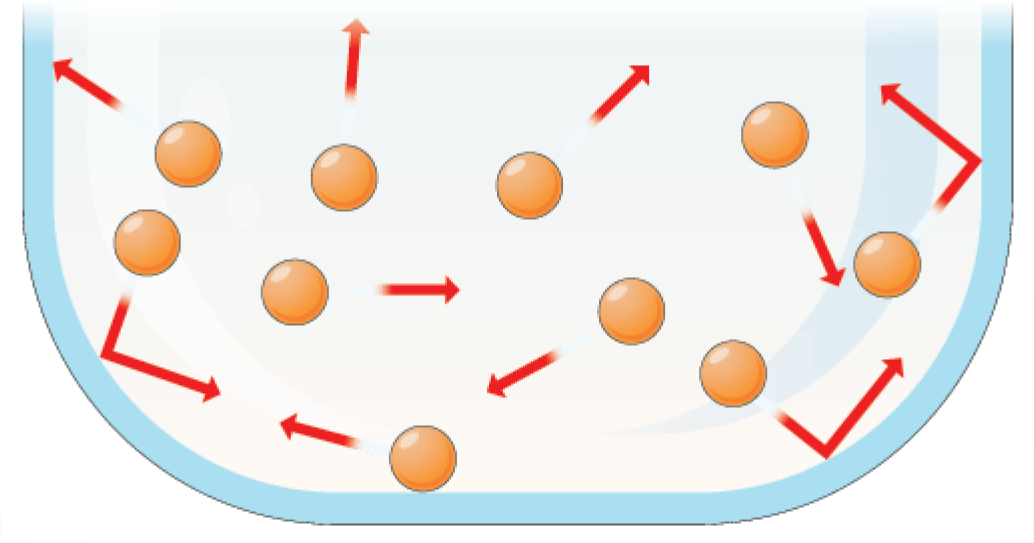
Chaos

Gases

-Gases fill their containers
-Compressible
-Diffuse
-Temperature affects the Volume or Pressure or Both



Pressure

Pressure is force per Unit Area
SI unit for Pressure is Kilopascal (Kpa)
Which represents a force
of 1000N(newtons) on an area of $1m^2$

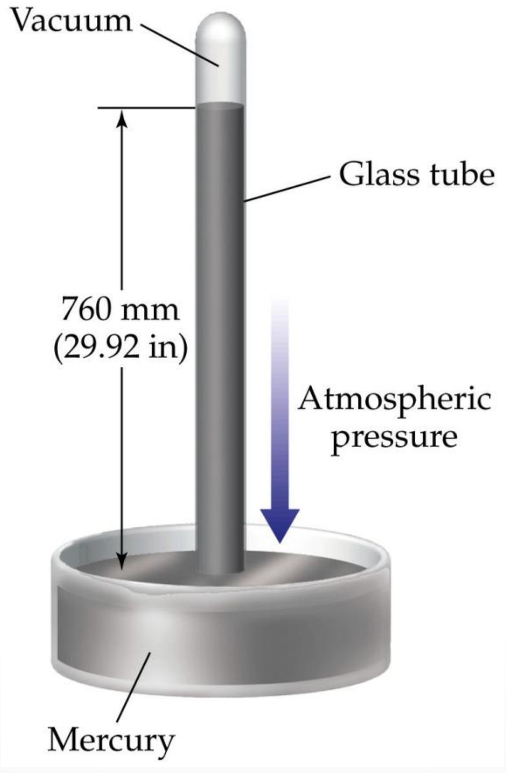
$1Kpa = 1000N/m^2$

Atmospheric pressure is the pressure exerted by the air.

At sea level P=101Kpa = 760mmHg

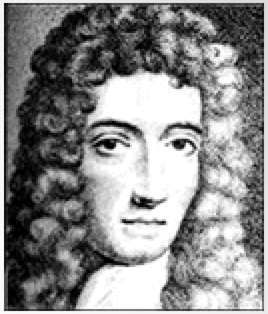
Standard Pressure = 101.325Kpa = (1atm)

Standard ambient pressure = 100 Kpa



STP (standard Temperature and Pressure)
T = 0°C
P = 101.325kpa (1atm)

SATP (standard ambient temp and pressure)
T = 25°C
P = 100 Kpa



Robert Boyle (1627-1691)

Robert Boyle (1627-1691)

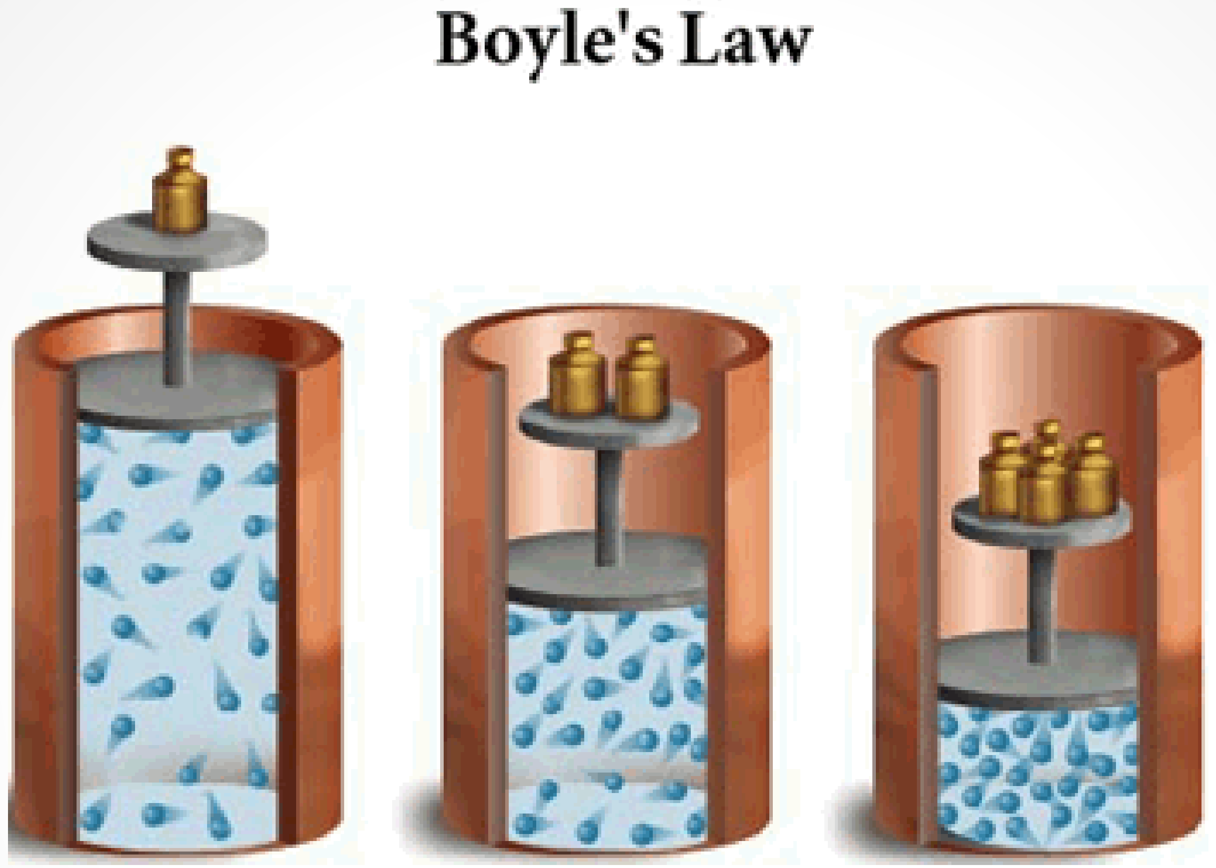
Boyles Law = as pressure on a gas increases the volume of the gas decrease proportionally provided that the temp and amount of gas remain constant.

$$PV = K\textit{onstant}$$

$$P_1V_1 = P_2V_2$$

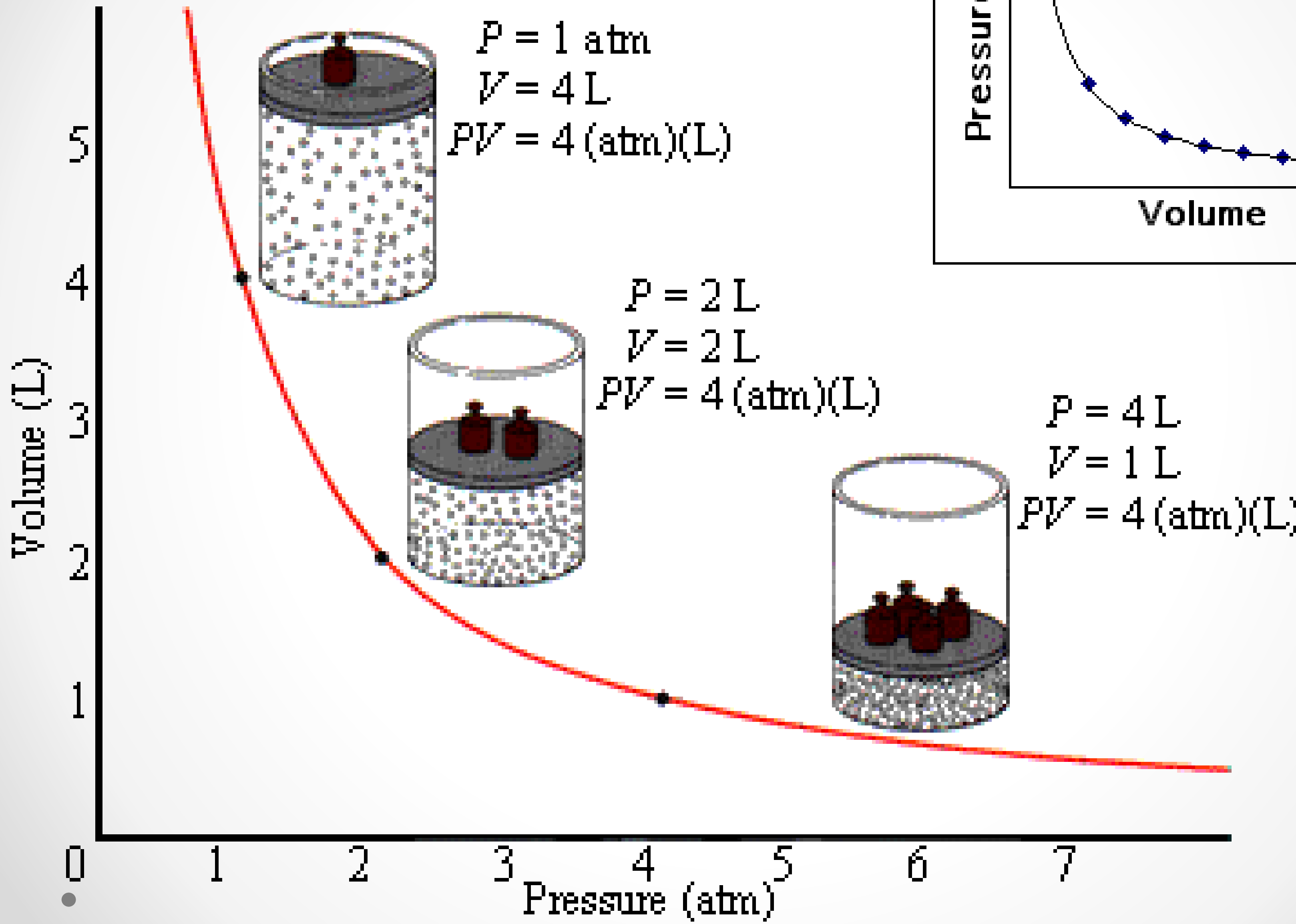
If P increase than V decreases

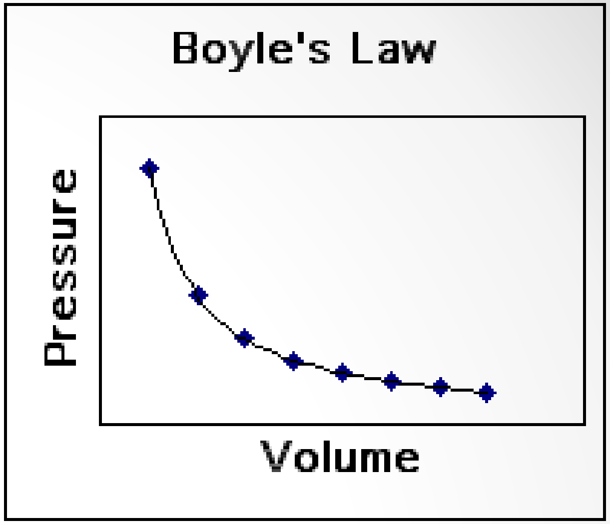
If P decrease than V increase



Increase the pressure and the volume decreases

P x V = Konstant





Example

A balloon contains 13L of Helium at 101Kpa. Assuming Temp remains Constant what is the volume of the balloon it rises up the atmosphere to a point of 80Kpa?

$$P_1V_1 = P_2V_2$$

Solution

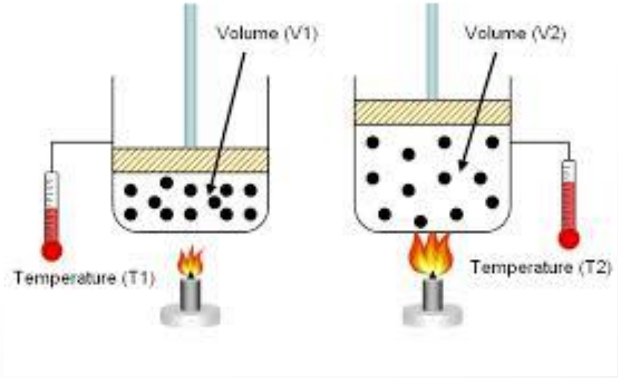
Charles' Law – as the temperature of a gas increases the volume increase Proportionally provided that the pressure and amount of gas remain constant.

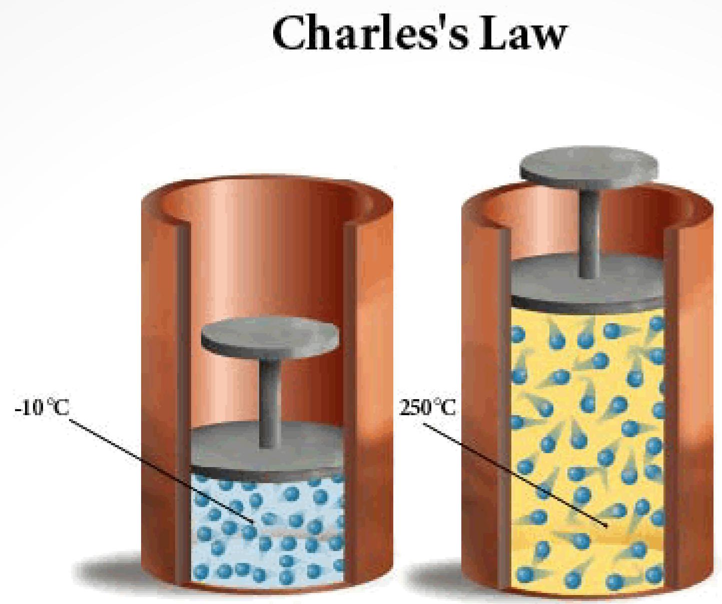
$V = KT \qquad \frac{V}{T} = K$

Temperature increase then Volume increases

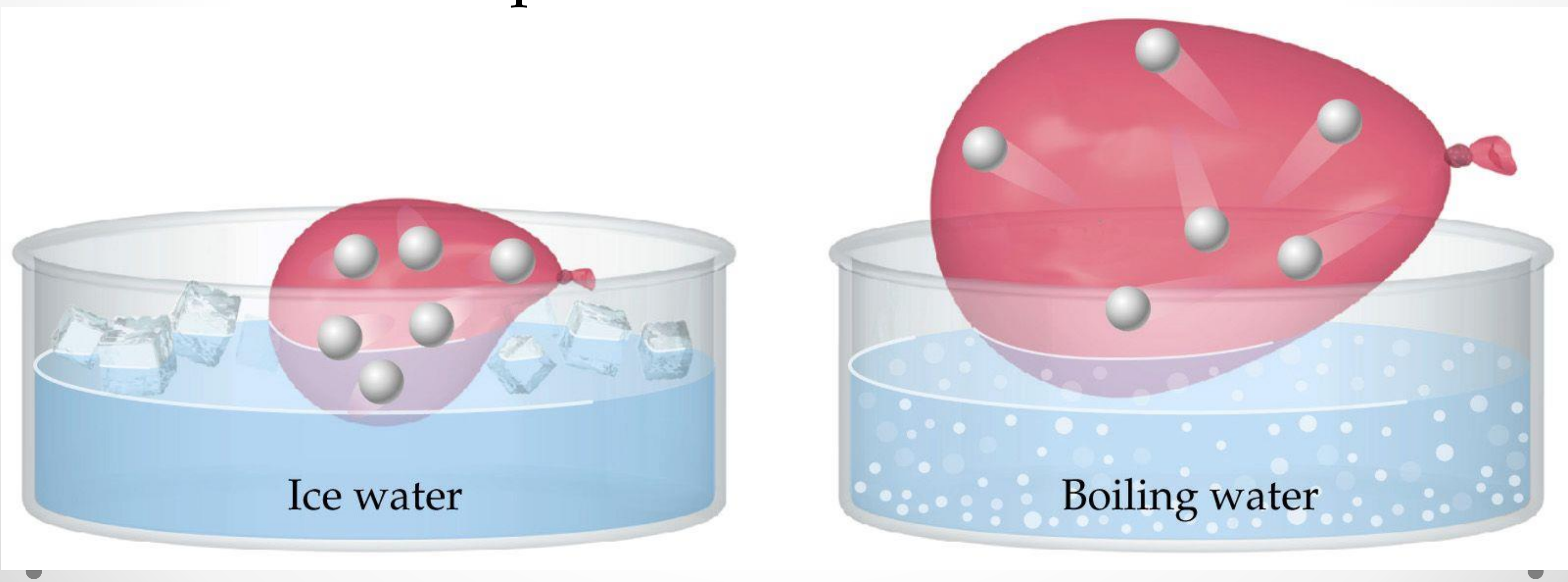
Temperature decreases then Volume decreases

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

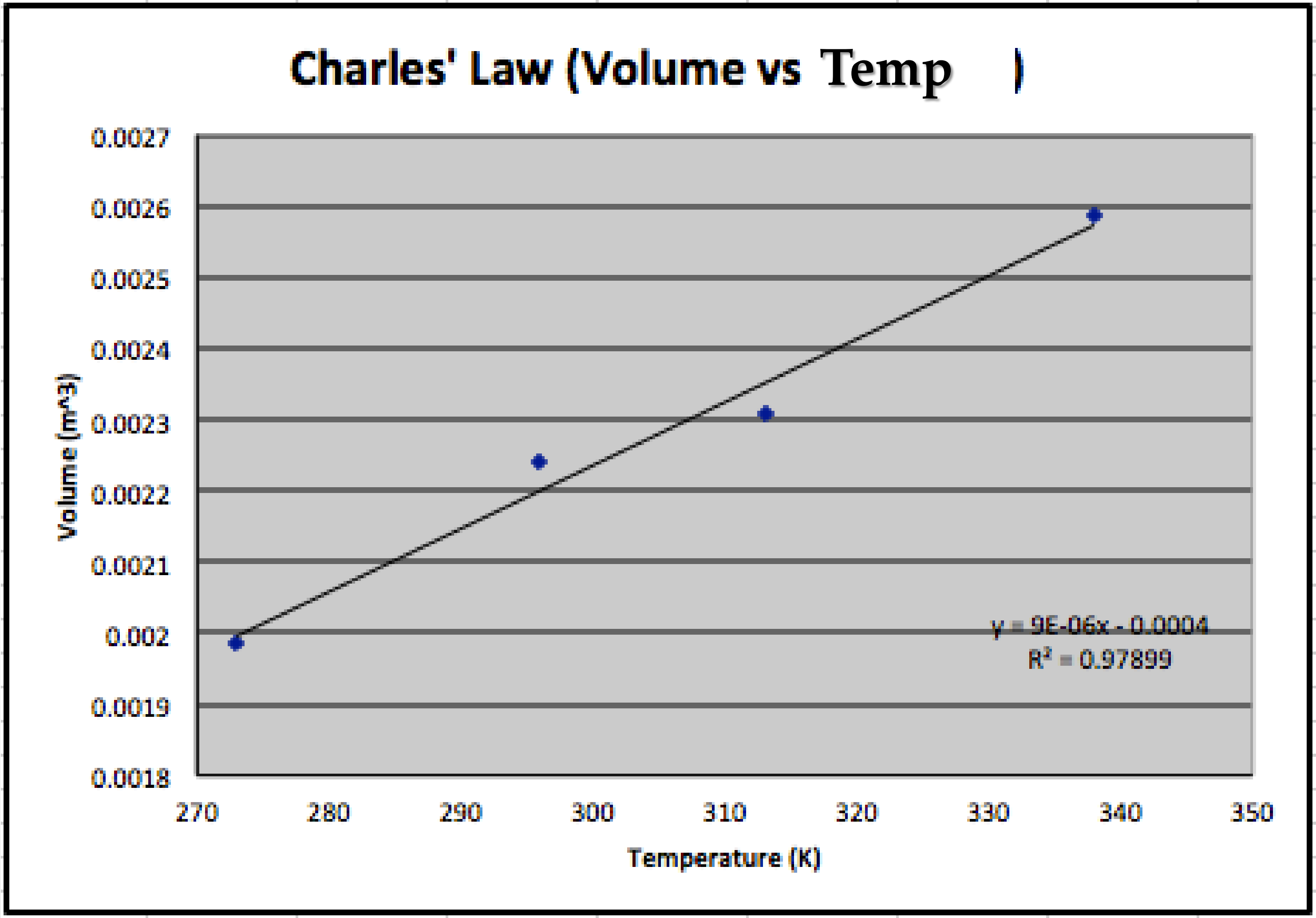




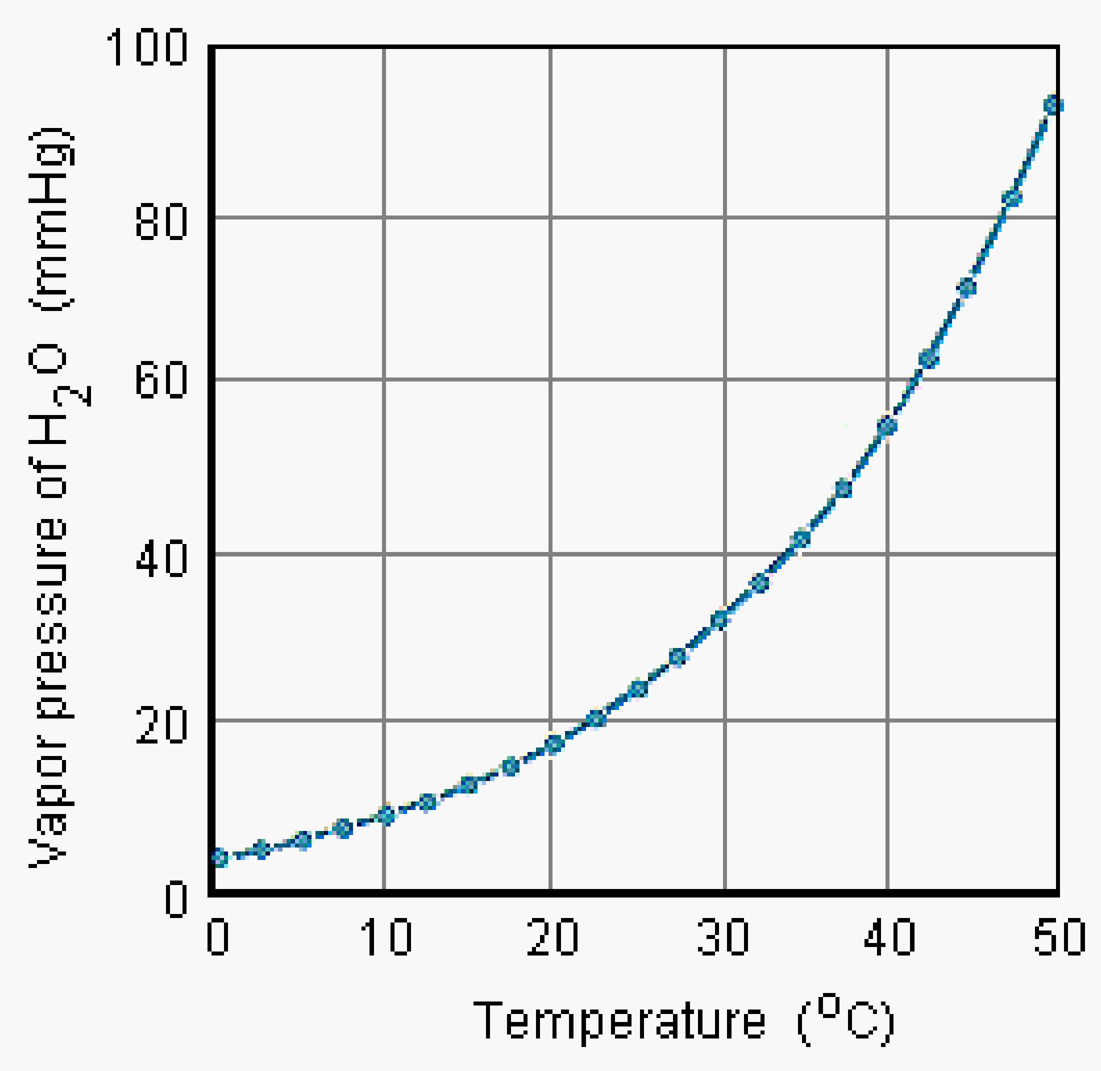
Increase the Temperature and the Volume increases



$$\frac{V}{T} = \text{Konstant}$$



Pressure versus Temperature



Kelvin Temperature Scale

Lord Kelvin found that the lowest Temperature that can be obtained Is - 273°C

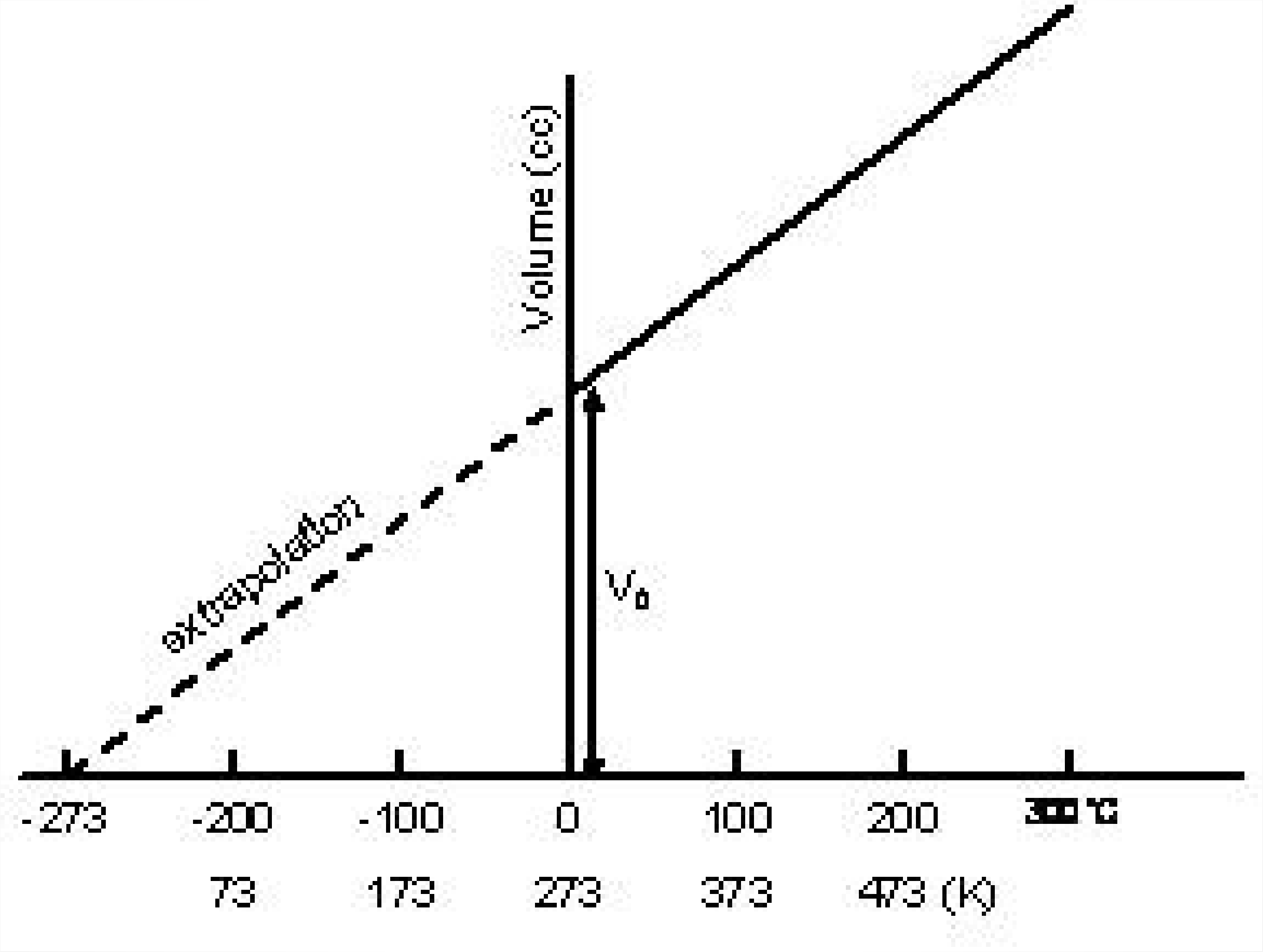
To convert °C to K add 273

- 273 °C = 0 K

0°C = 273 K

25 °C = 298 K

Kelvin extrapolated using Charles's Law to find Absolute zero.



Example
To what Temp must 850mL of gas at 22’C be cooled at constant pressure so that the volume of the gas is reduced to 250mL.

Convert ‘C to Kelvin add 273

Solution

Combined Gas Law

$PV = kT$

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

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

Example

A balloon has a volume of 5.00L at 20’C and 100kpa. What is its volume At 35’C and 90kpa.

Solution

Dalton's Law of partial pressure

The total pressure exerted by a mixture of gases is the sum of the pressure of each gas when measured alone.

$$P_{atmosphere} = P_{O_2} + P_{N_2} + P_{H_2O} + P_{CO_2}$$

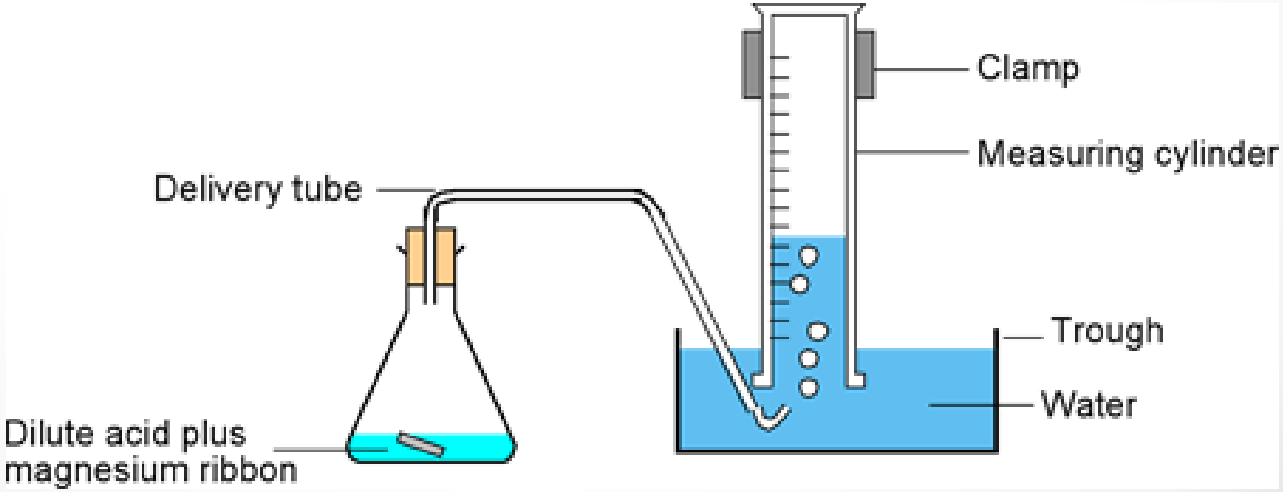
Example

A container is filled with N_2 (gas), O_2 (gas) and H_2O (gas). N_2 has a pressure of 50.1kpa, O_2 has a pressure of 13.1kpa and H_2O has a Pressure of 1.11kpa. What is the total pressure?

Vapour Pressure of H_2O

Temp	Vapour Pressure
0'C	0.61 kpa
17'C	1.94 kpa
20'C	2.34 kpa

In the lab gases are collected over water. Water is displaced by the gas and the volume of the gas collected can be calculated. However water vapour then contributes to the overall pressure and volume of the gas. Therefore, the volume and pressure of dry gas collected must be found by subtracting the volume and pressure of water vapour.



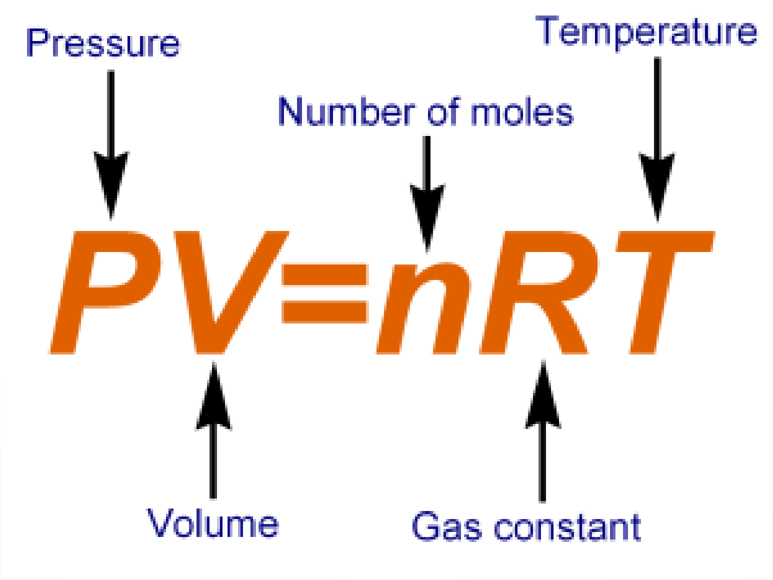
Example

A 150ml volume of H_2 gas is collected over water At a temperature of 25°C and an atmospheric Pressure of 100kpa. What is the volume of the dry H_2 gas at STP. Vapour pressure of water at 25°C is 3.17kpa.

Ideal Gas Law

Ideal Gas Law

Volume of gases not only depend on Temperature and pressure, it also depends On the amount of moles present. The more Moles present, the greater the volume. Therefore, if we incorporate moles into the Combined gas law, we get the IDEAL gas law



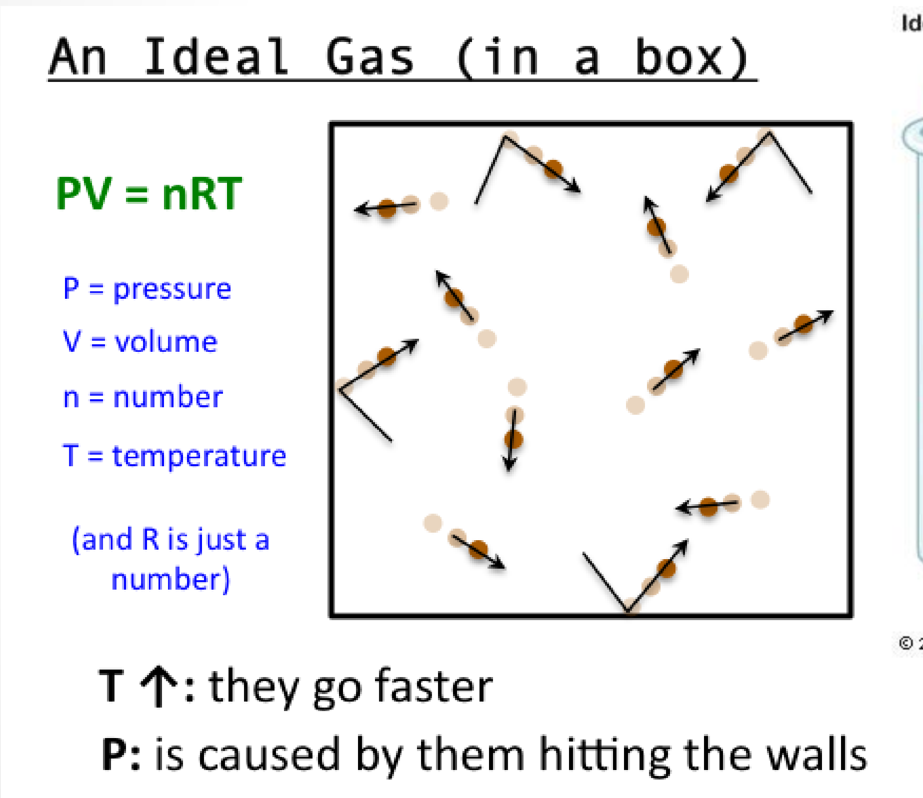
R is the Universal gas Constant

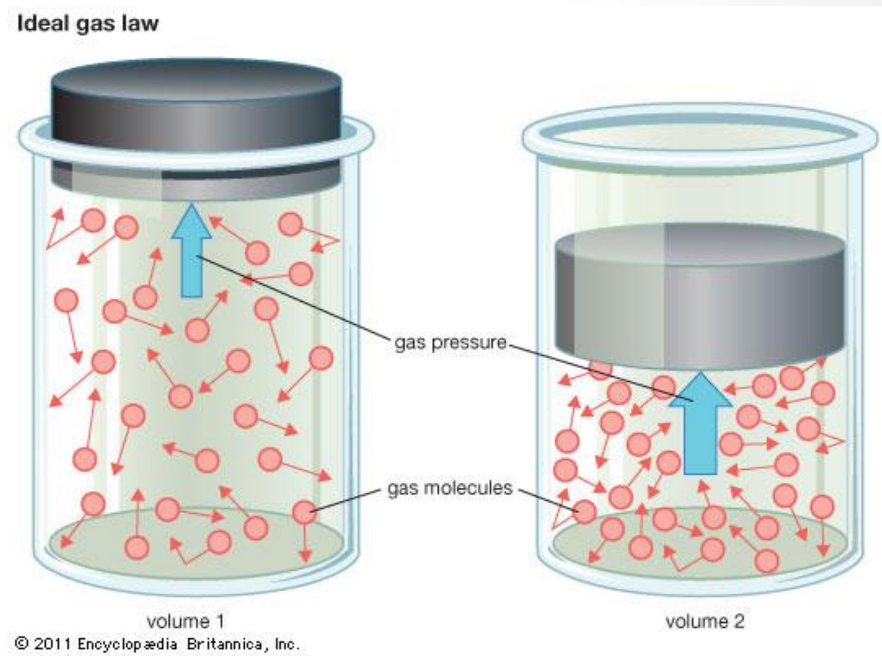
Experiments used to find molar volume
Found that one mole of an ideal gas at 273.15K and 101.325Kpa (STP) occupies 22.4L

$$R = \frac{PV}{nT} = \frac{101.315\text{Kpa} \times 22.4\text{L}}{1\text{mol} \times 273.15\text{K}}$$

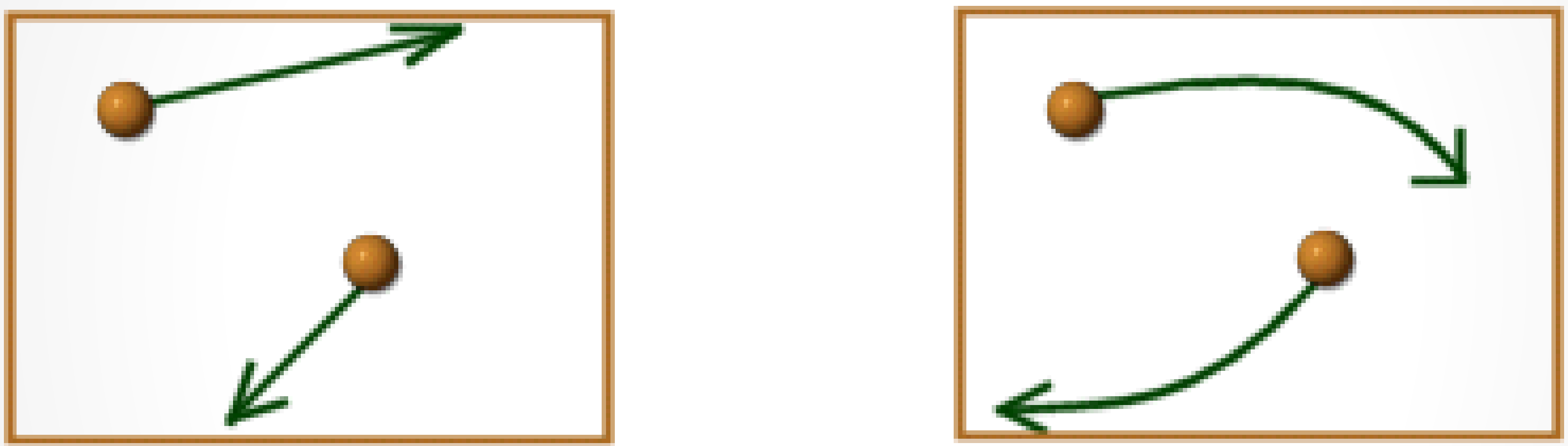
R = 8.314 Kpa·L/K·mol

It is called the ideal gas law because we are assuming ideal conditions. We are assuming no other forces are at play, such as dipole-dipole, H-Bonds, or london force. These forces would effect volume, but for The ideal gas law we ignore them





Assuming no Intermolecular forces



Ideal - no IMF
straight paths

Real - with IMF
curved paths

Example.
How many grams of Nitrogen gas are present if there is a volume of 12.84L at a temp of 309K and a pressure of 100kpa?

Step 1
Write down what you have
Step 2
Write down formula and rearrange to solve for missing variable
Step 3
Plug in numbers
Step 4
Includes additional calculations such as convert answer to grams or atoms

Solution