Boyle's Law

1659 - Robert Boyle, a British scientist, studied the relationship between pressure and the volume of a gas

Boyle's Law- the volume of a fixed mass of gas at constant temperature varies inversely with the applied pressure

i.e. $V \propto \frac{1}{P}$ or $V = \frac{k}{P}$ k is constant (pressure factor)

If the pressure or volume of a gas is changed, keeping the amount and temperature of the gas constant, the new volume or pressure can be calculated according to:

$$\mathbf{P_1V_1 = P_2V_2}$$

e.g. If a sample of gas has a volume of 100 mL when the pressure is 150 kPa, what will the volume be when the pressure is increased to 200 kPa? (T and n of gas are constant)

$\mathbf{P_1}$ = 150 kPa $\mathbf{P_2}$ = 200 kPa
$\mathbf{V_1}$ = 100 mL $\mathbf{V_2}$ = ?

Prediction: if P ⇧ then V ⇩

$$\mathbf{P_1V_1 = P_2V_2}$$

$$\mathbf{V_2 = \frac{P_1V_1}{P_2}}$$

$$= \frac{(150\ kPa)\ (100\ mL)}{200\ kPa}$$

$$= 75\ mL$$

e.g. What pressure is necessary to raise the volume of 100 mL of gas at a pressure of 150 kPa to 150 mL? (T and n of gas are constant)

Absolute Zero Determination

The straight line obtained for the Pressure - Temperature graph indicates the pressure of a gas is 0 kPa at - 273 ^{o}C. This is believed to be the lowest temperature possible for a gas to achieve.

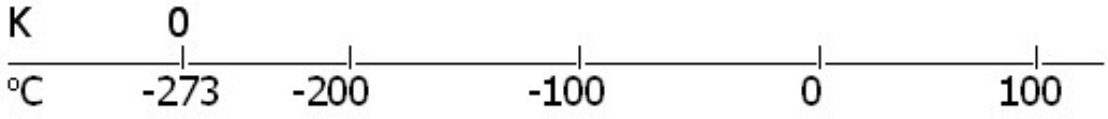
Absolute Zero = - 273.16 ^{o}C

Hypothetically, all molecular motion stops at this temperature.

The Kelvin Scale

This is a new temperature scale which makes use of absolute zero.

O Kelvin = - 273.16 ^{o}C



Conversions: $^{o}C + 273 = K$

$K - 273 = {}^{o}C$

e.g. Complete the following conversions:

a) 24.3 ^{o}C = ___ K

b) 280 K = ___ ^{o}C

Gay-Lussac's Law

1804- Joseph Louis Gay-Lussac, a French scientist, studied the relationship between temperature and the pressure of a gas

Gay-Lussac's Law - the pressure of a fixed mass of gas at constant volume varies directly with the applied temperature

i.e. $P \propto T$ or $P = kT$ k is constant

If the temperature of a gas is changed, keeping the amount and volume of the gas constant, the new pressure can be calculated according to:

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

T must be in Kelvin