Organic Chemistry Some Basic Principles and Techniques

1. **General Introduction, Purification and Analysis**
2. **Classification and IUPAC Nomenclature of Organic Compounds**
3. **Electronic Displacements in a covalent bond**
4. **Hemolytic and heterotypic Fission of a covalent Bond**
5. **Fundamental Concepts in Organic Reaction Mechanism**

In this unit, we have learnt some basic concepts in structure and reactivity of organic compounds, which are formed due to covalent bonding.

The nature of the covalent bonding in organic compounds can be described in terms of orbitals hybridisation concept, according to which carbon can have sp3, sp2 and sp hybridised orbitals.

Carbon has a tetrahedron shape as it is tetravalent. The sp3, sp2 and sp hybridized n carbons are found in compounds like methane, ethene and ethyne respectively.

The tetrahedral shape of methane, planar shape of ethene and linear shape of ethyne can be understood on the basis of orbitals hybridisation concept. A sp3 hybrid orbital can overlap with 1s orbital of hydrogen to give a carbon - hydrogen (C–H) single bond (sigma, σ bond).

Overlap of a sp2 orbital of one carbon with sp2 orbital of another results in the formation of a carbon–carbon σ bond. The unhybridised p orbitals on two adjacent carbons can undergo lateral (side-by- side) overlap to give a pi (π) bond.

Organic compounds can be represented by various structural formulas. The three dimensional representation of organic compounds on paper can be drawn by wedge and dash formula.

Classification of organic compounds:

Organic compounds can be classified on the basis of their structure or the functional groups they contain. Organic compounds are classified into two main group- Acyclic and Cyclic. Cyclic compounds can be Homocyclic or heterocyclic

A functional group is an atom or group of atoms bonded together in a unique fashion and which determines the physical and chemical properties of the compounds.

Homologus Series

Homologous series is defined as a family or group of structurally similar organic compounds containing same functional group, show a gradation in physical properties and similarity in chemical properties. Any two adjacent members of this series differ by -CH2 group.

The naming of the organic compounds is carried out by following a set of rules laid down by the International Union of Pure and Applied Chemistry (IUPAC).

In IUPAC nomenclature, the names are correlated with the structure in such a way that the reader can deduce the structure from the name.

Organic reaction mechanism concepts are based on the:

- structure of the substrate molecule
- fission of a covalent bond
- the attacking reagents,
- the electron displacement effects and the conditions of the reaction. These organic reactions involve breaking and making of covalent bonds.

A covalent bond may be cleaved in heterolytic or homolytic fashion. A heterolytic cleavage yields carbocations or carbanions, while a homolytic cleavage gives free radicals as reactive intermediate. Reactions proceeding through heterolytic cleavage involve the complimentary pairs of reactive species. These are electron pair donor known as nucleophile and an electron pair acceptor known as electrophile.

The inductive, resonance, electromeric and hyperconjugation effects may help in the polarisation of a bond making certain carbon atom or other atom positions as places of low or high electron densities.

Organic reactions can be broadly classified into following types; substitution, addition, elimination and rearrangement reactions.

Purification, qualitative and quantitative analysis of organic compounds are carried out for determining their structures.

The methods of purification of organic compound:

- Sublimation: is used to separate the sublimable compounds from non-sublimable compounds.
- Crystallisation: is based on the difference in the solubilities of compound and impurities in a suitable solvent.
- Distillation: is used to separate volatile liquids from non volatile liquids having sufficient difference in their boiling points.
- Steam distillation: is used to separate substances which are steam volatile and are immiscible with water.
- Differential Extraction:When an organic compound is present in an aqueous medium it is separated by shaking it with organic solvent in which it is more soluble than in water.
- Chromatography is a useful technique of separation, identification and purification of compounds. It is classified into two categories : adsorption and partition chromatography.
- Adsorption chromatography is based on differential adsorption of various components of a mixture on an adsorbent.
- Partition chromatography involves continuous partitioning of the components of a mixture between stationary and mobile phases. After getting the compound in a pure form, its qualitative analysis is carried out for detection of elements present in it.

Nitrogen, sulphur, halogens and phosphorus are detected by Lassaigne's test. Carbon and hydrogen are estimated by determining the amounts of carbon dioxide and water produced.

Nitrogen is estimated by Dumas or Kjeldahl's method and halogens by Carius method. Sulphur and phosphorus are estimated by oxidising them to sulphuric and phosphoric acids respectively. The percentage of oxygen is usually determined by difference between the total percentage (100) and the sum of percentages of all other elements present.