

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 chemicals.
 - **Why It Matters**
 - Basis of pharmaceuticals, plastics, fuels, agrochemicals, and materials.
 - Central to biochemistry and the chemistry of life.
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2. Core Concepts

Concept	Key Points
Carbon's Bonding Ability	• 4 valence electrons → four covalent bonds (tetrahedral geometry). • Forms single, double, triple bonds and rings.
Hybridization	• sp^3 – tetrahedral (4 bonds only). • sp^2 – trigonal planar (one π + one σ). • sp – linear (one π + two σ).
Isomerism	• Structural (constitutional) isomers – different connectivity. • Stereoisomers – same connectivity, different spatial arrangement (geometric & optical).
Functional Groups	Identify the reactive “signature” of a molecule (e.g., alcohol $-OH$, carbonyl $C=O$, carboxyl $COOH$). • Addition – π bond breaks, new σ bonds form (alkenes, alkynes).
Reaction Types	• Elimination – removal of atoms to form a π bond. • Substitution – one group replaces another ($SN1$, $SN2$). • Rearrangement – atoms shift within the molecule.
Stability Trends	• Alkane < Alkene < Alkyne (bond strength). • More substituted alkenes are more stable. • Aromatic systems gain extra stability (resonance).

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3. Classification of Organic Compounds

Class	General Formula	Representative Functional Group(s)
Alkanes	C_nH_{2n+2}	None (saturated C–C bonds)
Alkenes	C_nH_{2n}	C=C (double bond)
Alkynes	C_nH_{2n-2}	C≡C (triple bond)
Aromatics	C_nH_n (often C_nH_{n-6})	Conjugated ring with delocalized π electrons
Alcohols	R–OH	Hydroxyl (–OH)
Ethers	R–O–R'	Ether linkage (–O–)
Aldehydes	R–CHO	Carbonyl attached to at least one H
Ketones	R–CO–R'	Carbonyl between two carbon groups
Carboxylic Acids	R–COOH	Carboxyl (–COOH)
Esters	R–COO–R'	Carbonyl + alkoxy (–COOR)
Amines	R ₃ N	Nitrogen with three substituents
Amides	R–CONR ₂	Carbonyl attached to nitrogen
Halides	R–X (X = F, Cl, Br, I)	Carbon