CONCEPT MAP

GENERAL ORGANIC CHEMISTRY (TYPES OF ORGANIC REACTIONS AND METHODS OF PURIFICATION OF ORGANIC COMPOUNDS)

Reaction mechanism explains the pathway through which an organic reaction takes place and the various methods of purification of organic compounds are based on their physical and chemical properties.

TYPES OF ORGANIC REACTIONS

Substitution Reactions

Involve the direct replacement of an atom or a group of atoms by another atom or group of atoms without any change in the remaining part of the molecule.

Electrophilic Substitution Reactions

Brought about by electrophiles such as $H^+, Cl^+, R^+, SO_3, BF_3, AlCl_3, FeCl_3, SnCl_4$.

S_E1 : Unimolecular, first order, very rare in aliphatic compounds.

- Some important examples are replacement of the metal atom in an organometallic compound by hydrogen, decarboxylation of silver salt of carboxylic acid by bromine and isotopic exchange of hydrogen for deuterium or tritium.

S_E2 : Bimolecular, second order, very common in aromatic compounds.

- Some important examples are nitration, sulphonation, Friedel Crafts reaction etc.

Nucleophilic Substitution Reactions

Brought about by nucleophiles such as $H^-, BH_4^-, AlH_4^-, Cl^-, OH^-, OR^-, H_2\ddot{O}, \ddot{N}H_3, R\ddot{S}H, R\ddot{O}R$, etc.

S_N1 : Unimolecular, first order, two steps reaction and proceeds by carbocation mechanism.

- Favoured by mild and low concentration of nucleophiles and solvent of high polarity.
- Stability of carbocation is the rate determining factor.
- Catalysed by Lewis and Bronsted acids.
- Inversion and retention of configuration take place.

S_N2 : Bimolecular, second order, one step reaction and proceeds through transition state.

- Favoured by strong and high concentration of nucleophiles and solvent of low polarity.
- Steric hinderance is the rate determining factor.
- Not catalysed by any catalyst.

Elimination Reactions

Involve loss of atoms or groups from adjacent carbon atoms resulting in the formation of a π bond.

E1 reaction : Unimolecular and two steps reaction.

- Carbocation is formed as intermediate.
- Dehydration of 2° and 3° alcohols proceeds by E1 process.

E2 reaction : Bimolecular and one step reaction.

- Transition state is formed.
- Dehydration of 1° alcohol proceeds by E2 process.

Addition Reactions

Involve combination between two reacting molecules to give a single molecule of the product.

- Typical reactions of compounds containing double or triple bonds.
- May be initiated by electrophiles, nucleophiles or free radicals.
- The molecules containing $>C=C<$ or $-C\equiv C-$ are readily attacked by electrophiles while molecules having $>C=O$ or $-C\equiv N$ are readily attacked by nucleophiles.

METHODS OF PURIFICATION OF ORGANIC COMPOUNDS

Sublimation

Involves the direct conversion of a solid into gaseous state on heating without passing through the intervening liquid state *e.g.*, purification of iodine, camphor, naphthalene etc.

Crystallisation

Based on the principle of different solubilities of a given organic compound and its impurities in the same solvent *e.g.*, separation of sugar from common salt by dissolving in hot ethanol.

Simple Distillation

Involves conversion of a liquid into vapours by heating followed by condensation of vapours.

- Commonly used for liquids which are sufficiently stable at their boiling points and contain non volatile impurities *e.g.*, purification of benzene, ethanol, acetone etc.

Fractional Distillation

Involves repeated distillations and condensations using fractionating column.

- Used when the difference in boiling points of two liquids is not much *e.g.*, separation of crude oil in petroleum industry into various useful fractions such as gasoline, kerosene oil, diesel oil etc.

Distillation Under Reduced Pressure

Used to purify liquids having very high boiling points and liquids which decompose at or below their boiling points, *e.g.*, separation of glycerol from spent lye in soap industry.

Steam Distillation

Used to separate substances which are steam volatile, immiscible with water and contain non-volatile impurities *e.g.*, purification of essential oils, turpentine oil etc.

Differential Extraction

Involves shaking of the aqueous solution of the organic compound in a separating funnel with a suitable solvent which is immiscible with water but in which organic compound is very highly soluble.

- Used to recover organic compounds from their aqueous solutions *e.g.*, separation of benzoic acid.

Chromatography

Involves separation of components of a mixture by the differential movements of individual components through a stationary phase under the influence of a mobile phase.