Chemistry Study Materials for Class 11
(NCERT Based Notes of Chapter- 12)
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SOME BASIC PRINCIPLES AND TECHNIQUES

ORGANIC REACTION MECHANISM

Fundamental Concepts

In an organic reaction, the organic molecule (called substrate) reacts with an attacking reagent to form one or more intermediates and finally the products.

Substrate + attacking reagent → Intermediate → Products

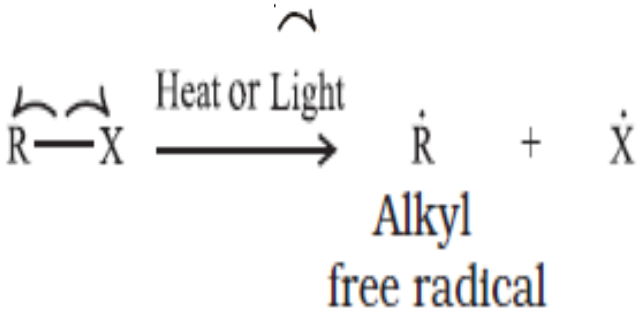
A sequential account of different steps in which the reactants are converted to products is called *reaction mechanism*.

Fission of a covalent bond

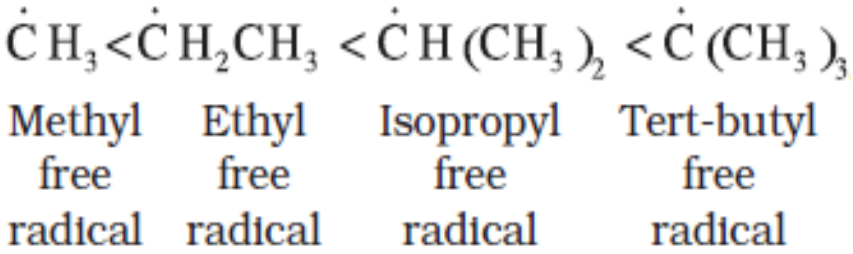
A covalent bond can be broken either by homolysis or by heterolysis.

1. **Homolysis**:

In homolysis or homolytic cleavage, each of the bonded atoms gets one of the electrons of the shared pair. Here the movement of a single electron takes place. The single electron movement is shown by half – headed arrow or fish hook arrow ( ).



The species formed as a result of homolysis is called ***free radical***. These are *species which contain an odd electron or an unpaired electron*. There are three types of free radicals – primary (1^0), secondary (2^0) and tertiary (3^0). Their stability increases in the order $1^0 < 2^0 < 3^0$.

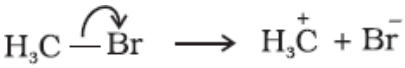


Organic reactions, which take place by homolytic fission, are called ***free radical or homopolar or nonpolar reactions.***

2. Heterolysis:

In heterolysis or heterolytic cleavage, the bond breaks in such a manner that the shared pair of electrons remains with one of the parts.

After heterolysis, one atom has a sextet of electron and a positive charge and the other atom has an octet of electron with at least one lone pair and a negative charge.



For example the bond cleavage in methyl bromide takes place in the following manner.

A species having a carbon atom possessing sextet of electrons and a positive charge is called a **carbocation (carbonium ion)**.

They are of three types – primary, secondary and tertiary.

Carbocations are highly unstable and reactive species. Their stability increases in the order $1^0 < 2^0 < 3^0$ The high stability of tertiary carbocations is due to inductive effect and hyper conjugation. In carbocations, carbon atom is in sp^2 hybridisation and hence they have trigonal planar (planar triangular) shape.

If the group attached to the carbon atom is less electronegative than C, due to heterolytic cleavage, a species with C atom containing a shared pair of electrons and negative charge is formed.

Such a species carrying a negative charge on carbon atom is called ***carbanion***. They are also unstable and reactive. Their stability increases in the order: $3^0 < 2^0 < 1^0$.

The organic reactions which proceed through heterolytic bond cleavage are called ***ionic or heteropolar or polar reactions.***

Nucleophiles and Electrophiles

A reagent that brings an electron pair is called a nucleophile (:Nu) and the reaction is called nucleophilic reaction. Or, nucleophiles are electron rich species attack at electron deficient centre. (The word

Nucleophile means nucleus seeking).

Example for nucleophiles are OH^-, CN^-, NO_3^-, Cl^-, Br^-, I^-, H_2O, NH_2 , R-NH_2 etc.

A reagent that takes away an electron pair is called an electrophile (E^+) and the reaction is called electrophilic reaction. Or, electrophiles are electron deficient species attack at electron rich centre. (The word electrophile means electron seeking).

Example for electrophiles are carbocations (R^+), -CHO, >CO etc.

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