

ORGANIC CHEMISTRY

FUNDAMENTALS

TYPES OF ORGANIC COMPOUNDS

HYDROCARBON	O-ADDED	C=O ADDED	-COO ADDED	NITROGEN ADDED	SULFUR ADDED
ALKANE C_nH_{2n+2} • ethane: C_2H_6 • methyl (Me): $-CH_3$ • ethyl (Et): $-C_2H_5$ ALKENE C_nH_{2n} • ethene: C_2H_4 • alkene: two C=C ALKYNE C_nH_{2n-2} • alkyne: three C-C AROMATIC C_nH_n • benzene: C_6H_6 • anion: C_6H_5 (Ar-)	ALCOHOL $n-OH$ • methanol: Me-OH (methyl alcohol) • phenol: Ar-OH • diol/glycol: (2 -OH) • glycerol: (3 -OH) ETHER $n-O-n$ • ethoxyethane: Et-O-Et (diethyl ether) EPOXY • cyclic ether PEROXIDE $R-O-O-R'$	ALDEHYDE • methanal: H-CHO (formaldehyde) • benzaldehyde: Ar-CHO KETONE • 2-propanone: Me-CO-Me (dimethyl ketone, acetone) • diketone: R-CO-R'-CO-R''	CARBOXYLIC ACID • ethanoic acid: Me-COOH (acetic acid) • acetone ion: Me-COO ⁻ • benzoic acid: Ar-COOH • dicarboxylic acid: HOOC-R-COOH ESTER • ethyl acetate: Me-COOEt • Me-COOEt, etc. Other derivatives: • amide: R-CO-NH ₂ • acid anhydride: (R-CO) ₂ O	AMINE $n-N$ • methyl amine: H_3C-NH_2 • phenyl amine: Ar-NH ₂ (aniline) • R-NH ₂ (1°), R ₂ NH (2°), R ₃ N (3°) NITRO R-NO ₂ BLAZO R-N=N-N NITRILE $n-CN$ • methane nitrile: Me-CN AMIDE • acetamide: Me-CO-NH ₂	• thiol: R-SH • disulfide: R-S-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 ₃ H HALOGEN ADDED • haloalkane: $n-X$ • Me-Cl chloromethane • haloalkene: Ar-X • chlorobenzene: Ar-Cl • acyl halide: R-CO-X • aryl halide: Ar-X

FORMULAS AND ISOMERS

Molecular formula: Elemental symbols with subscripts denote the composition of a compound.
Empirical formula: Subscripts denote the relative elemental composition.

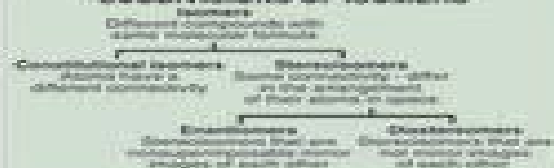
Graphical depiction:

- Dash formula:** Diagram all atoms, bonds as dashes.
- Bond line formula:** Only H, show carbon skeleton as lines, other atoms explicit.



- Newman Projection:** 2-D depiction.
- 3-dimensional:** Wedges of conformational structure.

SUBDIVISIONS OF ISOMERS



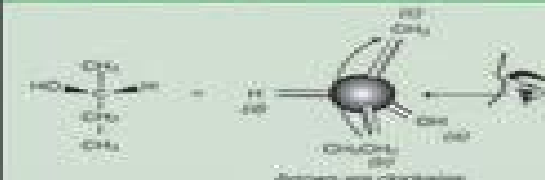
constitutional isomers: different bonding connectivity (ex. rings, bonds, branching, substituent positions)
stereoisomers: easily interconverted structural isomers (ex. keto-enol for ketones)

chiral: not identical with mirror image
achiral: has plane of symmetry (superimposable on mirror image)
enantiomers: a pair of diastereomers which differ only in the configuration of one atom

More than 1 chiral center:

- n chiral centers, 2^n stereoisomers
- none: two chiral centers, 4 isomers: 3 stereoisomers, 1 achiral (meso-form)

FORMULAS AND ISOMERS



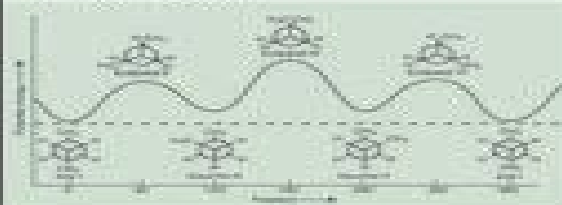
R/S notation: The four different atoms or groups attached to a central atom are ranked a,b,c,d, by molar mass. The lowest (d) is directed away from the viewer and the sequence of a-b-c produces clockwise (R) or counter-clockwise (S) configuration.

- chiral optically active:** $+$ or $-$ rotation of plane polarized light; (R/S) Opposite effects
- meso:** 50-50 mixture of enantiomers (no net optical activity)
- racemization:** None R/S and $+$ or $-$ in the compound name; example: R (+) bromochloromethane

Fischer 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), gauche (intermediate energy)



COMMON TERMS

aliphatic: non-aromatic
aromatic: benzene ring
heterocyclic: non-carbon atom in the ring structure
hydrocarbon: compound of H and C
paraffin: alkane
olefin: alkene
saturated: maximum # of H's (all C-C single bonds)
unsaturated: at least one C-C multiple bond

NOMENCLATURE

IUPAC: standard guidelines for naming compounds.
Nomenclature Strategy: find longest carbon chain, identify and note location of functional groups and substituents by chain position number.

Classes of compounds are defined by the functional group. There are many common names and substituent group names. Multiple names are possible.

CARBON CHAIN PREFIXES

Ends	Ends	Ends
1	methyl	methyl
2	ethyl	ethyl
3	propyl	propyl
4	butyl	butyl
5	pentyl	pentyl
6	hexyl	hexyl
7	heptyl	heptyl
8	octyl	octyl
9	nonyl	nonyl
10	decyl	decyl

cyclo: ring structure; example: cyclopentane, 3-carbon ring molecule

iso: two methyl groups on the terminus of a chain

n: normal straight chain

tert: tertiary alkyl group

vic (vicinal): two substituents on adjacent carbons

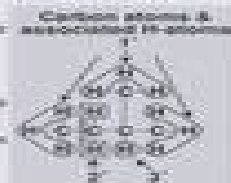
gem (geminal): two substituents on the same carbon

alkene isomers: cis or trans

benzene substitution positions:

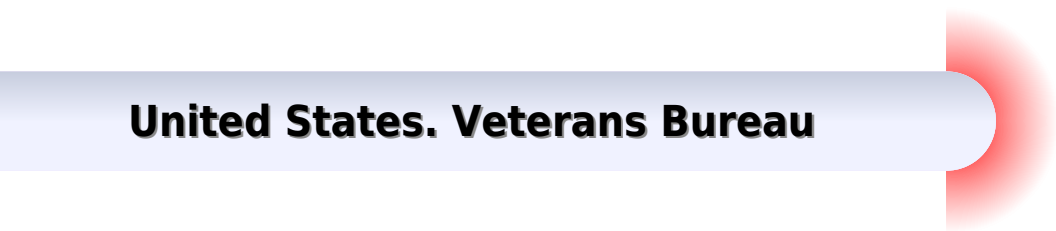
ortho (1,2), meta (1,3), para (1,4)

Carbon Position



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