

Basic concepts of Thermodynamics

Thermodynamics is essentially the study of energy, energy transformations and its relation to matter.

Some Important Terms Related to Thermodynamics

(i) **System** It refers to the part of universe in which observations are carried out.

(ii) **Surroundings** The part of universe other than the system is known as surroundings.

(iii) **Boundary** The wall that separates the system from the surroundings is called boundary.

(iv) **Thermodynamic equilibrium** A system in which the macroscopic properties do not undergo any change with time is called thermodynamic equilibrium.

(v) **Thermal equilibrium** If there is no flow of heat from one portion of the system to another, the system is said to be in thermal equilibrium.

(vi) **Mechanical equilibrium** If no mechanical work is done by one part of the system on another part of the system, it is said to be in mechanical equilibrium. Such a condition exists when pressure remains constant.

Types of Systems

(i) **Open system** The system in which energy and matter both can be exchanged with the surroundings.

(ii) **Closed system** The system in which only energy can be exchanged with the surroundings.

(iii) **Isolated system** The system in which neither energy nor matter can be exchanged with the surroundings.

Thermodynamics Properties

1. Intensive Properties

Properties of the system which depend only on the nature of matter but not on the quantity of matter are called Intensive properties, e.g., pressure, temperature, specific heat, etc

2. Extensive Properties

$$\Delta_r H = \Sigma H_{(p)} - \Sigma H_{(R)}$$

Enthalpy of reaction expressed at the standard state conditions is called standard enthalpy of reaction (ΔH).

Factors affecting enthalpy of reaction

- (i) Physical state of reactants and products.
- (ii) Allotropic forms of elements involved.
- (iii) Chemical composition of reactants and products.
- (iv) Amount of reactants.
- (v) Temperature.

Various Forms of Enthalpy of Reaction

1. Enthalpy of Formation (ΔH_f)

It is heat change when one mole of compound is obtained from its constituent elements.

Enthalpy of formation at standard state is known as standard enthalpy of formation $\Delta_f H^\circ$ and is taken as zero by convention. It also gives the idea of stability.

2. Enthalpy of Combustion

It is the Enthalpy change taking place when one mole of a compound undergoes complete combustion in the presence of oxygen (ΔH_c).

ΔH_c because process of combustion is exothermic.

3. Enthalpy of Solution

It is the Enthalpy change when one mole of a substance is dissolved in large excess of solvent, so that on further dilution no appreciable heat change occurs.

4. Enthalpy of Hydration