Organic Chemistry - Functional Groups and Reactions

Functional Groups

1. Alkanes (C-C single bonds)

- General formula: CnH2n+2
- Naming: Use -ane suffix (methane, ethane, propane, etc.)
- Properties: Nonpolar, low reactivity, low boiling points
- Reactions: Combustion, halogenation (free radical substitution)

2. Alkenes (C=C double bonds)

- General formula: CnH2n
- Naming: Use -ene suffix (ethene, propene, etc.)
- Properties: More reactive than alkanes
- Reactions: Addition reactions (hydrogenation, halogenation, hydration)
- Markovnikov's rule: In addition of HX to alkene, H attaches to carbon with more hydrogens

3. Alkynes (C≡C triple bonds)

- General formula: CnH2n-2
- Naming: Use -yne suffix (ethyne/acetylene, propyne, etc.)
- Properties: Linear geometry around triple bond
- Reactions: Addition reactions (similar to alkenes but can add twice)

4. Alcohols (C-OH)

- Naming: Use -ol suffix (methanol, ethanol, etc.)
- Classification: Primary (1°), secondary (2°), tertiary (3°)
- Properties: Hydrogen bonding enables water solubility
- Reactions: Oxidation, dehydration, esterification

5. Aldehydes (C=O-H)

- Naming: Use -al suffix (methanal/formaldehyde, ethanal/acetaldehyde)
- Properties: Polar, lower boiling points than alcohols
- Reactions: Oxidation to carboxylic acids, reduction to alcohols

6. Ketones (C=O in middle of chain)

- Naming: Use -one suffix (propanone/acetone, butanone, etc.)
- Properties: Similar to aldehydes but less reactive
- Reactions: Reduction to alcohols, nucleophilic addition

7. Carboxylic Acids (COOH)

- Naming: Use -oic acid suffix (methanoic/formic acid, ethanoic/acetic acid)
- Properties: Acidic, form hydrogen bonds, dimers
- Reactions: Esterification, reduction, decarboxylation

8. Esters (COOR)

- Naming: Alkyl alkanoate (methyl ethanoate/methyl acetate)
- Properties: Pleasant smells, used as flavoring agents
- Reactions: Hydrolysis, reduction

Key Reaction Mechanisms

1. Nucleophilic Substitution (SN1, SN2)

- SN2: Concerted mechanism, inversion of stereochemistry
- SN1: Two-step mechanism via carbocation, racemization

2. Elimination (E1, E2)

- E2: Concerted mechanism, anti-periplanar arrangement
- E1: Two-step via carbocation intermediate

3. Addition to C=C

- Electrophilic addition: Electrophile attacks π bond
- Syn addition: Both groups add to same face
- Anti addition: Groups add to opposite faces