MIND MAP

Thermochemistry

Thermochemistry deals with the energy changes involved in chemical reaction.

Types of Reaction

Exothermic reactions

These are the chemical reaction by which heat is released .

Examples :- Neutralisation reactions, combustion reactions, slaking of lime, etc.

Endothermic reactions

These are the chemical reaction involving adsorption of heat.

Examples :- Decomposition reactions, elimination reaction, etc.

Thermoneutral reactions

These are chemical reaction in which heat is neither absorbed nor released.

$1/2H_2(g) + aq. \rightarrow H^+(aq.)\ \Delta H^\circ = 0$

$AgClO_2(s) \longrightarrow Ag(s) + \frac{1}{2} Cl_2(g) + O_2(g)\ ;\ \Delta H^\circ = 0$

Thermo Chemical Equation

It represents a balanced chemical reaction in which the physical state along with allotropic form of all the reaction components as well as heat involved in reaction, are given.

$C_2H_5OH(\ell) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O)(\ell)$

$\Delta_rH^\circ = -1367$ kJ/mol

Enthalpy of Reaction (Δ_rH)

Enthalpy of reaction is defined as the quantity of heat evolved or absorbed when molar quantities of substances react completely in amounts represented by chemical equation, all components being maintained at same pressure and same temperature condition.

Standard Enthalpy of Reaction

The standard enthalpy of reaction is the enthalpy change for a reaction when all the participating substances are in their standard states.

Laws of Thermochemistry

(i) Lavoisier and Laplace law-

It states that the energy change accompanying any transformation is equal and opposite to energy change accompanying the reverse process. $A + B \rightarrow C + D\ ;\ \Delta H$

$C + D \rightarrow A + B\ ;\ -\Delta H$

(ii) Hess's law of constant heat summation :

Heat change of a process is the same whether the process takes place in one step or several steps

Enthalpy of Formation (Δ_fH)

The standard enthalpy change for the formation of one mole of a compound from its elements in their reference states is called Standard Molar Enthalpy of Formation.

Enthalpy of Combustion (Δ_cH)

Standard enthalpy of combustion is defined as the enthalpy change per mole (or per unit amount) of a substance, when it undergoes combustion and all the reactants and products being in their standard states at the specified temperature.

Application of Enthalpy of Combustion

$\Delta_rH = \Sigma\Delta_cH(\text{Reactant}) - \Sigma\Delta_cH(\text{Products})$

Bond Enthalpy ($\Delta_{bond}H$)

Bond strengths are commonly described by their bond dissociation energy which is the energy required to break one mole of a bond of particular type.

This is a definite quantity and is expressed in kJ mol–1.

$$\Delta_r H = \sum \Delta_{bond} H_{Reactants} - \sum \Delta_{bond} H_{products}$$

Resonance Energy

$\Delta_r H_{exp} - \Delta_r H_{theo} = \Delta H_{reso}$

Enthalpy of Neutralisation, $\Delta_{neut}H$

Heat released in the reaction in which one mole each of a strong acid and a strong base react to give a salt and water is called heat of neutralisation.

Enthalpy of Solution, $\Delta_{sol}H$

The change in enthalpy when one mole of a solute is dissolved in a specified quantity of a solvent at a given temperature is called enthalpy of solution.

Enthalpy of Hydration, $\Delta_{hyd}H$

This is defined as the enthalpy change (evolved or absorbed) when one mole of the anhydrous salt combines with the required number of moles of water to form the specific hydrated salt.

Lattice Enthalpy ($\Delta_{lattice}H$)

The lattice enthalpy of an ionic compound is the enthalpy change which occurs when one mole of an ionic compound is formed from it's ions in gaseous state under conditions of constant temperature and pressure.

MIND MAP

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Ionisation Enthalpy, $\Delta_i H$

Enthalpy change when one mole of gaseous atom is converted into gaseous ion be removing one mole electron from ground state is called ionisation enthalpy.

Electron Gain Enthalpy $\Delta_{eg}H$

Enthalpy change when 1 mole electrons are added to valence shell of gaseous atoms is called electron gain enthalpy.

Enthalpy of Atomisation, $\Delta_a H$

It is the enthalpy change (always positive) when one mole of a substance is completely dissociated into atoms in the gaseous state, under constant pressure and temperature condition.

Enthalpy of Transition (Enthalpy of allotropic form) , $\Delta trsH$

It is the enthalpy change when one mole of one allotropic form changes to another under conditions of constant temperature and pressure. $C(graphite) \longrightarrow C(diamond)$; $\Delta_{trs}H = 1.90$ kJ mol^{-1}

Enthalpy Changes During Phase Transformations

(i) Enthalpy of Fusion, $\Delta_{fus}H$: It is the enthalpy change that accompanies melting of one mole of a solid substance at constant temperature (melting point of solid) and pressure.
For example,
$H_2O(s) \longrightarrow H_2O(l)$;
$\Delta_{fus}H = +6.00$ kJ mol^{-1}

(ii) Enthalpy of Vaporisation, $\Delta_{vap}H$: It is the enthalpy change to vapourise one mole of a liquid substance at constant temperature (boiling point of liquid) and pressure for example :
$H_2O(l) \longrightarrow H_2O(g)$;
$\Delta_{vap}H = +40.79$ kJ mol^{-1}

(iii) Enthalpy of Sublimation, $\Delta_{sub}H$: It is the amount of enthalpy change to sublime one mole of a solid substance at constant temperature (sublimation temperature of solid) and pressure. For example
$CO_2(s) \longrightarrow CO_2(g)$;
$\Delta_{sub}H = +25.2$ kJ mol^{-1}