

Introduction to Organic Chemistry

Introduction to Organic Chemistry – Study Notes

1. What Is Organic Chemistry?

- **Definition:** The branch of chemistry that studies carbon-containing compounds (with the exception of a few simple carbon oxides and carbonates).
 - **Scope:** Includes hydrocarbons, functionalized molecules, biomolecules, polymers, and many industrial materials.
 - **Why It Matters:**
 - Basis of pharmaceuticals, plastics, fuels, agrochemicals, and dyes.
 - Central to biochemistry, materials science, and environmental chemistry.
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2. Core Concepts

Concept	Key Points	Typical Examples
Carbon's Bonding Ability	- Forms four covalent bonds (tetra-valent). - Can make single, double, triple bonds and rings. - Hybridization: sp^3 (tetrahedral), sp^2 (trigonal planar), sp (linear).	Methane (sp^3), ethene (sp^2), acetylene (sp)
Functional Groups	Specific atom/group patterns that dictate reactivity.	Alcohol ($-OH$), carbonyl ($C=O$), amine ($-NH_2$), carboxyl ($-COOH$), halide ($-X$)
Isomerism	Same molecular formula, different structures. - Structural (constitutional) isomers: different connectivity. - Stereoisomers: same connectivity, different spatial arrangement (geometric, optical).	Butanol (4 structural isomers), 2-butanol vs. 2-butene (geometric), (R)- and (S)-lactic acid (optical)
Nomenclature (IUPAC)	Systematic naming based on longest carbon chain, functional group priority, substituents, and numbering.	3-methyl-2-pentanol, 1-chloro-3-butene

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Concept	Key Points	Typical Examples
Reaction Types	- Addition (??bond breaks, new ?? bonds form).	Hydrogenation of alkenes, dehydration of alcohols, SN1/SN2 reactions, Claisen rearrangement
	- Elimination (??bond breaks, ??bond forms).	
	- Substitution (one group replaces another).	
	- Rearrangement (atoms shift within a molecule).	
Mechanisms	Step-by-step electron flow illustrated with curved-arrow notation.	SN2 (back-side attack), electrophilic aromatic substitution, free-radical halogenation
	- Nucleophilic vs. electrophilic pathways.	
	- Radical mechanisms involve unpaired electrons.	

3. Major Classes of Organic Compounds

Class	General Formula / Feature	Representative Reactions
Alkanes	C _n H _{2n+2} , saturated, sp ³ C	Combustion, free-radical halogenation
Alkenes	C _n H _{2n} , one C=C double bond, sp ² C	Hydrogenation, halogen addition, hydrohalogenation
Alkynes	C _n H _{2n-2} , one C≡C triple bond, sp C	Hydrogenation (to alkenes/alkanes), nucleophilic addition
Aromatics	Conjugated cyclic ??system (e.g., benzene)	Electrophilic aromatic substitution
Alcohols	R-OH	