B.Sc. I
Group-A

Deduction of gas Laws from the Kinetic gas equation

Kinetic gas equation $\frac{1}{3} mnu^2$

$$= \frac{2}{3} \cdot \frac{1}{2} Mu^2$$

M = total mass of gas ($\because m \times n = M$)

But

$\frac{1}{2} Mu^2$ = Kinetic energy of the gas

$$\therefore PV = \frac{2}{3} KE \quad \text{---- (i)}$$

From the postulates of kinetic theory of gases

Kinetic energy $\propto$ Absolute temperature (T)

$$\therefore KE = \underset{\substack{\downarrow \\ \text{Proportionality constant}}}{K}T$$

Putting these value in equation (i),

$$\therefore PV = \frac{2}{3} KT \quad \text{---- (ii)}$$

$\frac{2}{3}K$ is Constant

$\therefore \boxed{PV \propto T}$ ----- (iii)

This is Boyle's Law

From equation (ii)

$$PV = \frac{2}{3} KT$$

$$\therefore \frac{V}{T} = \frac{2}{3} \frac{K}{P}$$

$\frac{2}{3}K$ is Constant

If P is kept Constant

$\therefore \boxed{\frac{V}{T} = \text{Constant}}$ ---- (iv)

This is Charle's Law

Consider any two gases,
According to kinetic gas equation.

For 1st gas $P_1V_1 = \frac{1}{3} m_1 n_1 u_1^2$

For 2nd gas $P_2V_2 = \frac{1}{3} m_2 n_2 u_2^2$

Where, V = Volume , P = Pressure
m = Mass of each molecule of the gas
n = Total number of molecules of the ga
u = Root mean square velocity of the molecules of gas

If conditions of pressure and volume are similar for both the gases.

then, $P_1V_1 = P_2V_2$

$$\therefore \frac{1}{3} m_1 n_1 u_1^2 = \frac{1}{3} m_2 n_2 u_2^2$$

$$\therefore \frac{2}{3} n_1 \frac{1}{2} m_1 u_1^2 = \frac{2}{3} n_2 \frac{1}{2} m_2 u_2^2$$

$$\therefore \frac{2}{3} n_1 KE_1 = \frac{2}{3} n_2 KE_2$$

$$\therefore n_1 KE_1 = n_2 KE_2$$

Further, According to one of the postulates of the kinetic theory of the gases

Average kinetic energy of a gas α absolute temperature

Since conditions of temperature are similar in both the cases

$$KE_1 = KE_2$$

$$\therefore \boxed{n_1 = n_2} \quad \text{----} \quad (V)$$

This is Avogardo's Law