Gas Laws Part 2: Gay-Lussac Law: Avogadro'S Law: Combined Gas Law (For CBSE, ICSE, IAS, NET, NRA 2022)

Title: Gas Laws Part 2

Gay-Lussac Law

- This law gives the relationship between temperature and pressure at constant volume.
- Law states that at a constant volume, the pressure of the gas is directly proportional to the temperature for a given gas.
- If you heat up a gas, the molecules will be given more energy so they move faster.
- If you cool down the molecules, they slow down and the pressure decreases.
- The change in temperature and pressure can be calculated using Gay-Lussac law and it is mathematically represented as;

$$P \propto T$$

Or

$$\frac{P}{T} = k_1$$

Or

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

- Where P is the pressure of the gas
- T is the temperature of the gas in Kelvin.

Avogadro'S Law

- This law states that if the gas is an ideal gas, the same number of molecules exists in the system.
- Law also states that if the volume of gases is equal it means that the number of the molecule will be the same as the ideal gas only when it has equal volume.

- This above statement can be mathematically expressed as;

$$\frac{V}{n} = \text{constant}$$

Or

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

Where V is the volume of an ideal gas and n in the above equation represent the number of gas molecules.

Combined Gas Law

- This is also known as a general gas equation is obtained by combining three gas laws which include Charle's law, Boyle's Law and Gay-Lussac law.
- Law shows the relationship between temperature, volume, and pressure for a fixed quantity of gas.
- The general equation of combined gas law is given as;

$$\frac{\text{PV}}{T} = k$$

If we want to compare the same gas in different cases, the law can be represented as;

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

Ideal Gas Law

- Much like the combined gas law, the ideal gas law is also an amalgamation of four different gas laws.
- Avogadro's law is added and the combined gas law is converted into the ideal gas law.
- This law relates four different variables which are pressure, volume, no of moles or molecules and temperature.
- The ideal gas law gives the relationship between these above four different variables.

$$\text{PV} = \text{nRT}$$

Where,

- V = volume of gas.
- T = temperature of the gas.
- P = pressure of the gas.
- R = universal gas constant.

- n denotes the number of moles.

Application of Gas-Law

- When the physical condition is changing with changing in the environment the behaviour of gases particle also deviates from their normal behaviour. These changes in gas behaviour can be studied by studying various laws known as gas law.
- Besides, the gas law along with modern forms is used in many practical applications that concern a gas.
- For example, respiratory gas measurement of tidal volume and vital capacity etc are done at ambient temperature while these exchanges take place in the body at 37-degree Celsius.
- The law is also used often in thermodynamics as well as in fluid dynamics. It can be used in the weather forecast systems.
- The gas laws have been around for quite some time now, and they significantly assist scientists in finding amounts, pressure, volume, and temperature when coming to matters of gas.