Undergraduate Semester II

MJC-2(T): Physical Chemistry: States of Matter and Ionic Equilibrium

1. Gaseous State:

Derivation of Ideal Gas Equation:

Understanding the behaviour of gases is important in the field of chemistry, physics, and engineering. The ideal gas equation is one of the fundamental concepts in thermodynamics that links pressure, volume, temperature, & the number of moles of a gas. This class will discuss the derivation of the ideal gas equation, especially from the perspective of kinetic theory. Furthermore, this lecture will also focus on foundational questions, like "what is ideal gas?" and "what is an ideal gas equation?" and explore all the terms in the ideal gas equation in detail.

What is an Ideal Gas?

Before diving into all the equations, let's answer, what is ideal gas?

An ideal gas is a theoretical gas that is composed of many moving particles that have negligible volume and no intermolecular forces. The ideal gas equation is a combination of empirical laws like Charles' law, Boyle's law, Gay-Lussac's law, and Avogadro's law into a single expression.

Key Characteristics of an Ideal Gas:

- No intermolecular forces between gas molecules.
- Collisions between molecules are perfectly elastic.
- The volume occupied by the molecules of any gas is negligible when compared to its container's volume.
- All gas molecules are identical and in constant, random motion.

What is an Ideal Gas Equation?

It is important to know the answer to "What is an ideal gas equation?" to understand the concepts in a much clearer manner. The ideal gas equation describes the behaviour of an ideal gas under various conditions. It connects the macroscopic properties of a gas, such as pressure (P), volume (V), temperature (T), and the number of moles (n) in one equation.

The equation is:

PV=nRT

Where,

- P represents the pressure.
- n represents the number of moles of gas
- V is the volume.
- R represents the universal gas constant.
- T is the absolute temperature in Kelvin.

This equation provides a powerful tool for calculating the behaviour of gases under different conditions.

Terms in Ideal Gas Equation:

Here's a breakdown of all the terms in ideal gas equation and what they represent:

Term	Symbol	Unit	Description
Pressure	P	Pa, N/m², atm	The pressure created by gas molecules per unit area
Volume	V	L or m³	The space occupied by the gas.
Moles	n	mol	The quantity of gas particles.
Gas constant	R	Has various values depending on the units used for pressure, volume, and temperature.	A proportionality constant.
Temperature	T	K	The absolute temperature of the gas.