**Dr. Mohammad Aslam, Department of Physics A.N.D. College,**

**B.Sc. Part-1, Physics (Hons) Paper-ii**

**Lecture No. -13**

**Topic: Deduction of Perfect Gas Laws from Kinetic Theory of Gases.**

We Know that

$$PV = \frac{1}{3}mN\bar{v}^2$$

Where,

P $\rightarrow$ pressure of the gas,

V $\rightarrow$ volume of the gas,

m $\rightarrow$ mass of one gas molecule,

N $\rightarrow$ number of gas molecules,

$\bar{v}$ $\rightarrow$ average velocity of the gas molecules,

Since total mass of the gas molecules in a container is M= mN.

Therefore,

$$PV = \frac{1}{3}M\bar{v}^2$$

**1- Deduction of Boyle's Law:**

$$\text{kinetic Energy (K.E)} \propto T$$

$$\text{(K.E)} = \text{k}T,$$

where, k is the Boltzmann's constant and T is the temperature

$$PV = \frac{1}{3}M\bar{v}^2$$

Divide and Multiply by 2 on right hand side then

$$PV = \frac{2}{3} \times \frac{1}{2}M\bar{v}^2$$

But $\frac{1}{2}M\bar{v}^2$= Kinetic energy of the gas

$\frac{1}{2}M\bar{v}^2 = kT$

$$PV = \frac{2}{3} \times kT$$

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

$\frac{2}{3}$k is constant, If T is constant

Hence PV= Constant, which is Boyle's law

**2- Deduction of Charles Law:**

According to the kinetic theory of gases, the average kinetic energy(K.E) of the gas molecules is directly proportinal to its absolute temperature(T).

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

$$\frac{V}{T} = \frac{2k}{3P}$$

$\frac{2}{3}$k is constant, If P kept constant then

$$\frac{V}{T} = Constant,$$

which is charles law

**3- Deduction of Dalton's Law of partial pressure:**

According to the kinetic theory of gases , the attractive forces between the molecules of the same or different gases are very weak under ordinary conditions of temperature and pressure. Therefore the pressure due to a particular gas is not changed by the presence of the other gases in the container. The total pressure exerted by the gaseous mixture must be kept equal to the sum of partial pressures of each gas when present alone in that space.

$$PV = \frac{1}{3}mN\bar{v}^2$$

$$P = \frac{mN\bar{v}^2}{3V}$$

If only the first gas is enclosed in the vessel of volume V, the pressure exerted would be

$$P_1 = \frac{m_1 N_1 \bar{v_1}^2}{3V}$$

If second gas is enclosed in the same vessel then the pressure exerted would be

$$P_2 = \frac{m_2 N_2 \bar{v_2}^2}{3V}$$

Now,

$$P = \frac{m_1 N_1 \bar{v_1}^2}{3V} + \frac{m_2 N_2 \bar{v_2}^2}{3V}$$

$$P = P_1 + P_2$$

Which is Dalton's law of partial pressure.