B.Sc. Part-1 Physics (Hons) Paper-ii, Lecture-12 on the topic

"Basic Assumptions of Kinetic Theory of Gases."

Dr. Mohammad Aslam, Dept. of Physics. 20/04/2020

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

Lecture-12

(1)

* Basic assumptions of kinetic theory of gases:-

Kinetic theory of gases is based on the following assumptions.

(1) → Gas consists of large number of particles, atoms or molecules.

(2) → Particles make elastic collisions with each other and with walls of container.

(3) → There exist no external forces, (density remain constant)

(4) → Particles, on average, separated by distances large compared to their diameters.

(5) → No forces between particles except when they collide.

* Ideal gas approximation:-

Ideal gas laws are derived from the approximation that gas molecules behave like hard spheres.

The approximation is true for most gases at low pressure or elevated temperature.

for example: At atmospheric conditions, real gas behaviour at high pressure and lower temperature is frequently represented by modifications of the ideal gas laws.

Thus, the ideal gas laws are a good starting place for calculations of gas properties.

Boyle's Law states that constant temperature (T), the volume (V) of a fixed mass of an ideal gas is inversely proportional to the absolute pressure (P), that is

$$V \propto \frac{1}{P}$$

$$V = \frac{K}{P}$$

$$\boxed{PV = K \text{ (Constant)}}$$

Charles' Law states that constant pressure (P), the volume (V) of a given mass of an ideal gas is directly proportional to the absolute temperature (T). That is

$$V \propto T$$

$$V = KT$$

or $$\boxed{\frac{V}{T} = K \text{ (Constant)}}$$

These two laws may be combined to give the ideal gas law, an equation of the state:

$PV = RT$ for 1 mole of gas

for n mole of gas it can be written

$$\boxed{PV = nRT}$$

where $n = \frac{m}{M}$

m is the mass of the gas present,

M is molecular weight of gas.
R is universal gas constant in energy per mole per absolute degree.
the value of R is 8.314 J/g-mole-K

when n moles of an ideal gas undergo a chemical reaction, then

$$P_1 V_1 = nRT_1 \quad \text{and} \quad P_2 V_2 = nRT_2$$

$$\frac{P_1 V_1}{P_2 V_2} = \frac{nRT_1}{nRT_2}$$

$$\frac{P_1 V_1}{P_2 V_2} = \frac{T_1}{T_2}$$

$$\boxed{\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}}$$

where the subscripts 1 and 2 refer to the initial state and final state, respectively.