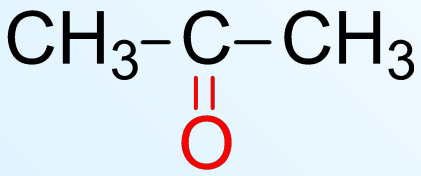
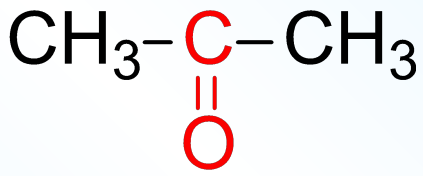
Eight types of systematic nomenclature systems are recognized by IUPAC. ***Substitutive*** and ***radicofunctional*** nomenclatures are the most common.

Example 1: acetone (trivial name).





propanone dimethyl ketone

(substitutive name) (functional class name)

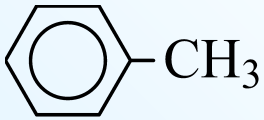
Trivial names of organic compounds

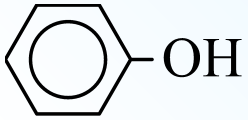
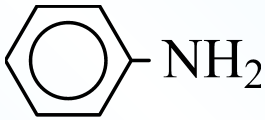
Formula	*Name*
CH_4	methane
C_2H_6	ethane
C_3H_8	propane
C_4H_{10}	butane
C_5H_{12}	pentane

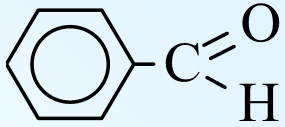
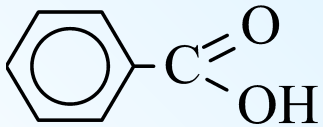
Formula	*Name*
C_6H_{14}	hexane
C_7H_{16}	heptane
C_8H_{18}	octane
C_9H_{20}	nonane
$C_{10}H_{22}$	decane

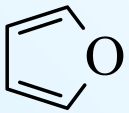
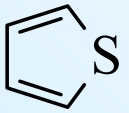
Formula	*Name*
$CH_2=CH_2$	ethylene
$CH_3–CH=CH_2$	propylene
$CH\equiv CH$	acetylene
$CH_2=\underset{\displaystyle CH_3}{\overset{\displaystyle \vert}{C}}–CH=CH_2$	isoprene

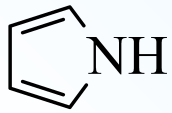
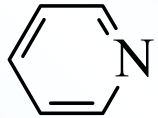
Trivial names of organic compounds

	benzene
	toluene

	phenol
	aniline

	benzaldehyde
	benzoic acid

	furan
	thiophene

	pyrrole
	pyridine

$HCOOH$	formic acid
CH_3COOH	acetic acid

C_2H_5COOH	propionic acid
C_3H_7COOH	butyric acid

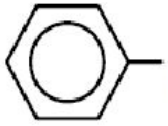
1. If only one functional group is present in the molecule, then:
   - list all hydrocarbon radicals in alphabetical order;
   - add the corresponding class name.

2. If there are two (or more) functional groups in the molecule, then:
   - choose the parent structure with a certain trivial name;
   - list all hydrocarbon radicals and functional groups in alphabetical order (except those in the parent structure);
   - add the trivial name of the parent structure;
   - indicate positions of the substituents using Greek letters (or prefixes *ortho*-, *meta*-, *para*- for benzene derivatives).

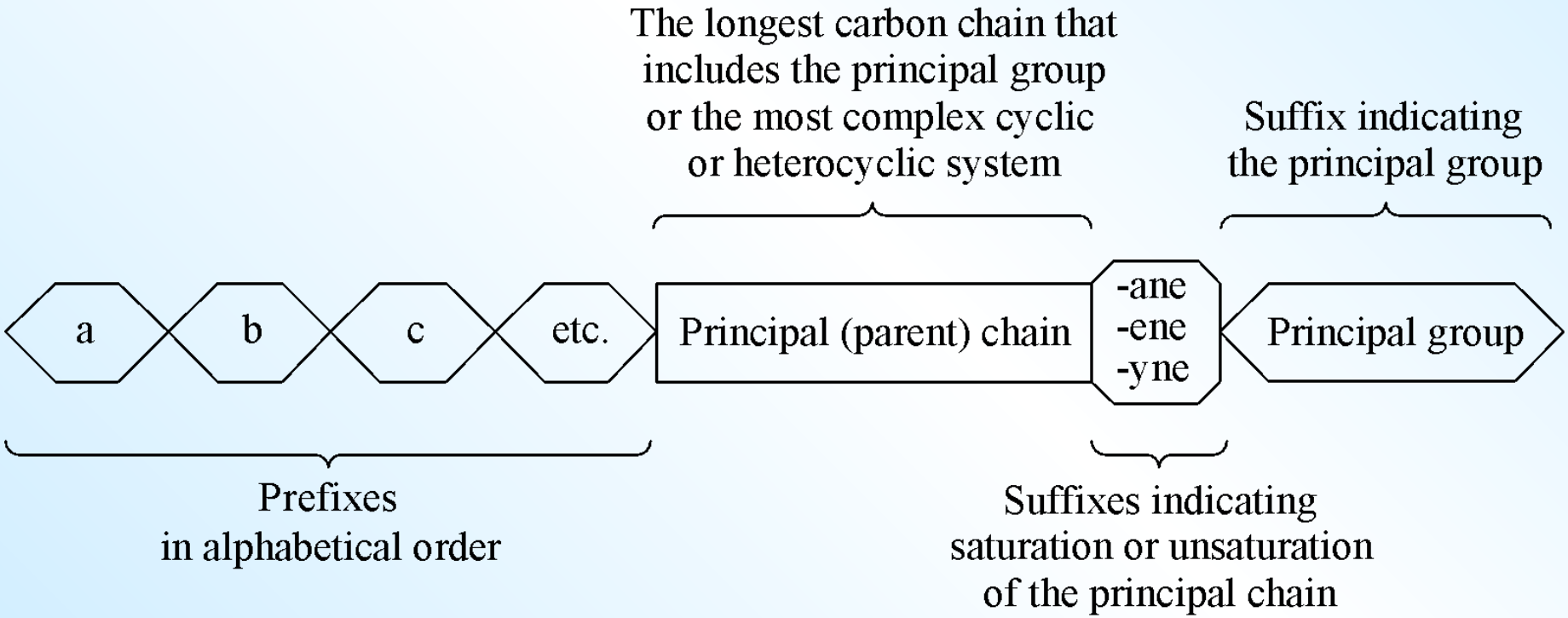
Selected organic compounds and univalent radicals

Compound		*Radical*	
Formula	*Name*	*Formula*	*Name*
CH_4	methane	$CH_3–$	methyl (Me)
$CH_3–CH_3$	ethane	$CH_3–CH_2–$ *or* $C_2H_5–$	ethyl (Et)
$CH_3–CH_2–CH_3$	propane	$CH_3–CH_2–CH_2–$ *or* $C_3H_7–$ $(CH_3)_2CH–$	propyl (Pr) isopropyl (*i*-Pr)
$CH_3–CH_2–CH_2–CH_3$	butane	$CH_3–CH_2–CH_2–CH_2–$ *or* $C_4H_9–$ $CH_3CH_2(CH_3)CH–$	butyl (Bu) *sec*-butyl (*s*-Bu)
$(CH_3)_2CH–CH_3$	isobutane	$(CH_3)_2CHCH_2–$ $(CH_3)_3C–$	isobutyl (*i*-Bu) *tert*-butyl (*t*-Bu)

Selected organic compounds and univalent radicals

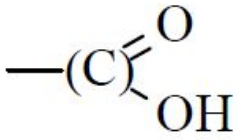
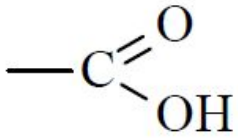
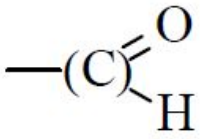
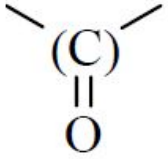
Compound		*Radical*	
$CH_2=CH_2$	ethylene (ethene)	$CH_2=CH–$	vinyl
$CH_3–CH=CH_2$	propylene (propene)	$CH_2=CH–CH_2–$	allyl
 *or* C_6H_6	benzene	 *or* $C_6H_5–$	phenyl (Ph)
 CH_3 *or* $C_6H_5CH_3$	toluene	 $CH_2–$ *or* $C_6H_5CH_2–$	benzyl

Systematic nomenclature — a set of terms and rules that allows to produce a unique name for any substance.

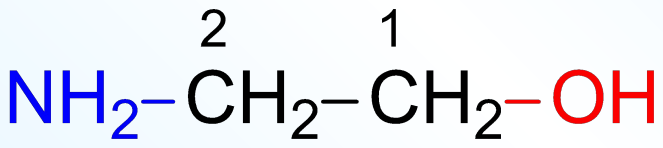


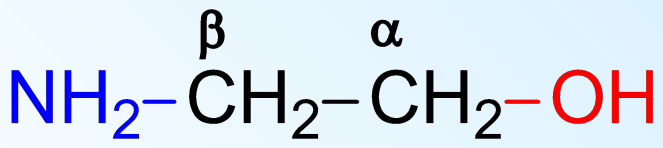
All prefixes and suffixes can be preceded with locants and/or multiplying affixes.

Selected Type I substituents in decreasing order of priority:

Functional group	*Prefix*	*Suffix*
	—	-oic acid
	carboxy-	-carboxylic adic
	oxo-	-al
	oxo-	-one
–OH	hydroxy-	-ol
–SH	mercapto-	-thiol
$–NH_2$	amino-	-amine

Example 2: colamine (trivial name).

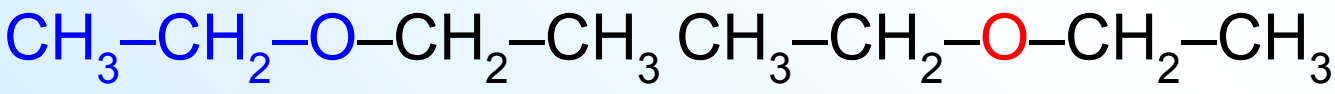




2-aminoethanol β-aminoethyl alcohol

(substitutive name) (functional class name)

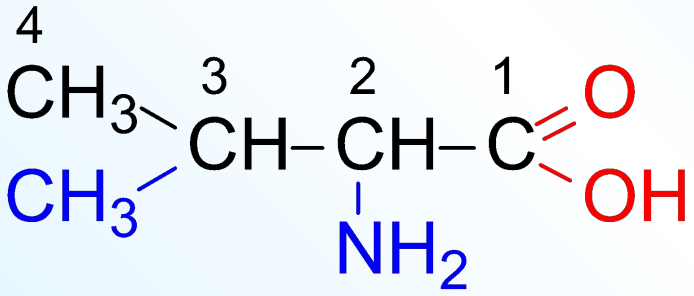
Example 3: medical ether (trivial name).

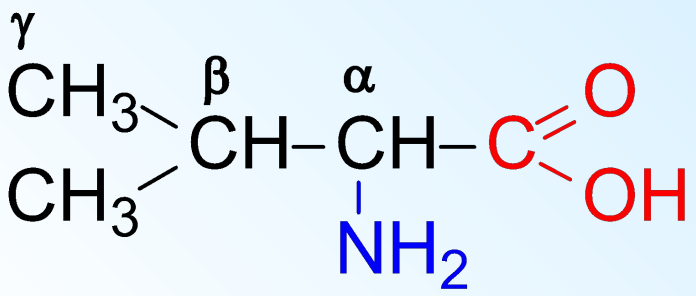


ethoxyethane diethyl ether

(substitutive name) (functional class name)

Example 4: valine (trivial name).





2-amino-3-methylbutanoic acid

(substitutive name)

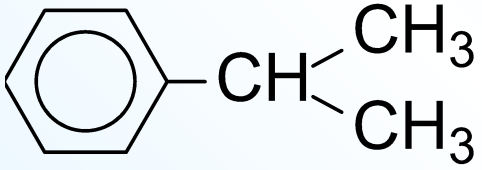
α-aminoisopentanoic acid *or*

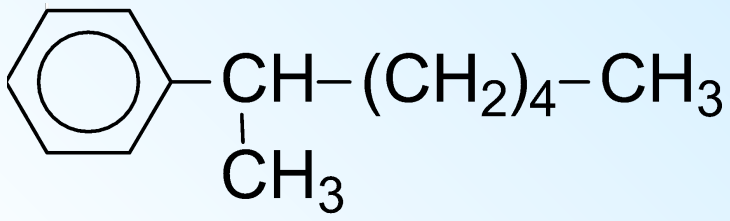
α-aminoisovaleric acid

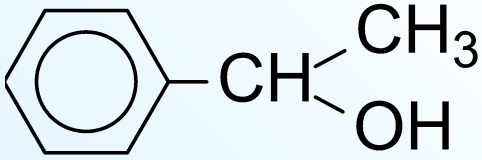
(functional class name)

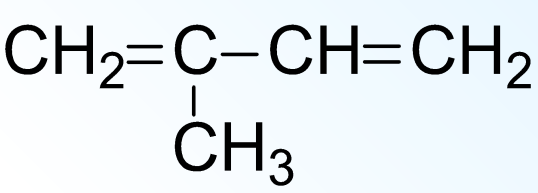
Nomenclature	***Substitutive***	***Radicofunctional***
Chemical name	*Usually one word*	*Usually two or more words*
Principal group	*Forms suffix*	*Forms class name*
Substituents	*Form prefixes*	*Named separately*
Locants	*1, 2, 3, ... (principal group included)*	*α, β, γ, ... (principal group excluded)*

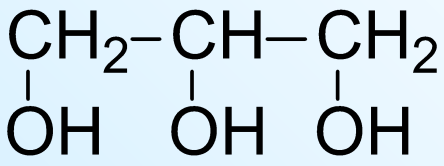
More examples:

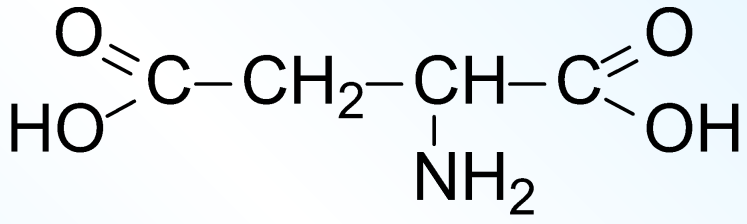
a) 

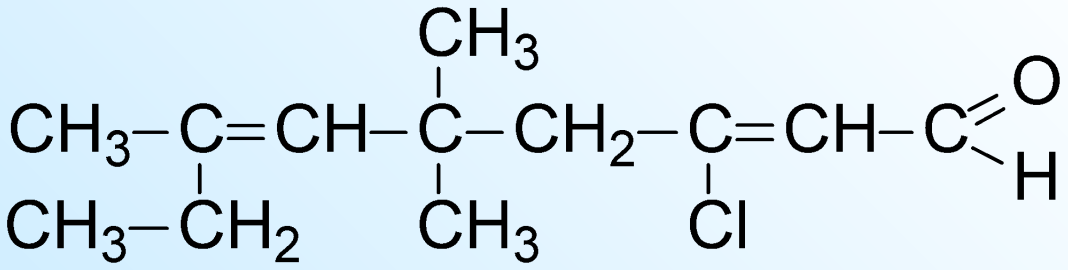
b) 

c) 

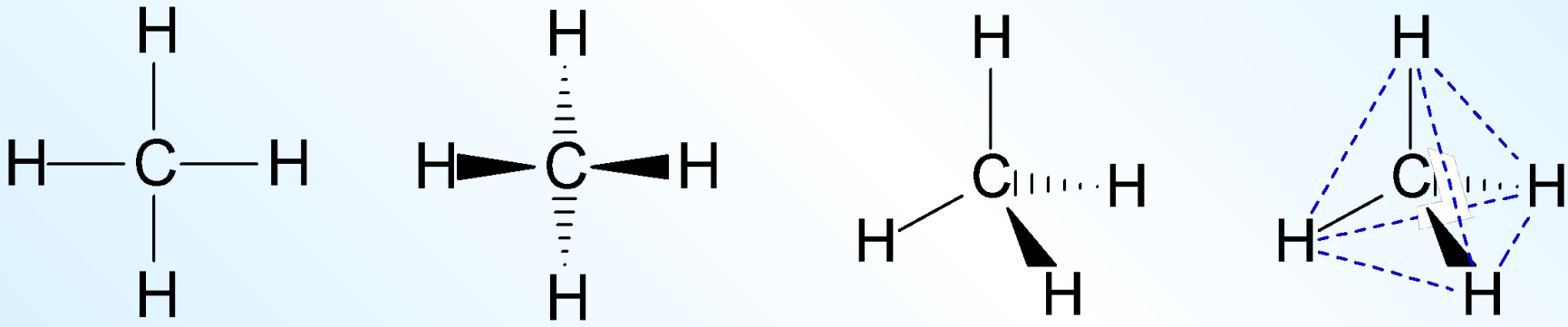
d) 

e) 

f) 

g) 

Line formula — a two-dimensional representation of molecular structure in which atoms are joined by the lines representing single or multiple bonds, without any indication of the spatial direction of the bonds.



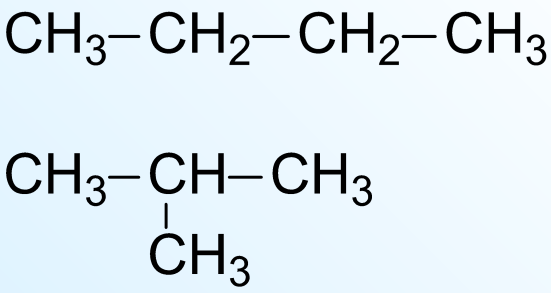
Stereochemical formula — a three-dimensional view of a molecule either as such or in a projection.

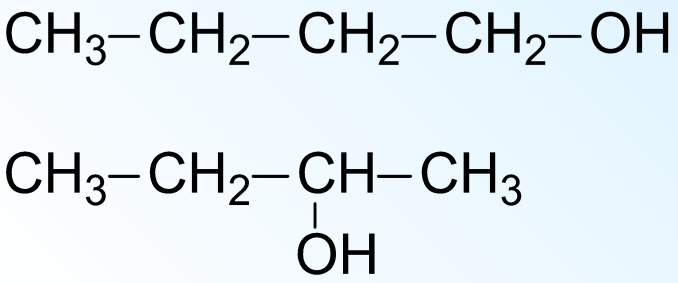
Types of isomerism

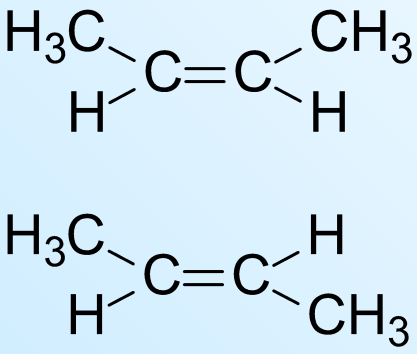
Constitutional isomers	principal chain (carbon skeleton)		
	multiple bond or functional group position		
	functional group		
Configura-tional isomers	enantio-mers	D- and L-	
		other types	
	diastereo-mers	π-diastereomers	*cis*- and *trans*-
		σ-diastereomers	*cis*- and *trans*-
			more than one chiral atom
Conforma-tions *	eclipsed		
	staggered		*gauche*- (skew-)
			anti- (*trans*-)

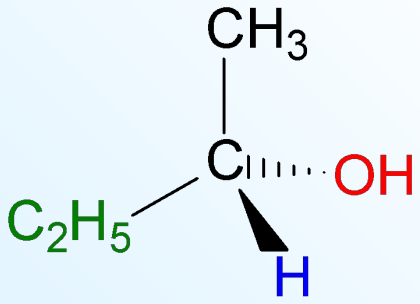
*) Usually undergo fast interconversions and are not considered as isomers

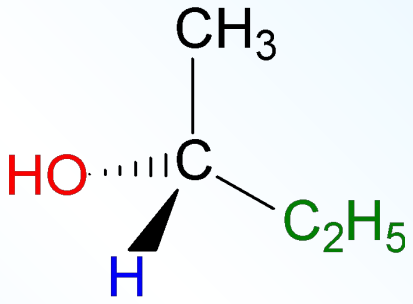
Isomers — molecular entities that have the same atomic composition (molecular formula) but different line formulas or different stereochemical formulas and hence different physical and/or chemical properties.











Configurational isomers — stereoisomers that <u>cannot</u> be interconverted without breaking of covalent bonds.

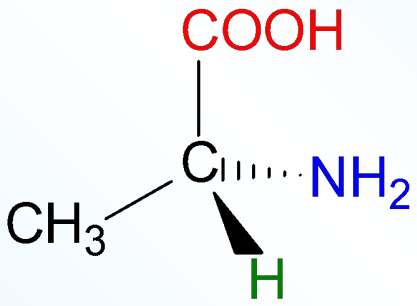
Configurational isomers:

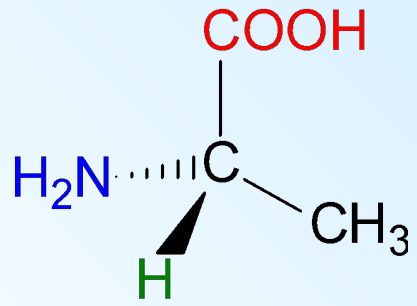
- have the same line formulas;
- have different stereochemical formulas.

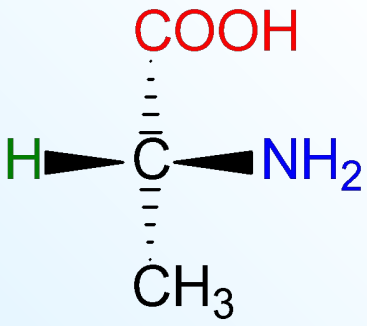
<u>*Example 1*</u>. Enantiomers of α-alanine:

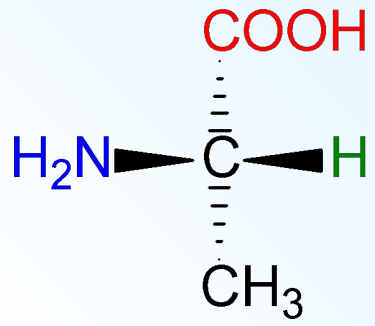
R-2-aminopropanoic acid *S*-2-aminopropanoic acid

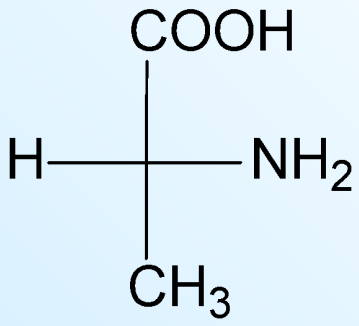
Fischer projections

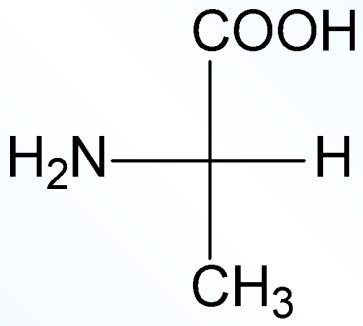






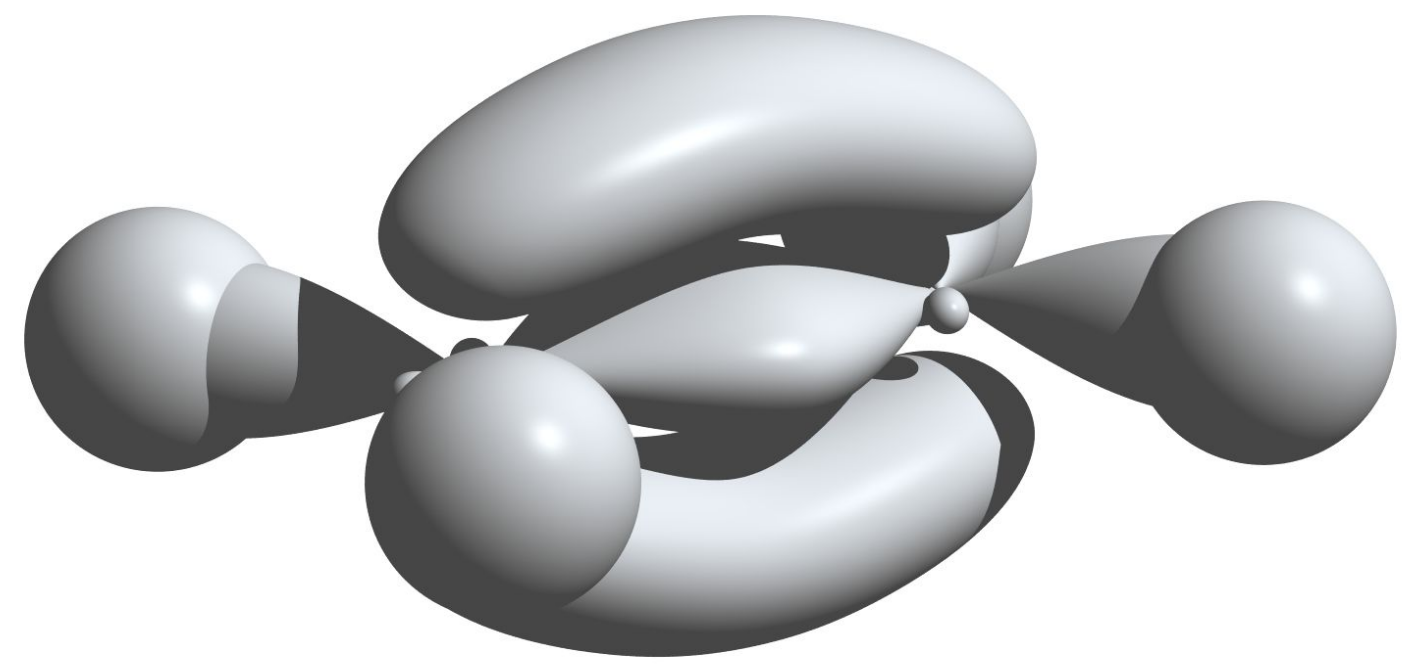




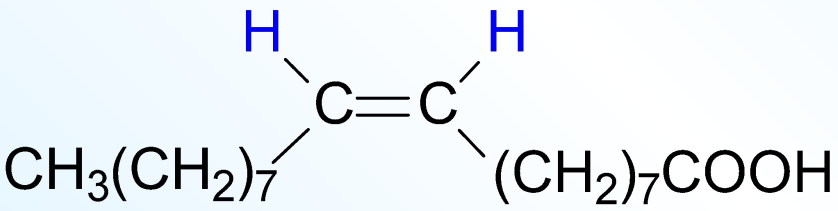


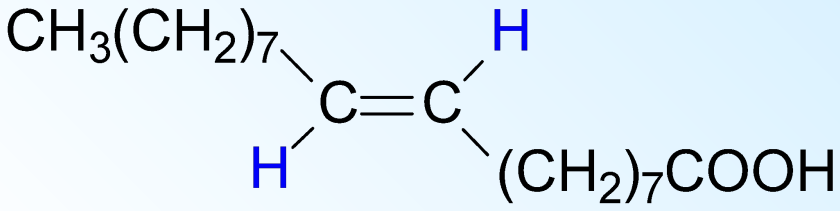
D-alanine L-alanine

Spatial configuration of σ- and π-bonds:



Example 2. Two π-diastereomers of 9-octadecenoic acid:





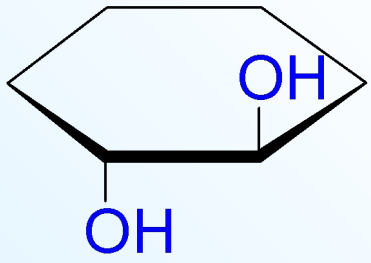
oleic acid elaidic acid

(*cis*-9-octadecenoic acid) (*trans*-9-octadecenoic acid)

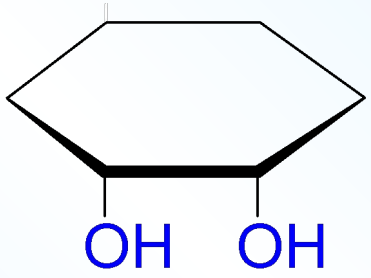
liquid (b. p. 13–16 °C) solid (b. p. 44–47 °C)

Z-isomer *E*-isomer

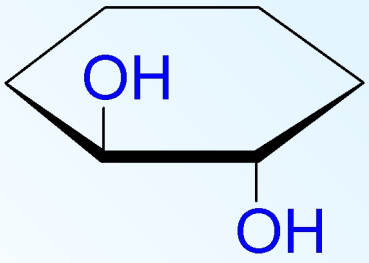
Example 3. Enantiomers and σ-diastereomers of 1,2-cyclo-hexanediol:



trans-

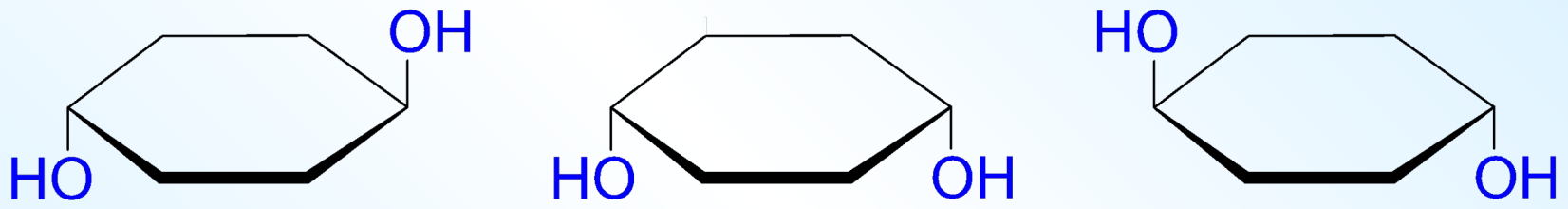


cis-



trans-

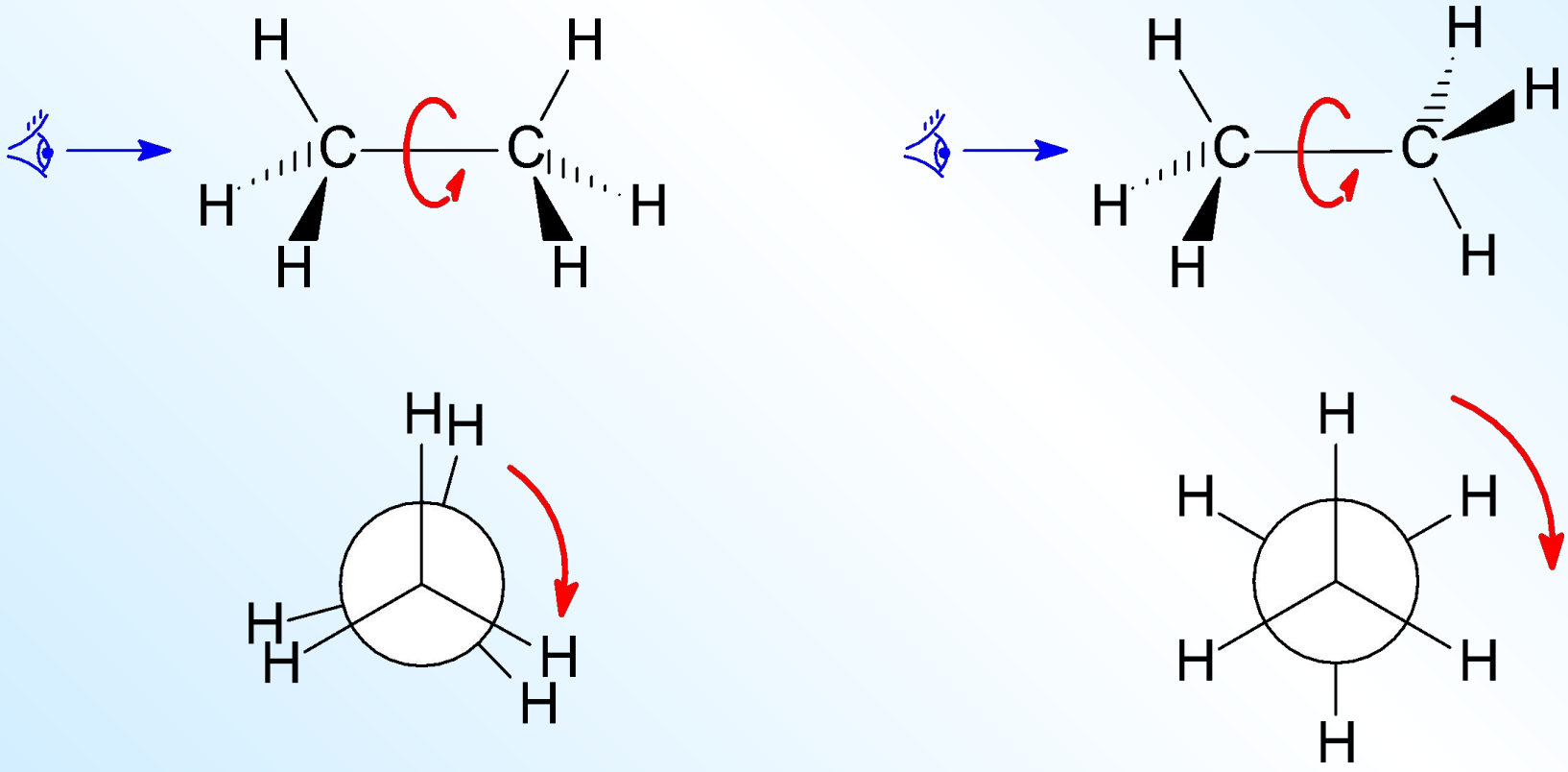
Example 4. Enantiomers and σ-diastereomers of 1,3-cyclo-hexanediol:



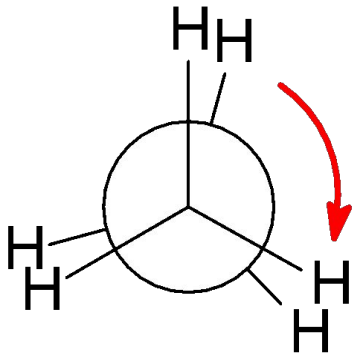
trans- *cis-* *trans-*

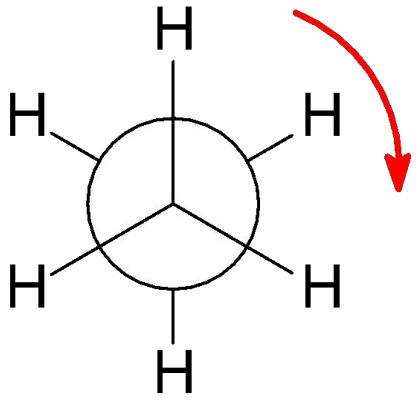
Conformational isomers — stereoisomers that can be interconverted without breaking of covalent bonds.

Example 5. Conformations of ethane:

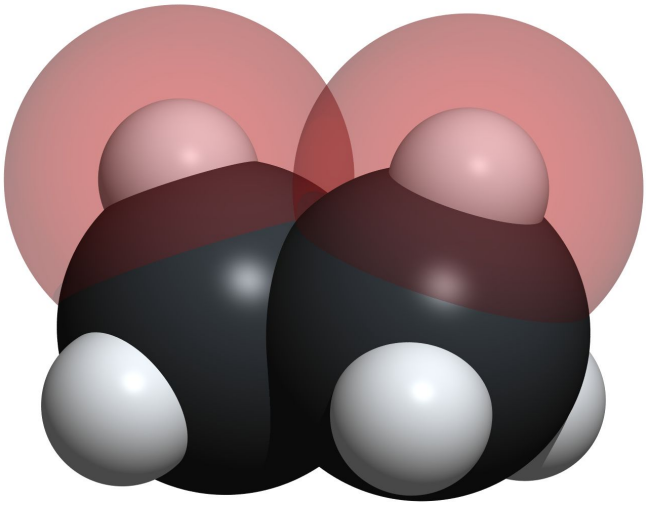


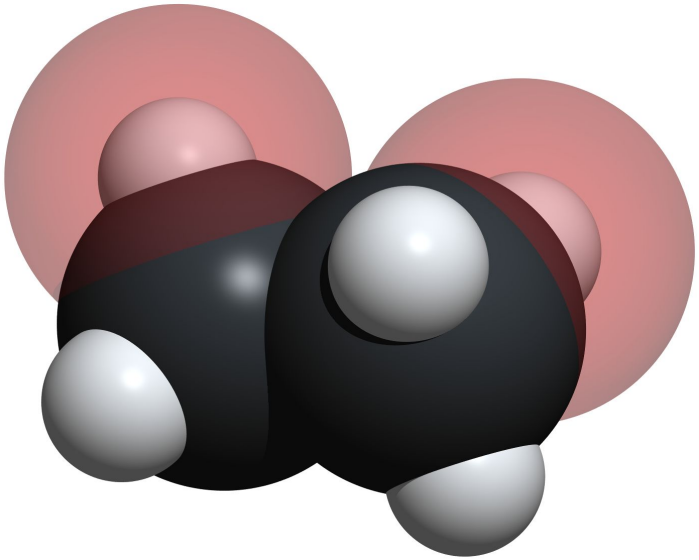
Eclipsed *Staggered*





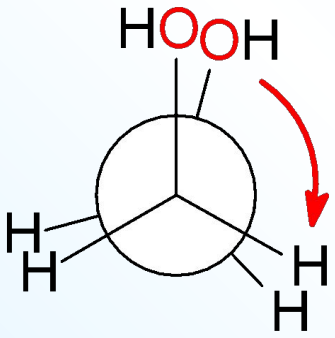
Eclipsed *Staggered*

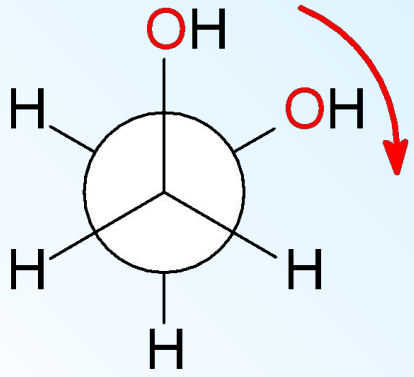




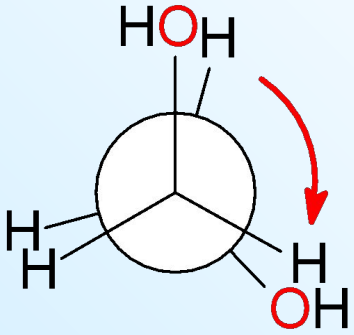
Torsion (eclipsional) strain: 12 kJ/mol

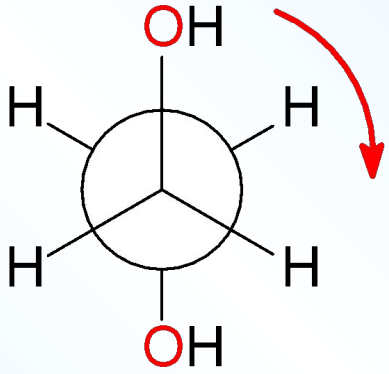
Example 6. Conformations of ethyleneglycol:





Eclipsed – 1 (syn) *Staggered – 1 (gauche)*





Eclipsed – 2 *Staggered – 2 (anti)*