

ORGANIC CHEMISTRY

FUNDAMENTALS

Types of Organic Compounds

Organic chemistry is the study of natural and synthetic materials that have carbon atoms as the key chemical feature. There are more than one million known organic compounds.

HYDROCARBON

ALKANE
 • Ethane: C_2H_6
 • Methyl (Me): $-CH_3$
 • Ethyl (Ety): $-C_2H_5$



ALKENE

• Ethene: C_2H_4
 • Diene: Two C=C
 • Triene: Three C=C



ALKYNE

• Ethyne: C_2H_2



AROMATIC

• Benzene: C_6H_6
 • Aroclor: C_6H_5 (Ar)



-O- ADDED

ALCOHOL

• Methanol: Me-OH
 (methyl alcohol)
 • Phenol: Ar-OH
 • Diol/Glycol: (2 -OH)
 • Glycerol: (3 -OH)



ETHER

• Ethoxyethane:
 Et-O-Et (diethyl ether)



EPOXY

• Oxirane:
 C_2H_4O (ethylene oxide)



PEROXIDE

• Acetone Peroxide: $C_4H_8O_4$



• Benzoyl Peroxide: $C_{14}H_{18}O_4$

>C=O ADDED

ALDEHYDE

• Methanal: H_2CO
 (formaldehyde)
 • Benzaldehyde: Ar-CHO



KETONE

• 2-propanone: Me-CO-Me
 (dimethyl ketone, acetone)
 • Diketone: R-CO-R'-CO-R'



>COO ADDED

CARBOXYLIC ACID

• Ethanoic Acid: Me-COOH
 (acetic acid)
 • Acetate Ion: Me-COO⁻
 • Benzoic Acid: Ar-COOH



Dicarboxylic Acid

HOOC-R-COOH

ESTER

• Ethyl Acetate:
 Me-CO-OEt
 Other derivatives:
 • Peroxyacid: R-CO-OOH
 • Acid Anhydrides: RCO-O-COR'



NITROGEN ADDED

AMINE

• Methyl Amine: H_3C-NH_2
 (amine)
 • R-NH₂ (1°), RR'NH (2°),
 RRR''N (3°)



NITRO



DIAZO



NITRILE



• Methane Nitrile: Me-CN

AMIDE

• Acetamide:
 Me-CO-NH₂



SULFUR ADDED

• Thiol: R-SH
 • Thioether: R-S-R'
 • Disulfide: R-S-S-R'
 • Thio Ester: R-CO-SR'
 • Sulfide: R-SO-R'
 • Sulfone: R-SO₂-R'
 • Sulfonic Acids: R-SO₃H

HALOGEN ADDED

• Haloalkane:
 Me-Cl chloromethane
 • Halobenzene: Ar-X
 • Chlorobenzene: Ar-Cl
 • Acyl Halide: R-CO-X
 • Aryl Halide: Ar-X



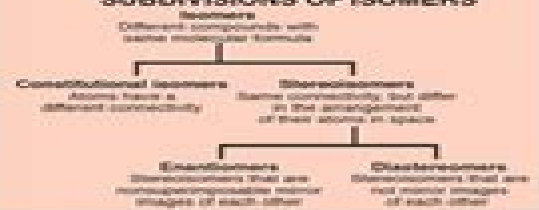
Formulas & Isomers

- Molecular Formula:** Elemental symbols with subscripts denote the composition of a compound
- Empirical Formula:** Subscripts denote the relative elemental composition
- Graphical depiction**
 - Dash Formula:** Diagram all atoms, show bonds as dashes
 - Bond-Line Formula:** Hide H; carbon atoms are depicted as lines, but other atoms are shown explicitly



- Newman Projection:** 2-d depiction
- 3-dimensional:** Wedges of same bond denote structure

SUBDIVISIONS OF ISOMERS



- Constitutional Isomers:** Different bonding connectivity (e.g., rings, bonds, branching, substituent positions)
- Tautomers:** Easily interconverted structural isomers (e.g., keto-enol for ketones)
- Chiral:** Not identical with its mirror image
- Achiral:** Has a plane of symmetry (i.e., superimposable on its mirror image)
- Epimers:** Pair of diastereomers which differ only in the configuration of one atom
- More than 1 chiral center
 - n chiral centers, $\leq 2^n$ stereoisomers
 - Meso: 2 chiral centers, 4 isomers: 3 stereoisomers, 1 achiral (mirror-plane)

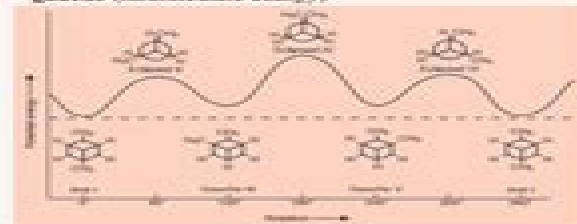


- R/S Notation:** The 4 different atoms or groups attached to a central atom are ranked (a), (b), (c), and (d), by molar mass. The lowest (d) is directed away from the viewer and the sequence of a-b-c produces clockwise (R) or counter-clockwise (S) configuration
 - Chiral (Optically Active):** + or - the rotation of plane polarized light, R/S: opposite effects

- Racemic:** 50/50 mixture of stereoisomers (no net optical activity)
- Nomenclature:** Note R/S and +/- in the compound name (e.g., R (+) bromochloromethanol)
- Fisher-Projection:** Diagram depicts chiral/3-D structure
 - Molecular Conformations:** Molecule exhibits structural variation due to free rotation about C-C single bond



- Newman Diagram:** Depict rotation about a C-C bond; eclipsed (high energy), anti (low energy), and gauche (intermediate energy)



Common Terms

Aliphatic: Non-aromatic	Aromatic: Benzene ring	Conjugation: Sequence of alternating double (or triple) and single bonds	Dielectric Effect: Polar solvent stabilizes ion formation	Exergonic Reaction: Chemical reaction that loses energy during the process of the reaction	Heterocyclic: Non-carbon atom in the ring structure	Hydrocarbon: Compound of H and C	Ketone: Molecule made up of a monosaccharide bonded to a ketone	Monosaccharide: Carbohydrate that cannot be reduced by hydrolysis into another simple sugar	Olefin: Alkene	Paraffin: Alkane	Radioisotope: Isotope that is radioactive	Saturated: Maximum # of Hs (all C-C single bonds)	Tetrose: Monosaccharide with four carbon atoms	Unsaturated: At least one C-C multiple bond	Zymology: The study of the process of fermentation
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Study Guide For Fundamentals Of Organic Chemistry

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