

Organic Reactions and Mechanisms



Here is an overview of organic reactions and mechanisms based on the provided notes:

1. Types of Organic Reactions:

Organic compounds undergo several types of reactions, broadly categorized into:

- **Substitution Reactions:** In these reactions, an atom or a group of atoms in a molecule is replaced by another atom or group of atoms. It can be further classified into:
 - **Nucleophilic Substitution (SN1 and SN2):** The attacking species is a nucleophile, which donates an electron pair.
 - **Electrophilic Substitution:** Involves an electrophile attacking a pi bond (common in aromatic compounds).
 - **Free Radical Substitution:** Involves homolytic cleavage, generating free radicals (e.g., halogenation of alkanes).
- **Addition Reactions:** These reactions occur in unsaturated compounds where multiple bonds are broken, and new atoms or groups are added. Types include:
 - **Electrophilic Addition:** An electrophile adds to the double or triple bond (e.g., bromination of alkenes).
 - **Nucleophilic Addition:** A nucleophile adds to a polar double bond (e.g., the addition of HCN to carbonyl compounds).
 - **Free Radical Addition:** Initiated by free radicals, often involving polymerization.
- **Elimination Reactions:** In these reactions, atoms or groups are removed from a molecule, resulting in the formation of double or triple bonds. Common elimination reactions include:
 - **E1 (unimolecular elimination)**
 - **E2 (bimolecular elimination)**
- **Oxidation and Reduction Reactions:** Oxidation involves the loss of electrons or addition of oxygen, while reduction involves the gain of electrons or addition of hydrogen. Examples include oxidation of alcohols to aldehydes and reduction of aldehydes to alcohols.
- **Rearrangement Reactions:** These involve the rearrangement of atoms or bonds within a molecule to form isomers, often observed in carbocation rearrangements.
- **Functional Group Interconversion:** Various reactions are used to convert one functional group into another, such as converting carboxylic acids into esters or alcohols through reduction.

2. Mechanism of Organic Reactions:

- Organic reactions typically proceed via a series of steps involving intermediates such as carbocations, free radicals, or carbanions. These intermediates undergo various transformations that lead to the final products.
- **Electron Movement:** Curved arrows are used in mechanisms to show the flow of electrons. This includes movements like:
 - Lone pair to bonding pair
 - Bonding pair to lone pair
 - Bond to bond transfer
- **Homolytic and Heterolytic Bond Cleavage:**
 - **Homolytic Cleavage** produces free radicals, where each atom in a bond retains one electron.
 - **Heterolytic Cleavage** results in ions, where one atom retains both bonding electrons, forming a cation and an anion.

3. Reagents and Conditions in Organic Reactions:

Different reagents play key roles in influencing the mechanisms:

- **Nucleophiles:** Electron-rich species that donate electron pairs (e.g., OH^- , CN^-).
- **Electrophiles:** Electron-deficient species that accept electron pairs (e.g., H^+ , NO_2^+).

Example Reactions:

- **Nucleophilic Substitution:**
 - $\text{CH}_3\text{Br} + \text{OH}^- \rightarrow \text{CH}_3\text{OH} + \text{Br}^-$
- **Electrophilic Addition:**
 - $\text{H}_2\text{C} = \text{CH}_2 + \text{Br}_2 \rightarrow \text{CH}_2\text{Br} - \text{CH}_2\text{Br}$
- **Elimination Reaction:**
 - $\text{CH}_3\text{CH}_2\text{Br} + \text{KOH (alc.)} \rightarrow \text{CH}_2 = \text{CH}_2 + \text{KBr} + \text{H}_2\text{O}$

These key concepts from organic reactions and mechanisms provide a foundational understanding for further studies in organic chemistry .