

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 (Et): $-C_2H_5$

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: $C_4H_8O_5$

• 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 Anhydride: $RCO-O-CO-R'$

NITROGEN ADDED

AMINE
• Methyl Amine: H_3C-NH_2
• Phenyl Amine: $Ar-NH_2$ (aniline)
• $R-NH_2$ (1°), $RR'NH$ (2°), $RR'R''N$ (3°)

NITRO

$R-NO_2$

DIAZO

$R-N=N$

NITRILE

$R-C\equiv N$

• Methane Nitride: $Me-CN$

AMIDE

• Acetamide: $Me-CO-NH_2$

SULFUR ADDED

• Thiol: $R-SH$
• Thioether: $R-S-R'$
• Disulfide: $R-S-S-R'$
• Thiol Ester: $R-CO-SR'$
• Sulfide: $R-SO-R'$
• Sulfone: $R-SO_2-R'$
• Sulfonic Acid: $R-SO_3H$

HALOGEN ADDED

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

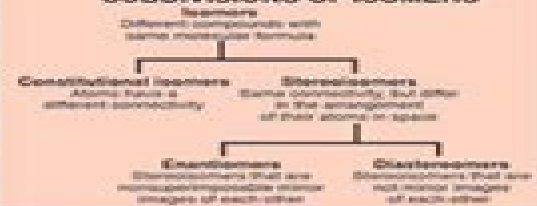
Formulas & Isomers

- 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:** 3-d depiction
- Sawhorse:** Wedges of sawhorse 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)

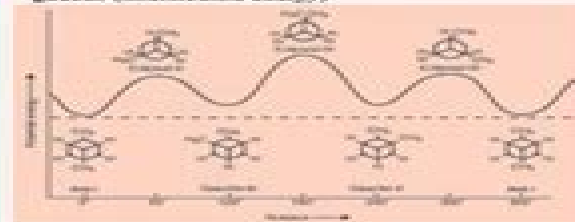


- R/S Notation:** The 4 different atoms or groups attached to a central atom are ranked (a), (b), (c), and (d), by molar mass. The lowest (d) is directed away from the viewer and the sequence of a-b-c produces clockwise (R) or counter-clockwise (S) configuration
- Chiral (Optically Active):** + or - 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 (+) bromochloromethane)
- 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
Diolefin 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)
Tetrasac: Monosaccharide with four carbon atoms
Unsaturated: At least one C-C multiple bond
Zymurgy: The study of the process of fermentation

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Susan M. Stejskal



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Organic Chemistry Fundamentals Melody Frost,2025-08-25 Organic chemistry is the branch of chemistry that focuses on the study of carbon containing compounds particularly those that also contain hydrogen These compounds known as organic compounds are diverse and can be categorized into various classes such as functional groups aliphatic compounds aromatic compounds heterocyclic compounds and polymers Organic compounds form the foundation of all life on Earth and make up the majority of known chemicals including agrichemicals petrochemicals and pharmaceuticals This discipline examines the properties structures and reactions of these compounds examining both qualitative and quantitative characteristics such as melting and boiling points conductivity solubility refractive index odor and color Analytical techniques like gas chromatography high performance liquid chromatography HPLC and separation methods such as crystallization distillation and solvent extraction are frequently used in organic chemistry to assess purity and isolate compounds The topics included in this book on organic chemistry are of utmost significance and bound to provide incredible insights to readers It explores all the important aspects of the field in the present day scenario It will serve as a valuable source of reference for those interested in this field

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