Marwari college Darbhanga

Subject---physics (Sub)

Class—B.Sc. part 1

Group—C

Topic—Ideal Gas Equation (Thermal physics)

By:- Dr. Sony Kumari,

Assistant professor

Marwari college Darbhanga

Ideal Gas Equation

Ideal Gas

An ideal gas is a theoretical gas! It does not exist in reality but is assumed to exist for the purpose of simplifying calculations. It also generates a reference point in relation to which the behavior of other gases can be studied.

An ideal gas is defined as a gas composed of randomly moving particles as all gases do, the only difference being that for an ideal gas when its particles collide with each other, these collisions are assumed to be perfectly elastic which means no energy of either of these particles is wasted.

In reality, however, when actual gas particles collide with each other, some of their energy is wasted in changing directions and overcoming friction.

Generally, any gas behaves similarly to an ideal gas under the conditions of high temperature and low pressure.

Important Gas Laws

Boyle's Law

Boyle's Law states that 'The absolute pressure exerted by a given mass of an ideal gas is inversely proportional to the volume it occupies if both the temperature and amount of gas remain unchanged'. In mathematical terms this law is given as:

$P \propto 1/V$ or that $PV = K$

where P=Pressure of the gas; V=Volume of the gas; K=constant. It means that both the pressure and volume of a given mass of gas are inversely proportional to each other at a constant temperature. Furthermore, it also expresses that the product of pressure and volume for any gas is a constant and thus can be used to study the comparison of the gas under different conditions as:

$P'V' = P''V''$

where both the products are for the same gas but under different pressures and volumes.

Charles' Law

Charles' law states that ' When the pressure of a sample of air is held constant, then the volume of the gas is directly proportional to its temperature', that is

$$V \propto T$$

where V= Volume of a gas sample; T= Absolute temperature. Quite simply put, it says that Gases expand on heating and contract on cooling.

Avogadro's Law

Avogadro's law states that 'Equal volumes of all gases at conditions of same temperature and pressure have the same number of molecules', written as:

$$V \propto n \text{ or } V/n = K$$

where V=volume of gas; n=Number of moles (1 mole=6.022 x 10^{23} molecules). It implies that under similar conditions of pressure, volume and temperatures all gases will have an equal number of molecules, independent of the weight and density of the gas.

Ideal Gas Equation

If we combine the results of all the above gas laws we get an equation that holds true for an ideal gas. The most common form of this equation is since PV= K and V/T =k then

PV/T = constant

Thus, the Ideal Gas Equation is given as

PV = nRT

where P= pressure of the gas; V=volume of the gas; n= Number of Moles; T=Absolute temperature; R=Ideal Gas constant also known as Boltzmann Constant = 0.082057 L atm $K^{-1}mol^{-1}$.