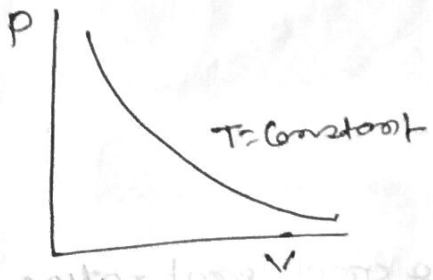
Kinetic theory of Gases

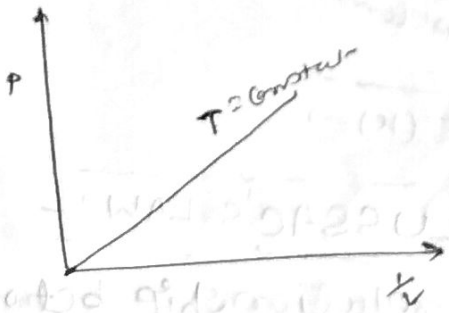
BOYLE'S LAW:- It is a fundamental gas law, discovered by Robert Boyle in 1662. It states that the volume of a given mass of a gas is inversely proportional to its pressure, provided the temp. remains constant.

Mathematically, $V \propto \frac{1}{P}$ or, $V = \frac{K}{P}$ or, $PV = K$

Where K is a constant. Its value depends on (i) mass of the gas (ii) Its temp. (iii) The units in which P and V measured.

If P_1 and V_1 are the initial values of pressure and volume and P_2, V_2 are their final values, then according to Boyle's law, $P_1V_1 = P_2V_2$





CHARLE'S LAW:- This law gives relationship between volume and temp. of a gas at constant pressure. It was discovered by Alexandar Charle's in 1787. It states that if the pressure remains constant, then the volume of a given mass of a gas increases or decreases by $\frac{1}{273.15}$ of its volume at 0°c for each 1°c rise or fall of Temp.

let V_0 be the volume of the given mass of a gas at 0°C. According to charle's law, its volume at 1°c is

$$V_1 = V_0 + \frac{V_0}{273.15} = V_0\left(1 + \frac{1}{273.15}\right)$$

volume of the gas at 2°C.

$$V_2 = V_0\left(1 + \frac{2}{273.15}\right)$$

∴ volume of the gas at t°c

$$V_t = V_0\left(1 + \frac{t}{273.15}\right) = V_0\left(\frac{273.15 + t}{273.15}\right)$$

If T_0 and T are temperature on Kelvin scale corresponding to $0^\circ C$ and $t^\circ C$, then,

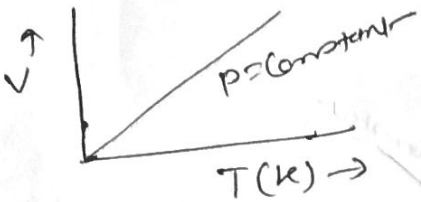
$T_0 = 273.15 + 0 = 273.15$

and $\boxed{T = 273.15 + t}$

$\therefore V_t = V_0 \frac{T}{T_0}$ or, $\frac{V_t}{T} = \frac{V_0}{T_0}$.

or, $\frac{V}{T} = \text{Constant}$ $\boxed{\text{i.e } V \propto T}$

So, charle's law can be stated in another way. pressure remaining constant, the volume of a given mass of a gas is directly proportional to its volume absolute Temp.



GAY LUSSAC'S LAW :-

This law gives relationship between pressure and Temperature of a gas. It was discovered by Joseph Gay Lussac. It states that if the volume remains constant, the pressure of a given mass of a gas increases or decreases by $\frac{1}{273.15}$ of its pressure at $0^\circ C$ for each $1^\circ C$ rise or fall of Temp.

If P_0 and P_t are the pressure of a given mass of gas at $0^\circ C$ and $t^\circ C$ respectively, then according to Gay Lussac's law,

$P_t = P_0\left(1 + \frac{t}{273.15}\right) = P_0\left(\frac{273.15 + t}{273.15}\right)$

or, $P_t = P_0 \frac{T}{T_0}$.

Where $T_0(K) = 273.15$ and $T(K) = 273.15 + t$

$\therefore \frac{P_t}{P_0} = \frac{T}{T_0}$ or, $\frac{P}{T} = \text{Constant}$ or $\boxed{P \propto T}$

So, Gay Lussac's law can be stated in another way. volume remaining constant, the pressure of a given mass of a gas is directly proportional to its absolute temperature. =