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Topic :- Chemical Kinetics (Continued)

Activation energy & Chemical reaction

All the molecules cannot take part in the chemical reaction. It is only a certain number of molecules that may be called active molecules which could take part in a chemical reaction. Thus reactants donot pass directly to Products but must first acquire necessary energy to pass over an energy barrier known as the activated state or transitional state.

This amount of energy which the reactants must absorb to pass over this activated energy barrier is known as the activation energy. The necessary energy of activation is acquired by the molecules as a result of interchange occuring in collision among the molecules.

When two molecules having the necessary energy of activation come together they must first form an activated complex or transition complex.

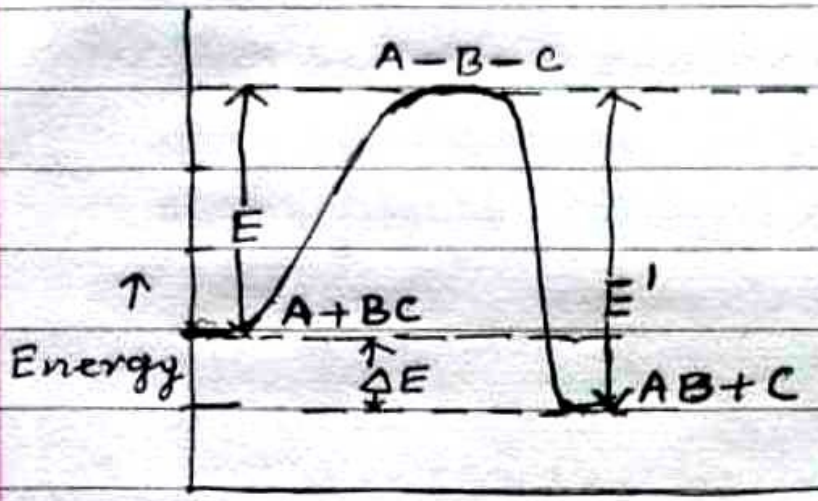
For example:- $A + BC = AB + C$

When A is relatively far from BC, the atoms of BC are vibrating about their mean position and thus the Potential energy of the system is unaffected. As the distance of A is decreasing towards BC, the nuclei of atoms B and C of molecule BC are forced apart and this results an increase in the potential energy. This increase in potential energy is continued till a configuration A–B–C is attained. This A–B–C is known as the activated complex or transition state complex and has the maximum potential energy. The activated complex A–B–C can decompose to yield the products of the reaction (AB and C) or vice versa.

$$A + BC \rightleftharpoons A\text{–}B\text{–}C \rightleftharpoons AB + C$$

Initial state — Activated complex — Final state

The change of potential energy is given in figure below —



The energy of activation for the forward reaction $E = E_{A-B-C} - E_{A+BC}$

Where E_{A-B-C} is the potential energy of the activated complex and E_{A+BC} is that of reactant (A + BC)

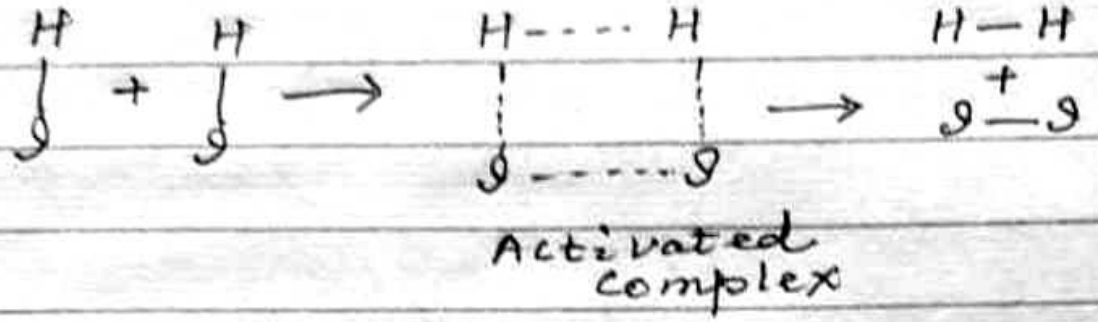
Similarly the energy of activation for the backward reaction or reverse reaction is given by $E' = E_{A-B-C} - E_{AB+C}$

Where E_{AB+C} is the potential energy of the Products (AB + C)

Thus $\Delta E = E - E_1$

Where ΔE gives the heat of reaction at constant volume.

The activated complex of the bimolecular decomposition of hydrogen Iodido might be represented as follows :-



Characteristics of an activated Complex :—

(1) The formation of an activated complex is regarded as the characteris-tics of all chemical changes.

(2) The activated complex has a transient existence only and break up at a definite rate to form Products of the reaction.

(3) The Potential energy of activated complex is maximum.