

# Introduction to Organic Chemistry

## Introduction to Organic Chemistry – Study Notes

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### 1. What Is Organic Chemistry?

- **Definition:** The branch of chemistry that studies carbon-containing compounds (with the notable exception of a few simple carbon oxides and carbides).
  - **Scope:** Includes hydrocarbons, functionalized molecules, biomolecules, polymers, and many industrial chemicals.
  - **Why It Matters**
    - Basis of life (proteins, nucleic acids, carbohydrates, lipids).
    - Foundation for pharmaceuticals, agrochemicals, materials, and fuels.
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### 2. Core Concepts

| Concept                  | Key Points                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Carbon's Bonding Ability | <ul style="list-style-type: none"><li>• Four valence electrons → forms four covalent bonds.</li><li>• Enables chains, rings, branched structures, and multiple bonds (double, triple).</li></ul>                                                                                                                                                                 |
| Hybridization            | <ul style="list-style-type: none"><li>• <math>sp^3</math> – tetrahedral (4 bonds only).</li><li>• <math>sp^2</math> – trigonal planar (one <math>\pi</math> + one <math>\sigma</math>).</li><li>• <math>sp</math> – linear (one <math>\pi</math> + two <math>\sigma</math>).</li></ul>                                                                           |
| Isomerism                | <ul style="list-style-type: none"><li>• <b>Structural (constitutional) isomers</b> – different connectivity.</li><li>• <b>Stereoisomers</b> – same connectivity, different spatial arrangement.<ul style="list-style-type: none"><li>– Geometric (<i>cis/trans</i>, <i>E/Z</i>)</li><li>– Optical (<i>enantiomers</i>, <i>diastereomers</i>)</li></ul></li></ul> |
| Functional Groups        | Specific atom/group patterns that dictate reactivity (e.g., $-OH$ , $-COOH$ , $-NH_2$ , $-C=O$ , $-C\equiv C$ ).                                                                                                                                                                                                                                                 |
| Nomenclature (IUPAC)     | Systematic naming based on longest carbon chain, substituents, and functional groups.                                                                                                                                                                                                                                                                            |

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## Concept

## Key Points

### Reaction Types

- **Addition** – to multiple bonds (e.g., hydrogenation).
- **Elimination** – removal of small molecules (e.g., dehydration).
- **Substitution** – replacement of a group (e.g., SN1, SN2).
- **Rearrangement** – migration of atoms/groups within a molecule.

### Mechanisms

Step-by-step electron flow (curved arrow notation) that explains how reactants convert to products.

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## 3. Classification of Organic Compounds

| Class            | General Formula / Features                                       | Example               |
|------------------|------------------------------------------------------------------|-----------------------|
| Alkanes          | Saturated C–C single bonds (C <sub>n</sub> H <sub>2n+2</sub> )   | Methane, propane      |
| Alkenes          | One or more C=C double bonds (C <sub>n</sub> H <sub>2n</sub> )   | Ethene, 1-butene      |
| Alkynes          | One or more C≡C triple bonds (C <sub>n</sub> H <sub>2n-2</sub> ) | Acetylene, propyne    |
| Aromatics        | Conjugated cyclic $\pi$ -system (benzene ring)                   | Benzene, toluene      |
| Alcohols         | –OH attached to sp <sup>3</sup> carbon                           | Ethanol, cyclohexanol |
| Ethers           | R–O–R' (oxygen between two carbons)                              | Diethyl ether         |
| Aldehydes        | –CHO (carbonyl at end of chain)                                  | Formaldehyde          |
| Ketones          | C=O within chain                                                 | Acetone               |
| Carboxylic Acids | –COOH                                                            | Acetic acid           |
| Esters           | –COOR                                                            | Ethyl acetate         |
| Amines           | –NH <sub>2</sub>                                                 |                       |