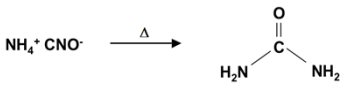
Structures of Organic Compounds

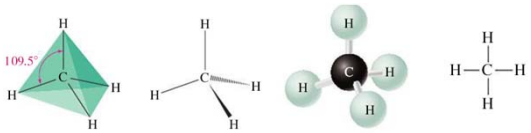
In 1828 Wöhler excitedly reported to J. J. Berzelius, I must tell you that I can make urea without the use of kidneys, either man or dog. Ammonium cyanate is urea!



Organic compounds contain carbon and hydrogen or carbon and hydrogen in combination with a few other types of atoms, such as oxygen, nitrogen, and sulfur.

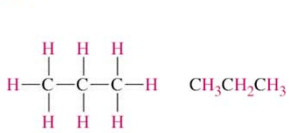
Carbon is singled out for special study because the ability of C atoms to form strong covalent bonds with one another allows them to join together into straight chains, branched chains and rings.

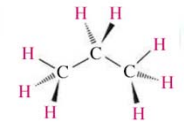
Methane CH_4



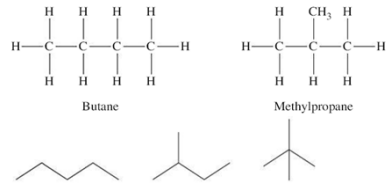
Hydrocarbons

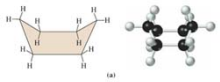
Propane C_3H_8

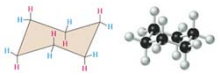




Constitutional isomers

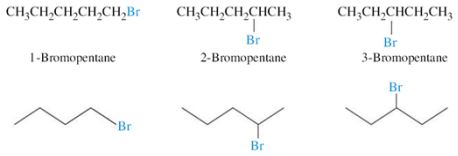


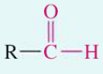
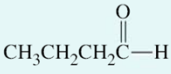
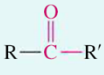
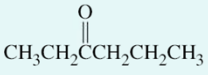


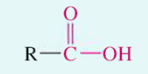
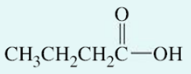
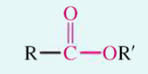
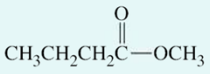
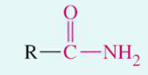
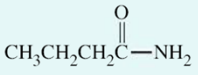
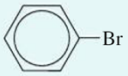


Cyclohexane

Functional Groups: Organic compounds typically contain elements in addition to carbon and hydrogen. These groupings of one or several atoms called ***functional groups***



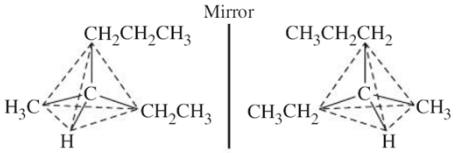
Class	Formula[a]	Example	Name of Example
Alkane	R—H	$CH_3CH_2CH_2CH_2CH_2CH_3$	Hexane
Alkene		$CH_2{=}CHCH_2CH_2CH_3$	1-Pentene
Alkyne		$CH_3C{\equiv}CCH_2CH_2CH_2CH_2CH_3$	2-Octyne
Alcohol	R—OH	$CH_3CH_2CH_2CH_2OH$	1-Butanol
Alkyl halide	R—X[b]	$CH_3CH_2CH_2CH_2CH_2CH_2Br$	1-Bromohexane
Ether	R—O—R′	$CH_3—O—CH_2CH_2CH_3$	1-Methoxypropane (methyl propyl ether)[c]
Amine	R—NH_2	$CH_3CH_2CH_2—NH_2$	1-Aminopropane (propylamine)[c]
Aldehyde			Butanal (butyraldehyde)[c]
Ketone			3-Hexanone (ethyl propyl ketone)[c]

Class	Formula[a]	Example	Name of Example
Carboxylic acid			Butanoic acid (butyric acid)[c]
Ester			Methyl butanoate (methyl butyrate)[c]
Amide			Butanamide (butyramide)[c]
Arene	Ar—H[d]		Ethylbenzene
Aryl halide	Ar—X[b]		Bromobenzene
Phenol	Ar—OH		4-Chlorophenol (p-chlorophenol)[c]

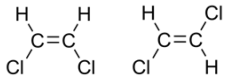
[a]The functional group is shown in red. R and R′ represent alkyl groups.
[b]X stands for a halogen atom: F, Cl, Br, or I.
[c]Common name.
[d]Ar stands for an aromatic (*aryl*) group such as the benzene ring.

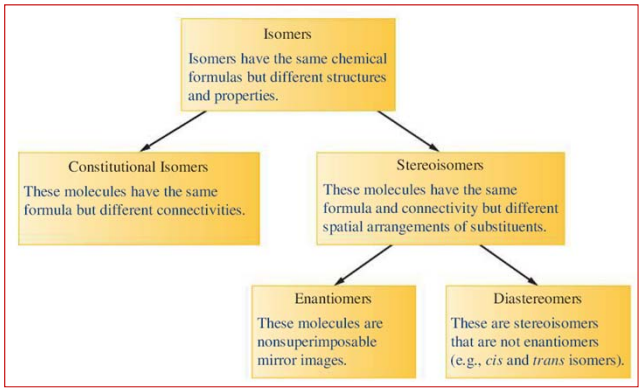
Stereoisomers

Enantiomers (chiral molecules)

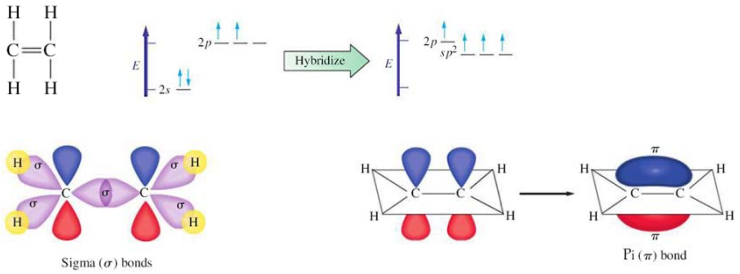


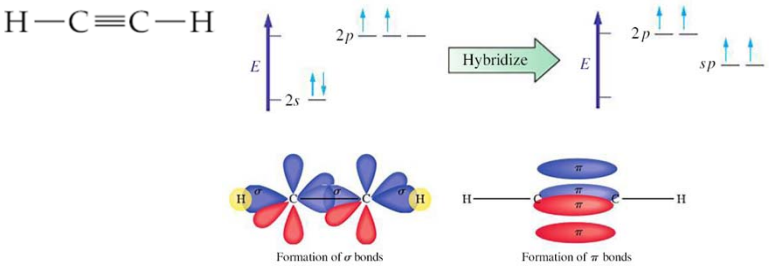
Diastereomers





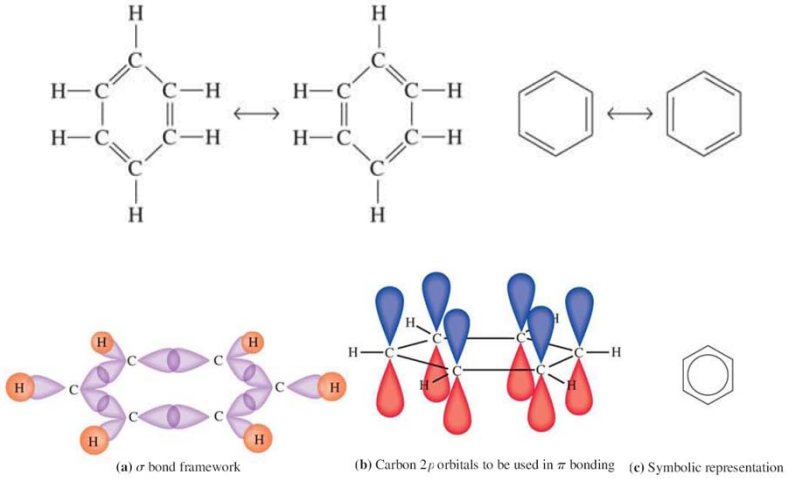
Multiple Covalent Bonds





Aromatic Hydrocarbons

Aromatic hydrocarbons have ring structures with *conjugated* bonding system (a bonding scheme among the ring atoms that consists of alternating single and double bonds).

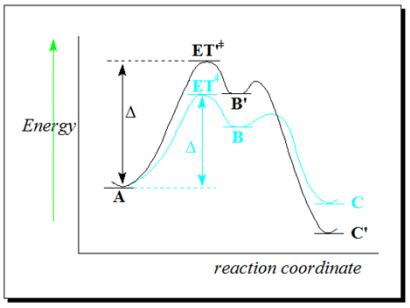


Kinetic and thermodynamic control of the reactions

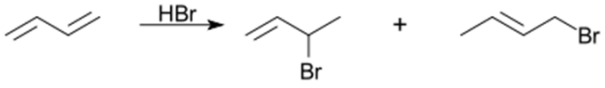
Thermodynamic control: the most stable product (C') is obtained.

Kinetic control: yields the product that comes up lower barriers (C).

Should we provide a lot of energy thermodynamic control is reached; otherwise we will have kinetic control.



Example:



T = 0 °C	71%	29%
T = 40 °C	15%	85%