Energetics

- When a chemical reaction or a chemical process is taking place there will be a definite energy taking place simultaneously.This energy change occurs in the form of heat energy in process where heat is given out the energy of products will be less than the energy of the reactants.Therefore,it is called as exothermic .In the endothermic process the energy is taken in or absorb therefore the energy of products is greater than that of the reactants.

- Energetics is Sub-divided into 2 :

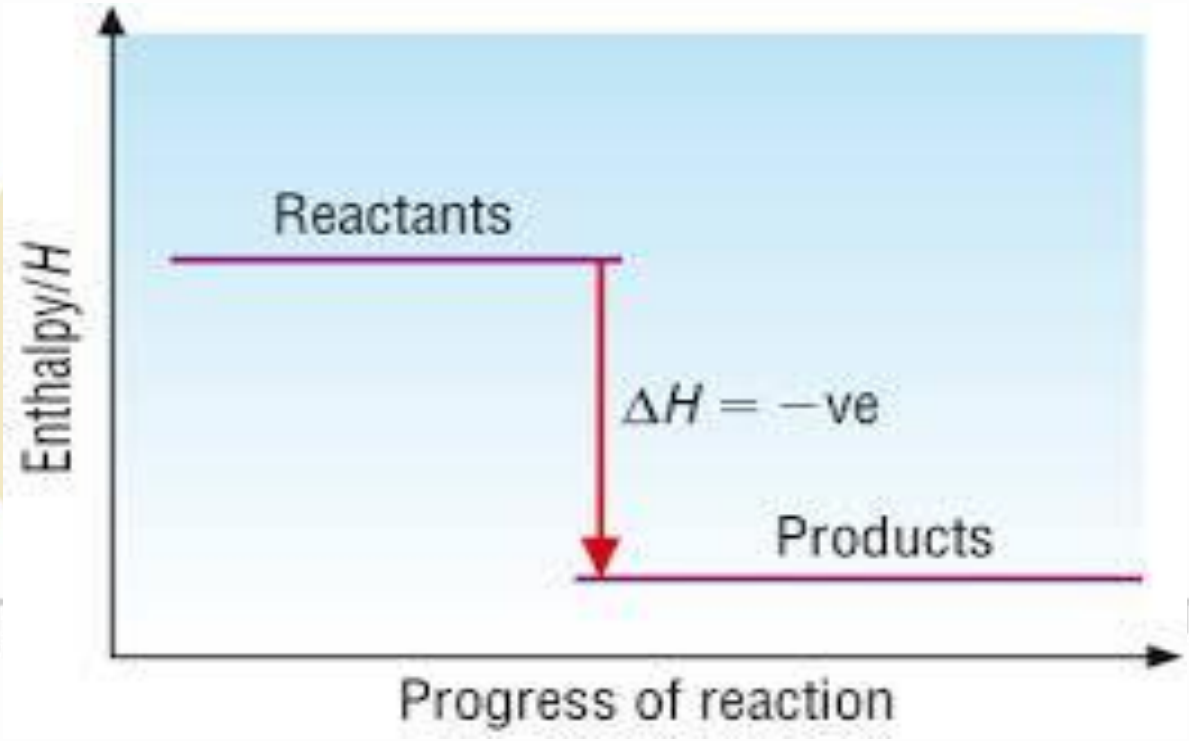
1. Thermo-chemistry
2. Thermo-dynamics

- Enthalpy change is a heat change of a process measured under constant pressure.
- When a reaction is taking place a heat change is taking place with that the energetics of molecules will be changed and accordingly the no: of collision and the energy of collision will also be changed. When the collisions of gas molecules with the walls of the container will change the pressure will be changed. Therefore to get the enthalpy changed the reaction must occur in a system where the volume is variable(fixed into a friction piston) so as to make a constant pressure.

Thermo-chemistry

- This Section deals with enthalpy changed or heat energy changes(heat measure under constant pressure) in order to workout the enthalpy changed in a reaction which cannot be mesured inside a Laboratory due to varies reason :
- Energy released by the reaction that occurs in a survivor bomb explosive cannot be measured practically.
- In certain reaction heat will be given out those are called exothermic reactions

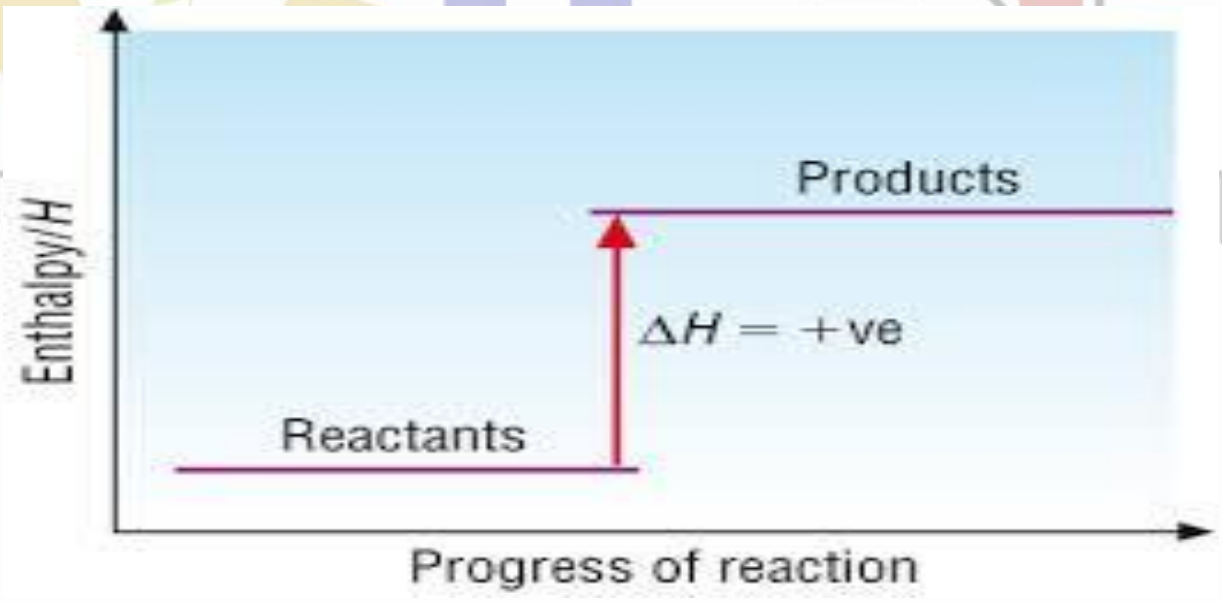
Exothermic Reaction



Reaction enthalpy changes = Total enthalpy of products -- Total enthalpy of the reactant

Endothermic reaction

- For the endo-thermic reaction the energy of reactants will be less compared to the ennergy of products therefore a net absorption of energy will be there in the reaction.



- In thermo-chemistry we use only one law which is important and that is called the law of conservation of energy(energy conservation).A scientist named Hess forwarded this in the context of enthalpies as follows(In terms of heat energy).
- Hess's Law of heat transition

For a given thermo-chemical process the overrule enthalpy change doesn't depend on the pathway or the no : of steps involved(parth independent)

Standard enthalpy of elements and compound

- At the beginning people used this term to express the internal energy of elements and compounds at standard Laboratory temperature and pressure . Intact this one has got nothing to do with the internal energies of substances yet they used it by giving on arbitrary zero and it is help-full in working out energy changes(differences).

- Certain elements process more than one allotrope. Allotrope are different arrangements of the same element thereby there different forms for example :

1. Carbon has different allotropes such as Graphite , Diamonds ,Carbon tubes ,fullerene and tube carbon . In all these allotropes consists of element carbon but there arrangement in the solid structure is different.

- When they establish standard enthalpy definition for the elements it is stated that any element at STP(standard temperature Pressure) is having zero standard enthalpy value but for the elements having more than one allotrope. For Carbon most abundance allotropes is Graphite .for Oxygen the most abundance is allotrope molecular $O_{2(\text{molecular Oxygen})}$.

- Standard enthalpy of any compound or any less abundant allotropes or all the element is found to be equal to there formation enthalpies.

Calculation of combustion enthalpies and formation enthalpies

- Inportant points to remember

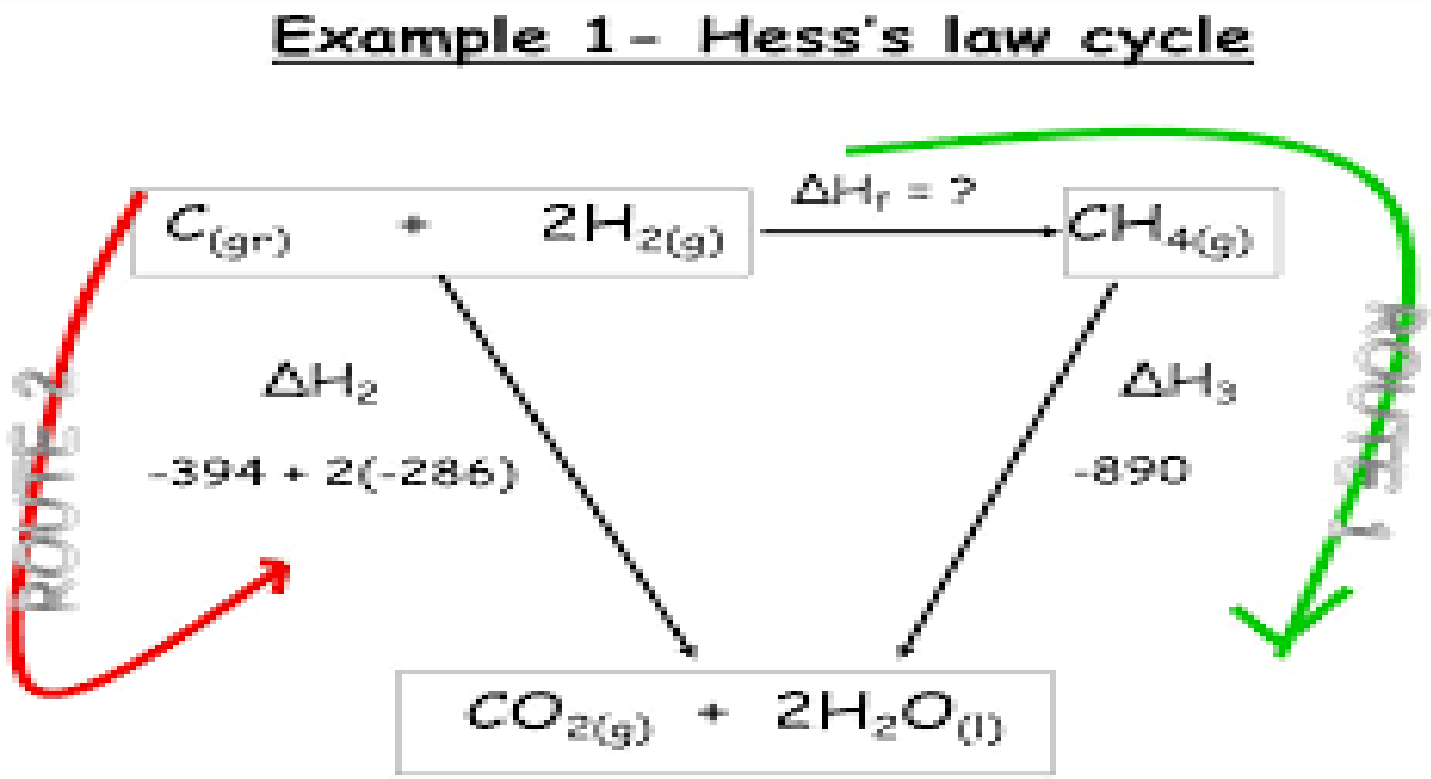
1. Enthalpy of a reaction or the enthalpy change of a reaction is given by the total enthalpies of the products – The total enthalpies of the reactants and it is called the standard reaction enthalpy and this reaction must be given in a balance chemical equation and this balance equation cannot have fraction as the Stoichiometry(In Other Words ,Stoichiometry factors should be whole numbers)

2. Formation enthalpy of a Substance = Total Combustion enthalpy of reactant - Total Combustion enthalpy products

3.For the Calculation of the enthalpy changes we can use a thermo –chemical cycle or an enthalpy diagram(A graph) or the above equation.

4.In the Calculations the algebraic method is also considered equally valid.

Methods of Calculation



Thermochemical cycle Method

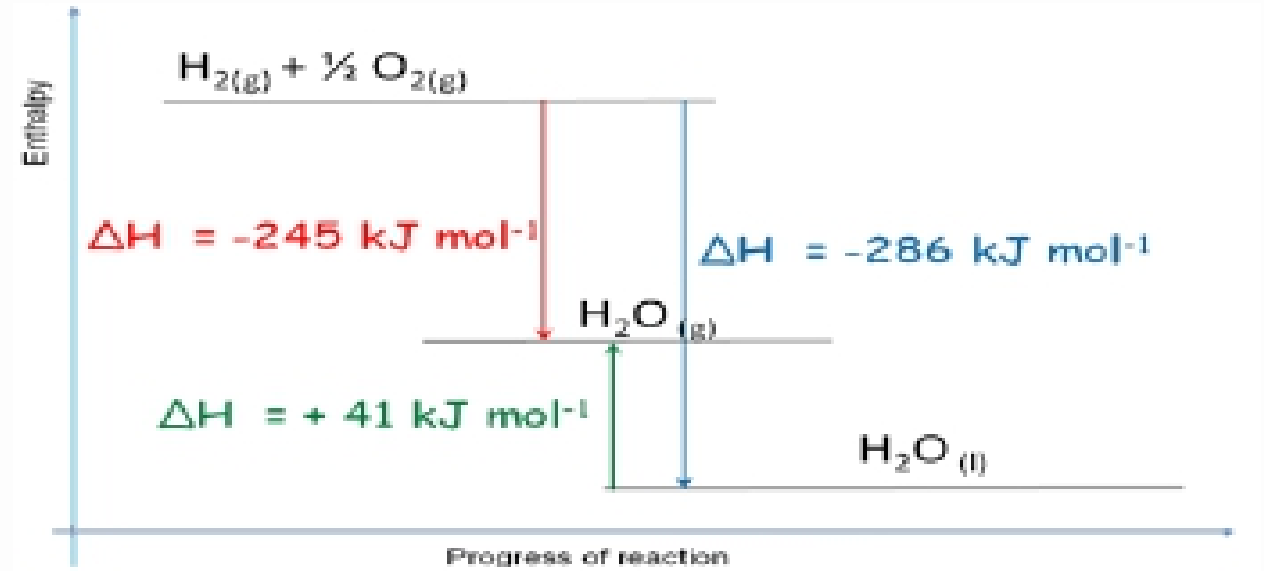


Fig: Enthalpy Diagram of Water

Enthalpy Diagram Method

(i) $CH_3COOH(l) + 2O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$;

$\Delta H = -867\ kJ$

(ii) $C(s) + O_2(g) \rightarrow CO_2(g)$;

$\Delta_r H^0 = -393.5\ kJ$

(iii) $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$;

$\Delta_r H^0 = -285.9\ kJ$

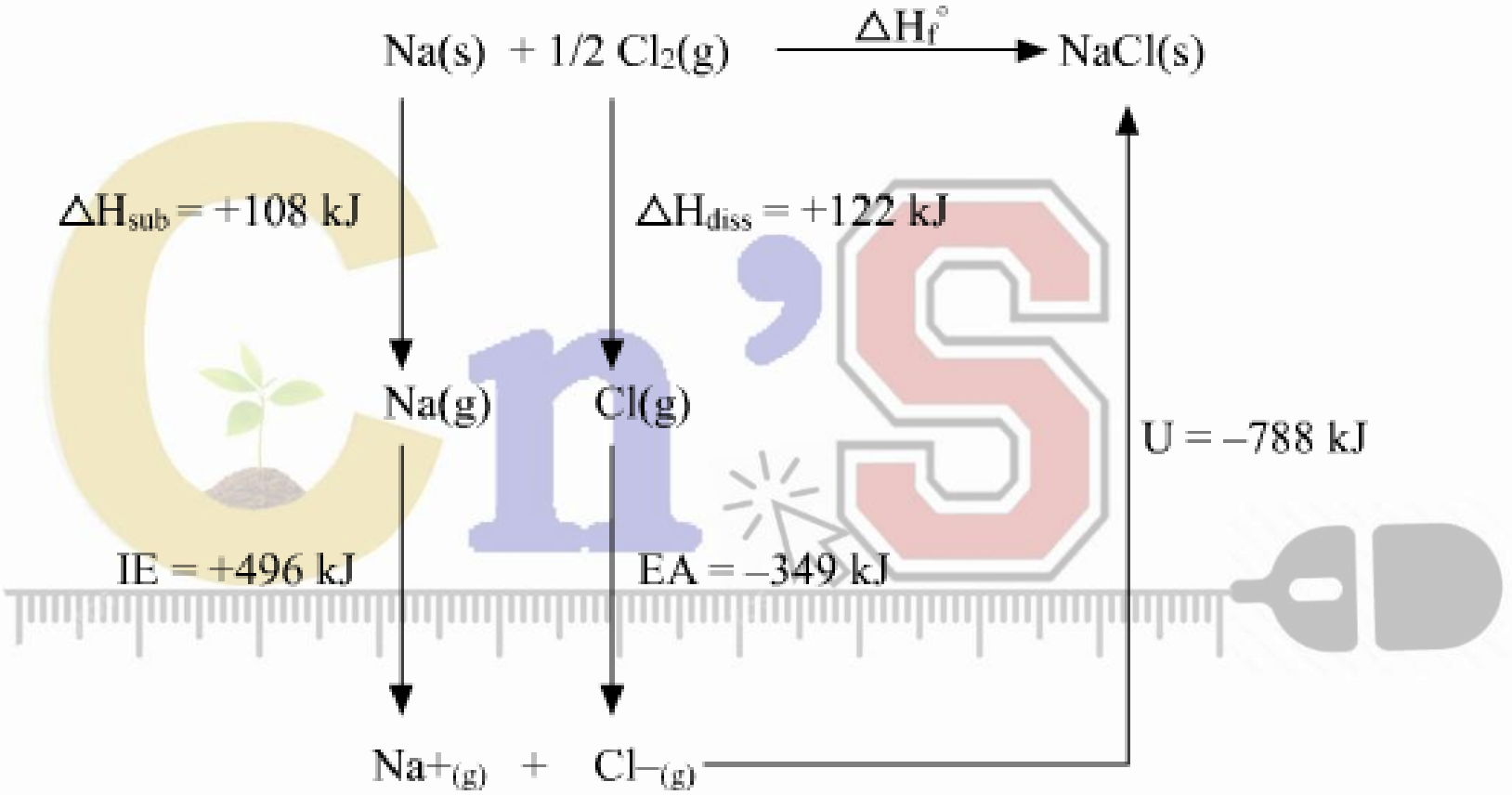
Algebric Method

Ionic Lattice forming Compunds

- Solid ionic compound excite as ionic lattice

Eg :$NaCl_{(s)}$ has a simple cubic lattice

- It is found that the enthalpy of lattice formation of the lattice enthalpy of an Ioinc Compound can't be measured easily thereby a specific thermo-chemical cycle designed for this purpose is used with there relavant enthalpy definition .This thermo-chemical cycle is called the Born-Haber Cycle.



$$\Delta H_f^\circ = \Delta H_{sub} + IE + \Delta H_{diss} + EA + U$$

$$\Delta H_f^\circ = 108 + 496 + 122 - 349 - 788 = -411 \text{ kJ/mol}$$

- In this cycle the enthalpy value of the last step

L generally cannot be measured easily but the rest can be easily measured therefore , in most of the cases we use born – Haber cycle to Calculate lattice enthalpies put from that we use born-Haber cycle to compare thermo-chemical stability of different lattice.