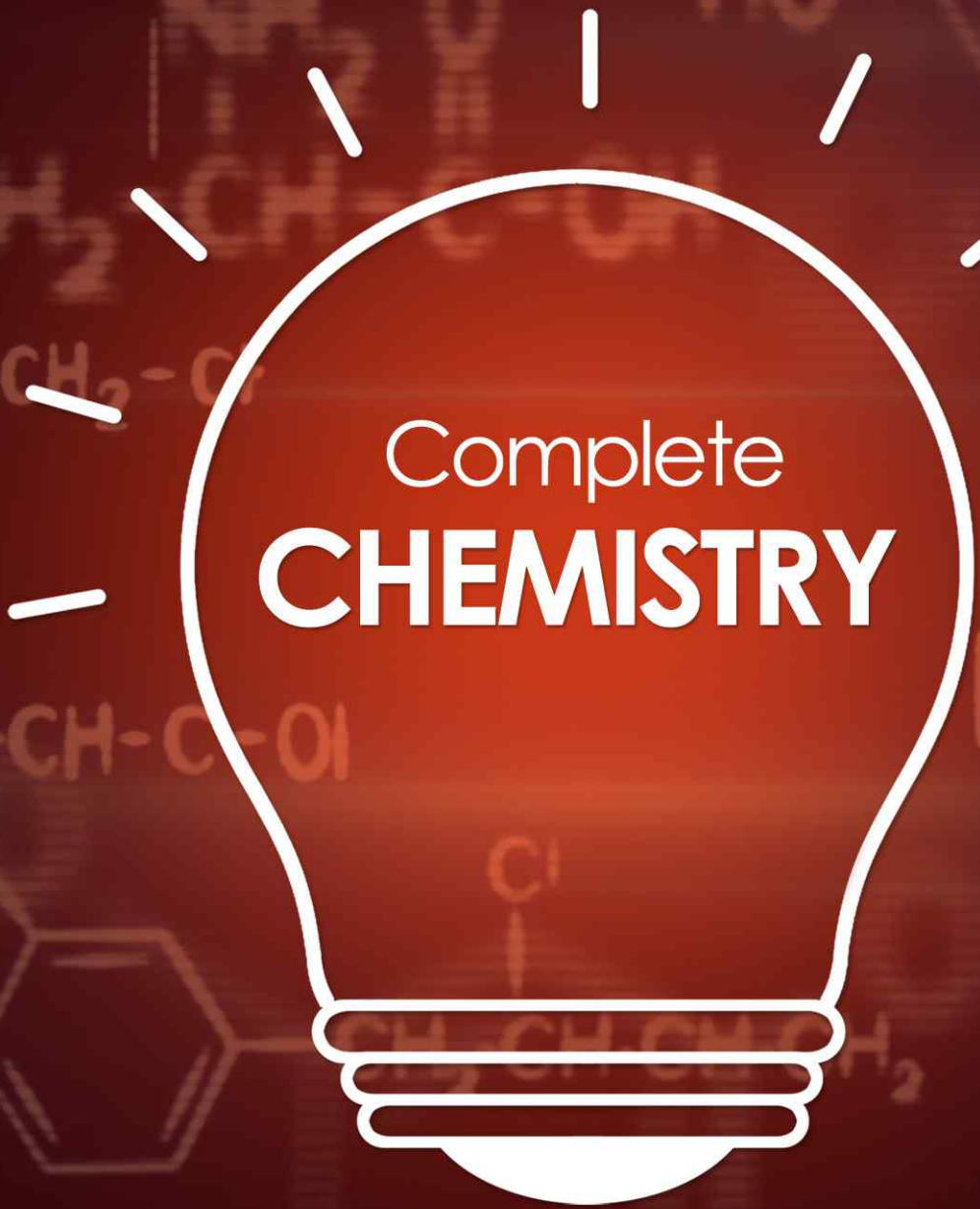
misostudy.com
smart learning



Complete CHEMISTRY

IIT-JEE · NEET · CBSE eBOOKS

CLASS 11&12th

CLASS 11th

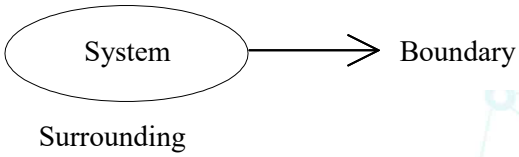
Thermodynamics and Thermochemistry

Thermodynamics

01. Introduction

The study of energy transformations is the subject matter of thermodynamics.

Some Basics Terms



Types of system

(I) **Based or exchange of mass and energy**
- (i) **Isolated system :** It cannot exchange matter and energy with the surrounding.
- (ii) **Closed system :** It can exchange energy but not matter.
- (iii) **Open system :** It can exchange matter.

(II) **Based on system composition**
- (i) **Homogeneous system :** Made up of one phase only
- (ii) **Homogeneous system :** More than one phase.

02. Properties of a System

Particular set of its measurable quantities.
Intensive property : value does not depend on the size (or mass) of the system.
Extensive property : value depends on the size (or mass) of the system.
Variables like P,V , T are *State Functions* or *Stage Variables* because their values depends only on initial and final state.

Path function

Function which depends on the path .
State functions : Pressure, volume, temperature, Gibb's free energy, internal energy, entropy
Path function : Work, heat, Loss of energy due to friction

03. Reversible and Irreversible Process

S.No.	Reversible process	Irreversible process
1.	Driving force is infinitesimally small.	Driving force is large and finite. PV
2.	A reversible heat transfer take place across temperature difference dT	Irreversible heat transfer take place across difference ΔT
3.	It is an ideal process.	It is a real process
4.	It take infinite time for completion of process.	It take finite time for completion of process.

Cyclic Process $\Delta E = 0$ and $\Delta H = 0$
Isochoric Process $\Delta V = 0$
Isobaric Process $\Delta P = 0$

04. Work

PV- Work analysis :
For small displacement dx due to force F, work done on the system.

$dw = F.dx$

Also $F = PA$

$dW = PA.dx$

$V = (\ell - x)A$

$\Rightarrow \quad dV = -A.dx \qquad \Rightarrow \quad dW = -P_{ext.}dV$

$$\Rightarrow \quad W_{PV} = -\int_{V_1}^{V_2} P_{ext} dV$$

- **Isothermal Process** $dT = 0$
- **Adiabatic process** $q = 0$

05. Heat

Heat is defined as the energy that flows into or out of a system.
(i) $q_V = nC_V dT$ (for constant volume process)
(ii) $q_p = nC_p dT$ (for constant volume process)
(iii) $C_{p,m} - C_{v,m} = R$
(iv) C_v & C_p depends on temperature even for an ideal gas. ($C = a + bT + cT^2$.....)

06. Internal Energy (E & U)

$U = U_{Kinetic} + U_{Potential} + U_{Electronic} + U_{nuclear} + ...$

NOTE ☞ (i) U is a state function & is an extensive property.
(ii) $\Delta E + q_v$, heat supplied to a gas constant volume, since all the heat supplied goes to increase the internal energy of the gas.
(iii) $U = f(T, V)$
(iv) $dU = C_V\, dT$
(v) $\Delta U + \int C_V .\, dT$

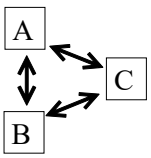
07. Degree of Freedom and Equipartition principle

The degree of freedom in a molecule are given by the number of coordinates required to locate all the mass points (atoms) in a molecule. it has three degree of freedom corresponding to translation motion in the three independent spatial directions X, Y and Z. If a molecule contain N atoms, each atom contributes these three degree of freedom, so the molecule has a total of 3N degree of freedom.

Atomicity		n_u	n_{R_0}	n_{vib}	C_V		C_P		γ	
					Excl.Vib	Incl.Vib	Excl.Vib	Incl.Vib	Excl.Vib	Incl.Vib
Mono		3	0	0	$\frac{3}{2}R$	$\frac{3}{2}R$	$\frac{5}{2}R$	$\frac{5}{2}R$	$\frac{5}{3}$	$\frac{5}{3}$
Di		3	2	2	$\frac{5}{2}R$	$\frac{7}{2}R$	$\frac{7}{2}R$	$\frac{9}{2}R$	$\frac{7}{5}$	$\frac{9}{7}$
Tri	Linear	3	2	4	$\frac{5}{2}R$	$\frac{13}{2}R$	$\frac{7}{2}R$	$\frac{15}{2}R$	$\frac{7}{5}$	$\frac{15}{13}$
	Non Linear	3	3	3	3R	6R	4R	7R	$\frac{4}{3}$	$\frac{7}{6}$

08. Laws of Thermodynamics

Zeroth law of thermodynamics : It is based on thermal equation, two systems in thermal equilibrium with a 3rd system are also in thermal equilibrium with each other.



First Law:

"Total energy of universe remain constant". It is law of conservation of energy.

$$\Delta U = q + W,$$

09. Enthalpy

Enthalpy is a measure of the total energy of a thermodynamics system.

$$H = U + PV$$

$$dH + dU + d(PV)$$

Property of Enthalpy parameter

(i) Enthalpy is a thermodynamic potential. It is a state function and an extensive quantity.

(ii) The change ΔH is positive endothermic reaction, and negative in exothermic process.

(iii) $\Delta H + \Delta U + P\ \Delta V$

combining with first law.

$\Delta H = q_p$ = Heat added at constant pressure