Organic chemistry

The term organic chemistry derives from the early concept that substances of plant or animal origin were different from those of mineral origin(inorganic substances)

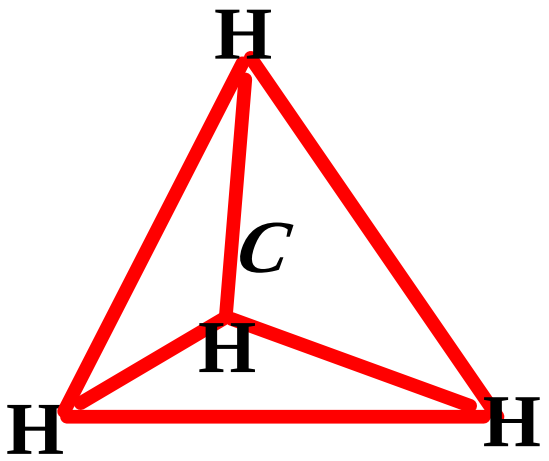
Organic chemistry:
The chemistry of hydrocarbons and their derivatives

Alkanes

The Alkanes are hydrocarbons in which all carbon-carbon bonds are single bonds

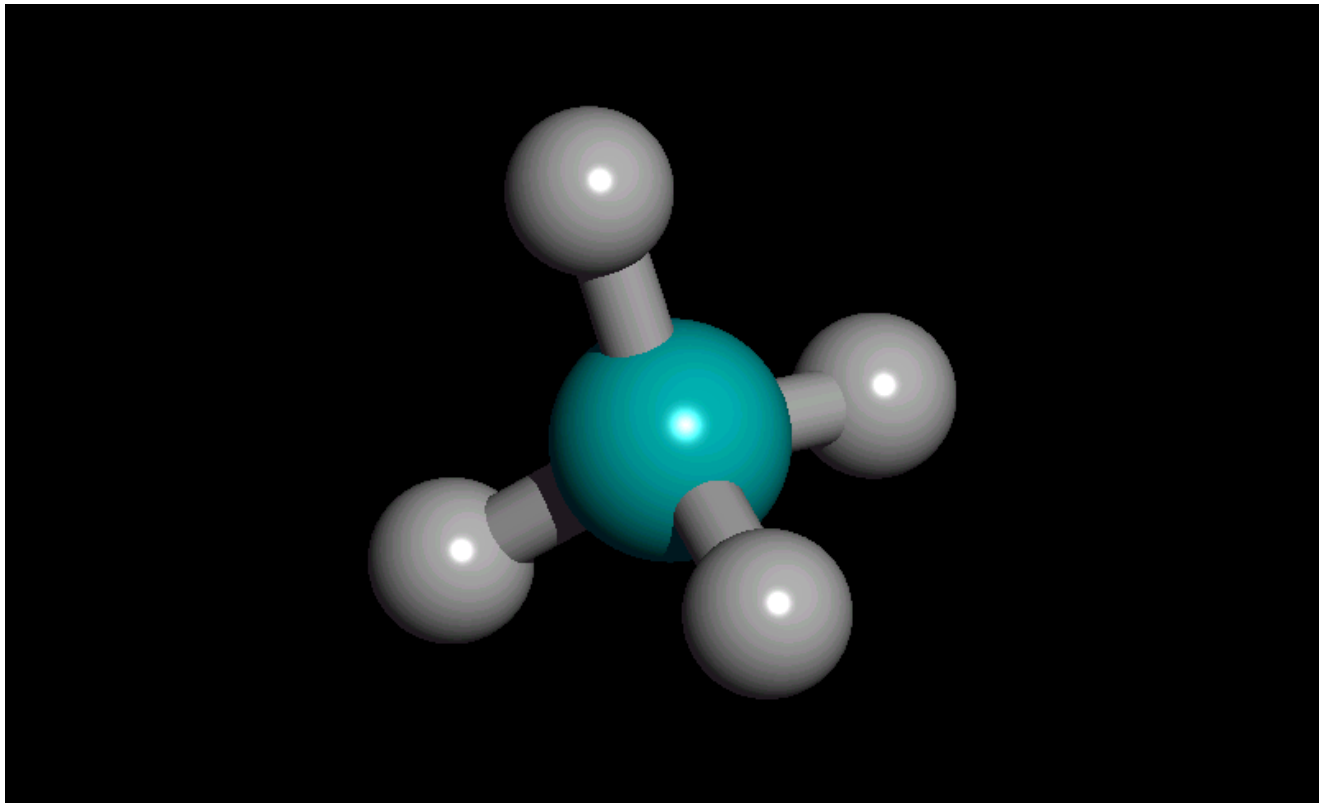
General formula for Alkanes C_nH_{2n+2}

Simplest alkane: CH_4



Angle = 109.5º

CH_4



Tetrahedral shape

Hybridization of atomic orbitals

CH_4 : tetrahedral

Four equal bonds with equal HCH angles

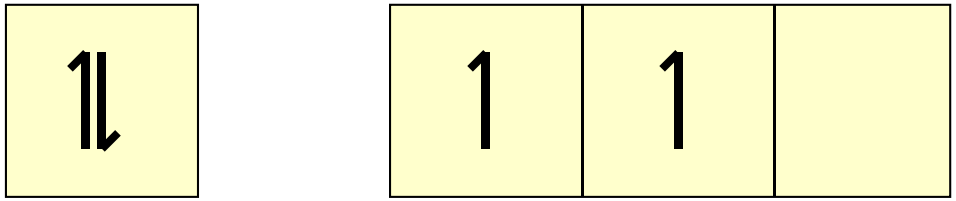
A covalent bond is formed by sharing two electrons by two atoms

Imagine an orbital (containing 1 electron) from one atom overlaps with an orbital from the other atom to form the bond

According to this view four orbitals are needed from the carbon atom to overlap with the four orbitals of the hydrogen atoms

The ground state of C: $1s^2\ 2s^2\ 2p^2$

Valence shell can be represents as:



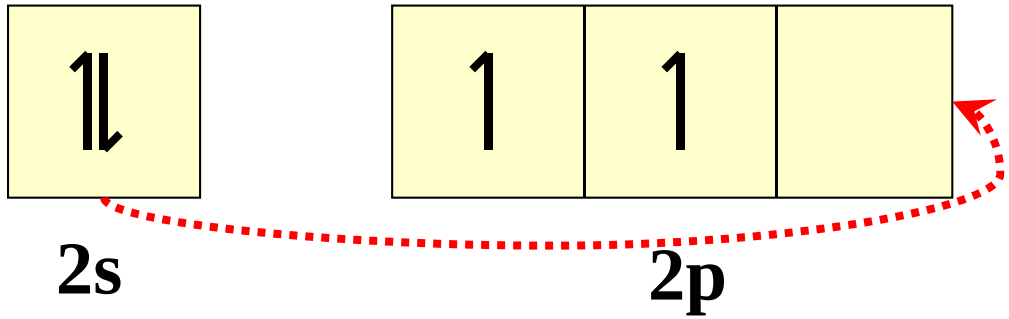
2s **2p**

there are only two orbitals with two single electrons!

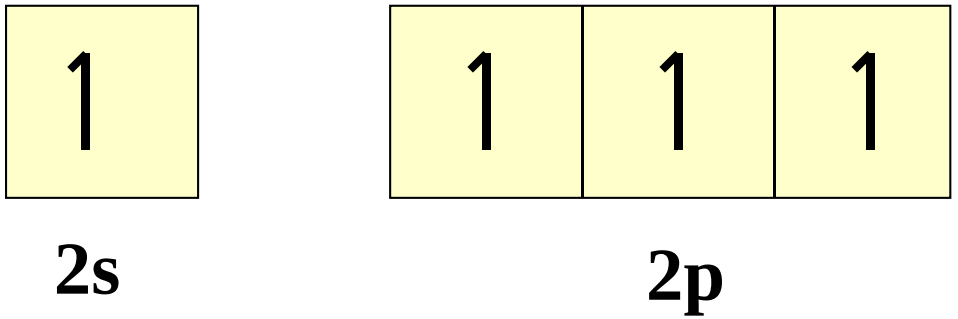
So, how the four bonds in CH_4 were formed?

This can be explained by the concept of hybridization

Ground state of C



Excited state of C



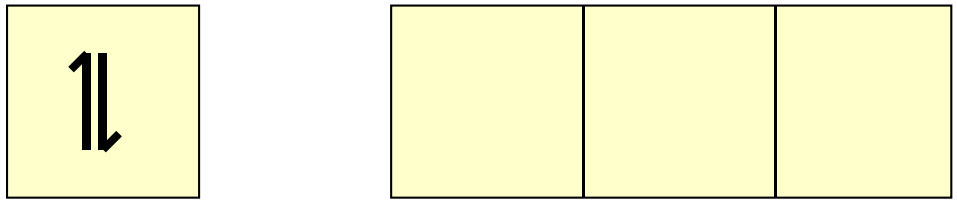
Now we have four orbitals with one electron in each orbital

One (2s) orbital mixes with three (2p) orbitals to form Four orbitals of sp^3 type

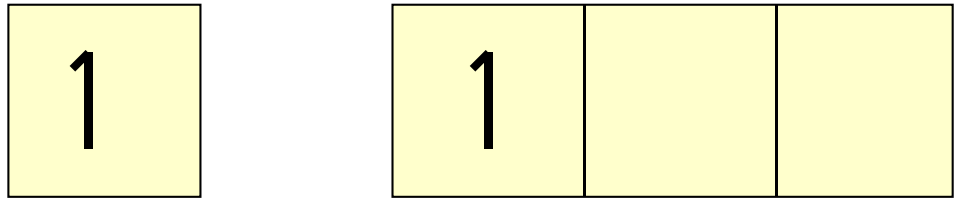
sp hybridization

$BeCl_2$ **Lewis structure: Cl—— Be —— Cl**

Ground state for B



Excited state for B

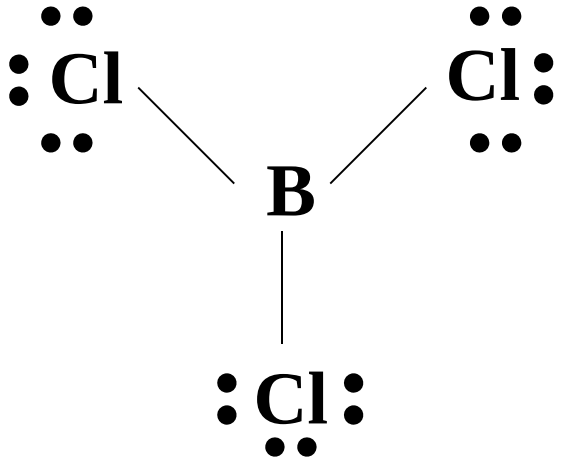


One (2s) orbital mixes with one (2p) orbital to form two orbitals of *sp* type

Molecules with sp hybridization are *linear*

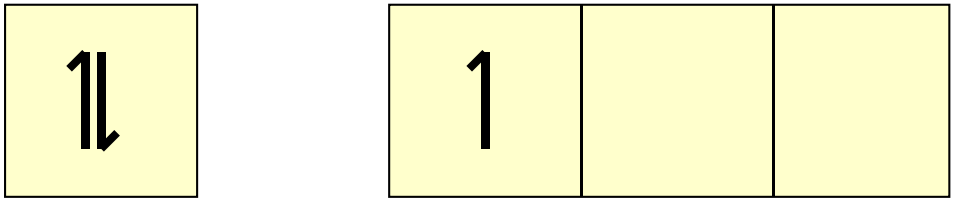
sp^2 hybridization

BCl_3 **Lewis structure:**

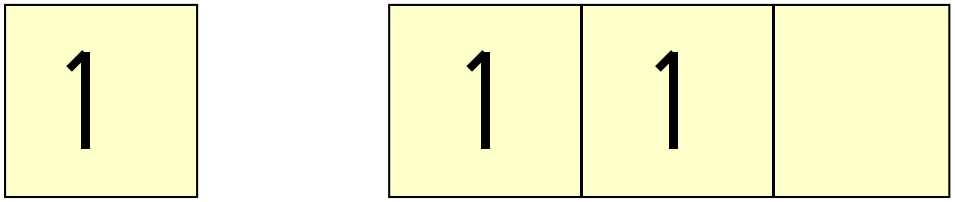


Shape: triangular & planar

Ground state for B



Excited state for B



One (2s) orbital mixes with two (2p) orbital to form three orbitals of *sp*^{2} type

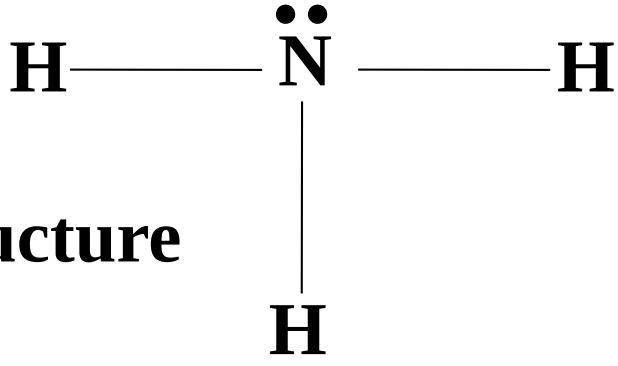
Molecules with sp^2 hybridization are *triangular and planar*

sp^3 hybridization

We saw the the tetrahedral CH_4 has a sp^3 hybridization

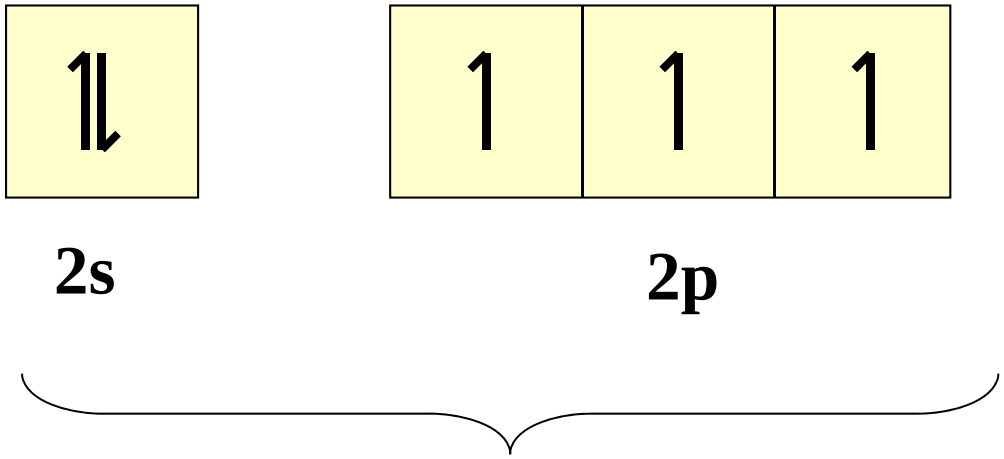
Consider NH_3

Lewis structure



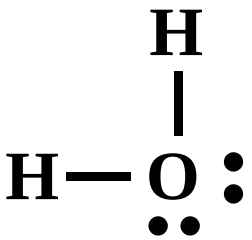
The valence shell of the central atom (N) in the molecule has four orbitals three bonding and one nonbonding

Ground state for N

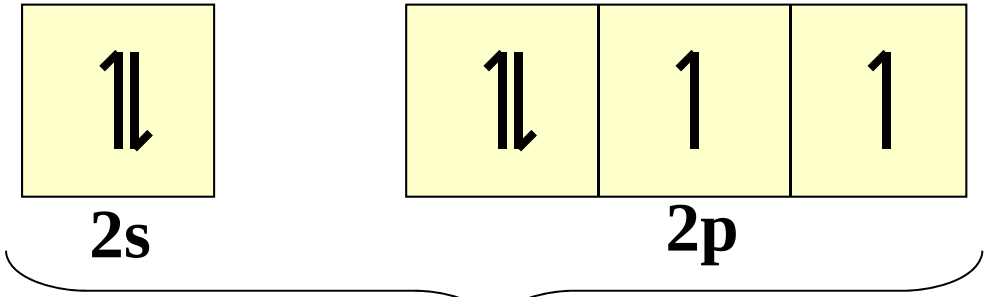


H_2O

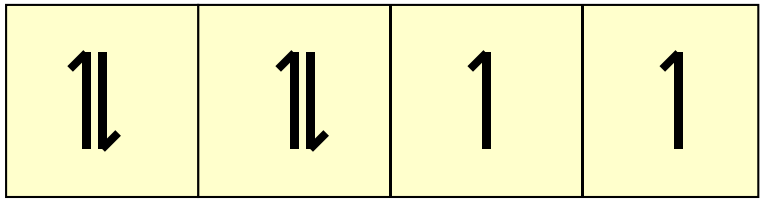
Lewis structure



Ground state for O:



hybridize



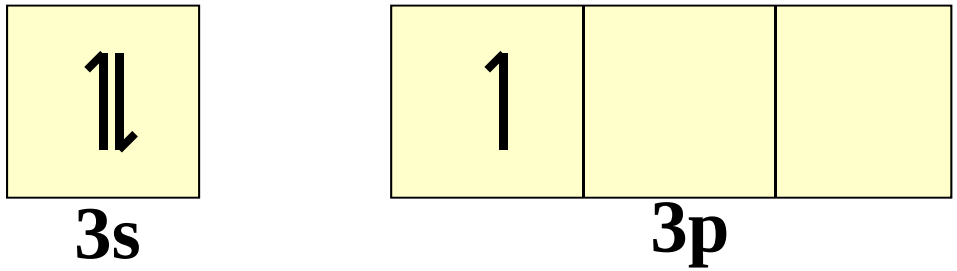
sp³

Example

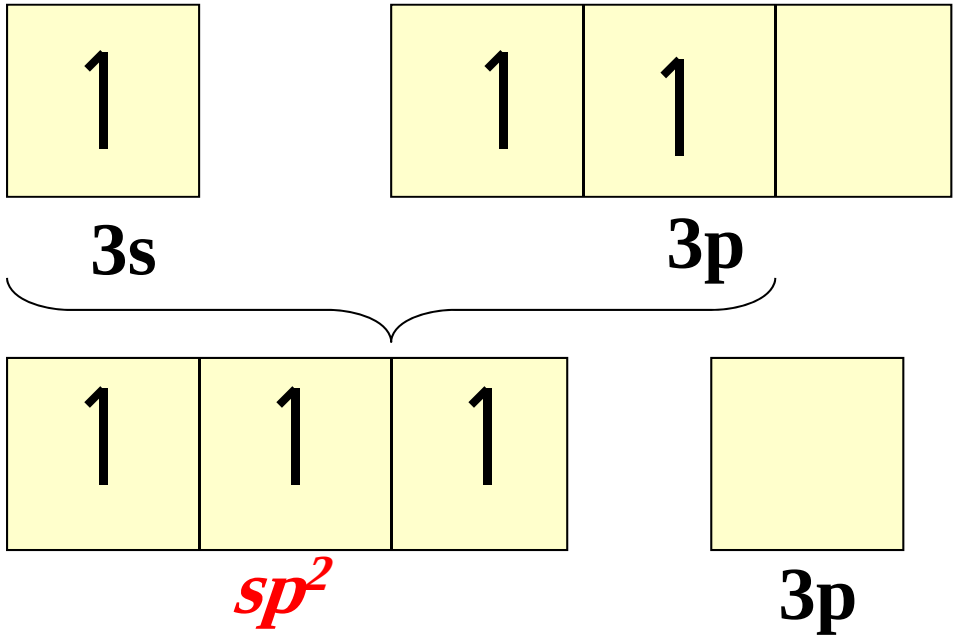
What type of hybrid orbital is employed by *Al* in AlI_3?

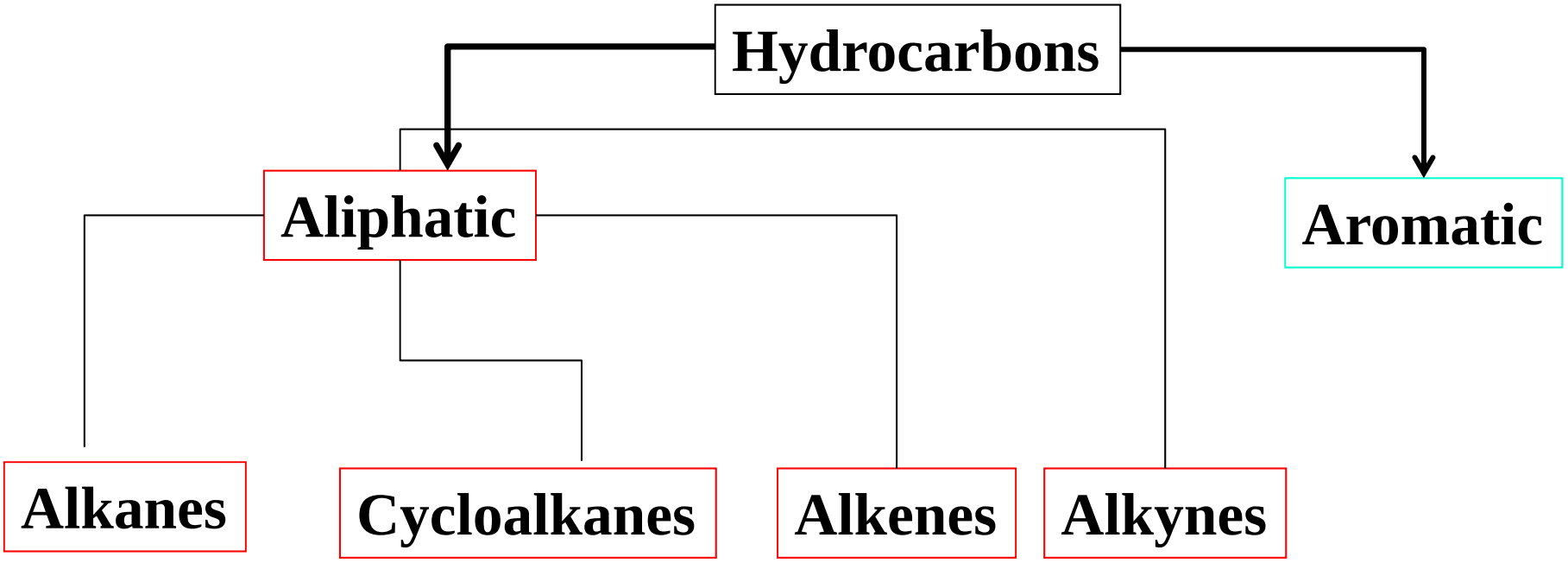
Electronic configuration of *Al*: [Ne] $3s^2\ 3p^1$

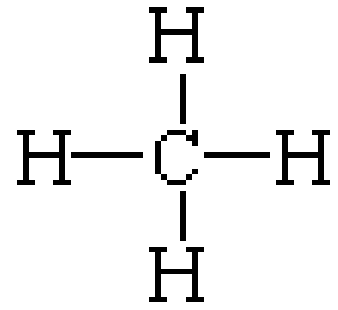
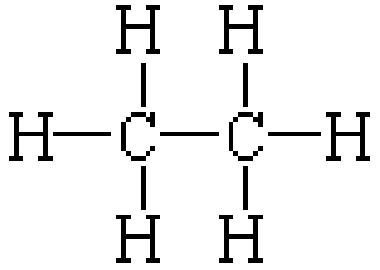
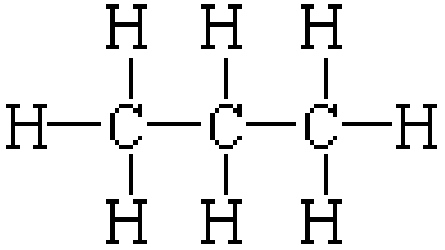
Ground state



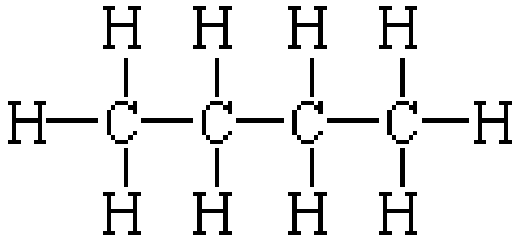
Excited state



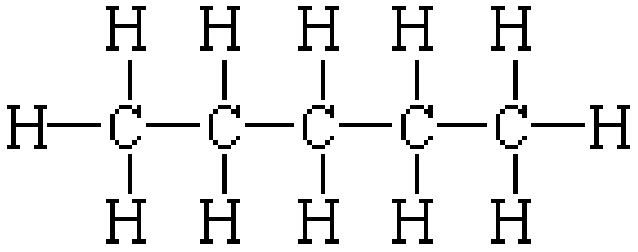

Hydrocarbons
Aliphatic
Aromatic
Alkanes
Cycloalkanes
Alkenes
Alkynes

Number of Carbons	Name	Formula	Normal Structures	
			Lewis Dot From	Line Form
1	**methane**	CH_4		CH_4
2	**ethane**	C_2H_6		
3	**propane**	C_3H_8		

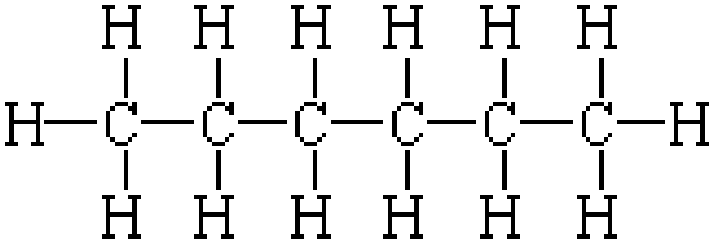
4 **butane** C_4H_{10}



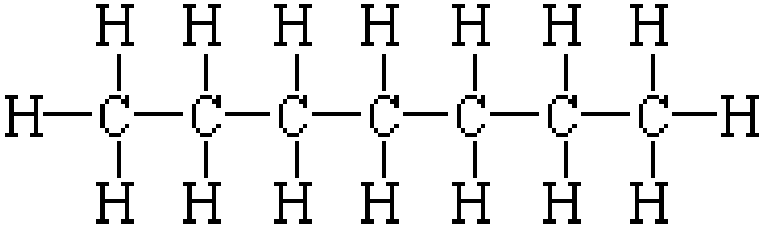
5 **pentane** C_5H_{12}

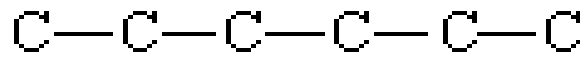


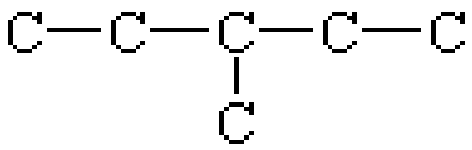
6 **hexane** C_6H_{14}

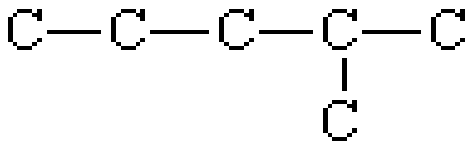


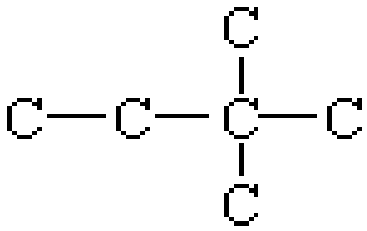
7 **heptane** C_7H_{16}

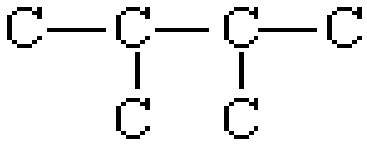


1  n-hexane

2  3-methylpentane

3  2-methylpentane

4  2,2-dimethylbutane

5  2,3-dimethylbutane

Groups:

CH_3 : methyl

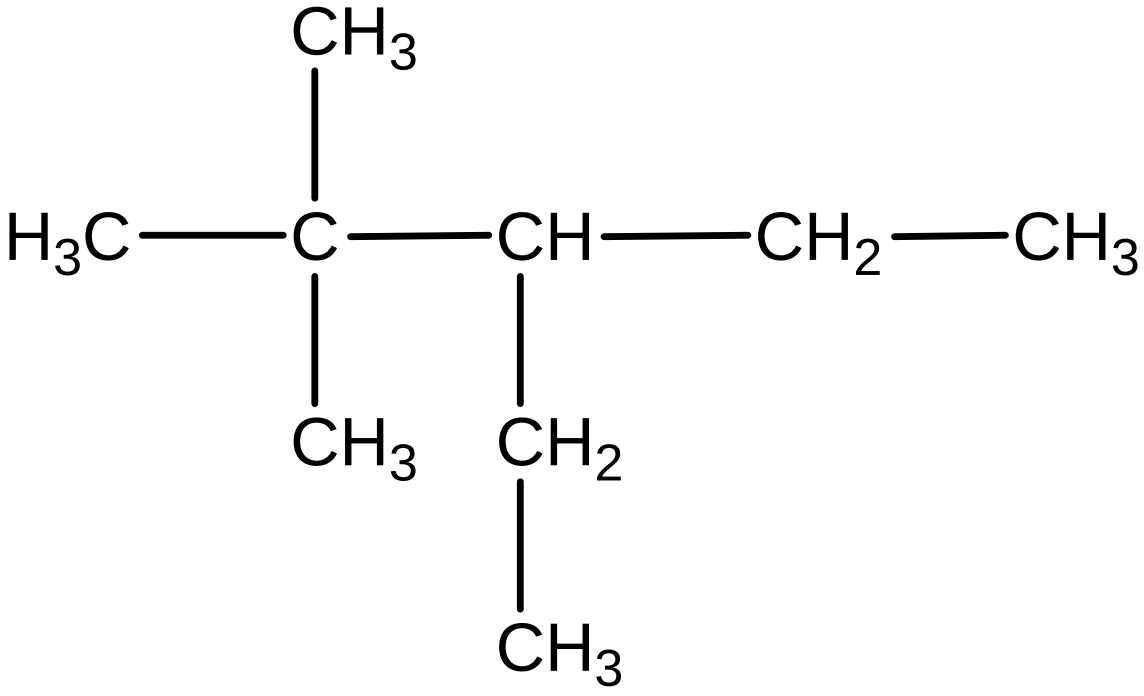
C_2H_5 : ethyl

Cl : chloro

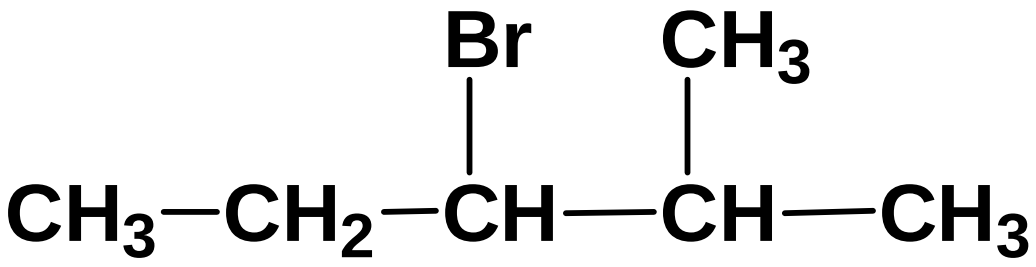
Br : bromo

NO_2 : nitro

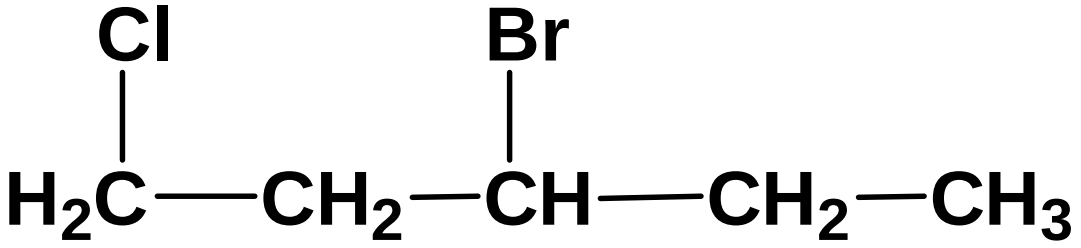
OH : hydroxy



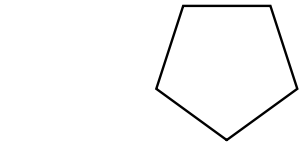
2,2 dimethyl-3-ethyl pentane

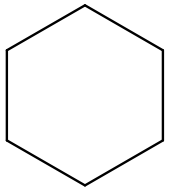


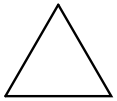
3-bromo 2-methyl pentane

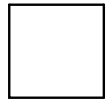


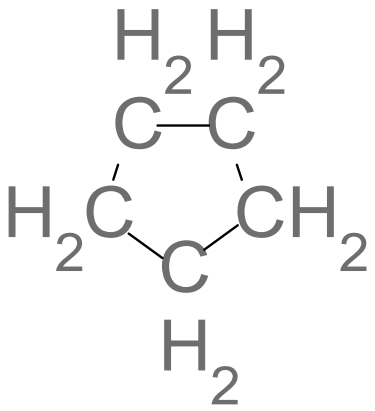
3-bromo 1- chloro pentane

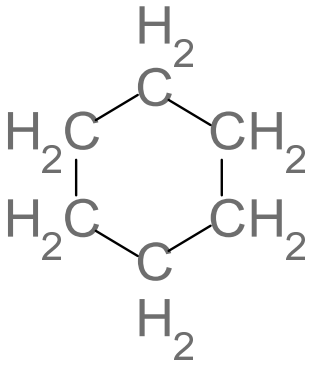


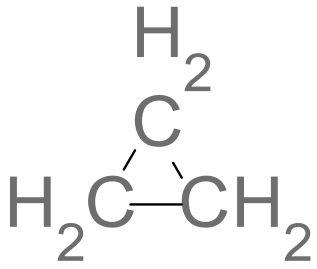


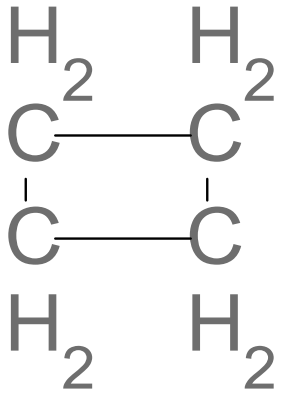












cyclopentane **cyclohexane** **cyclopropane** **cyclobutane**

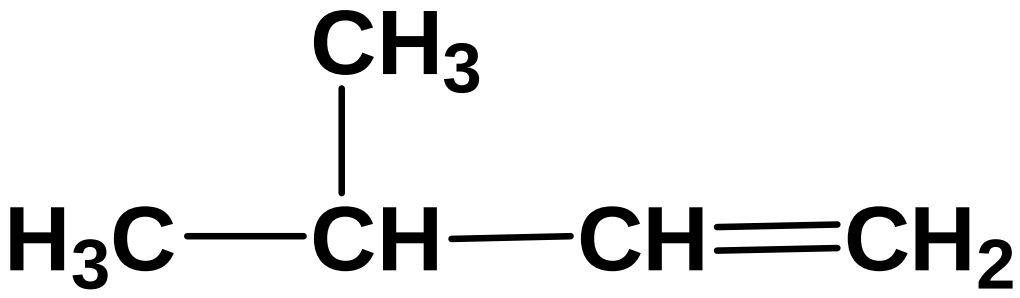
Alkenes

General formula: C_nH_{2n}

ethene $CH_2{=}CH_2$

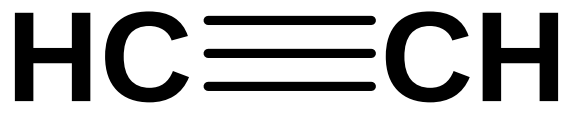
Butene: C_4H_8

Pentene: C_5H_{10}

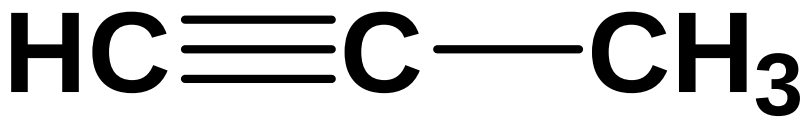


3-methyl 1-butene

Alkynes: C_nH_{2n-2}



ethyne



Propyne

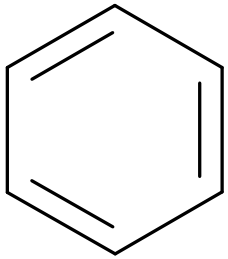
$$HC{\equiv}C{-}CH_2{-}CH_3$$

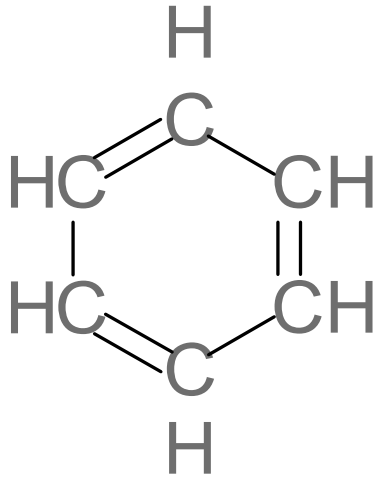
1-butyne

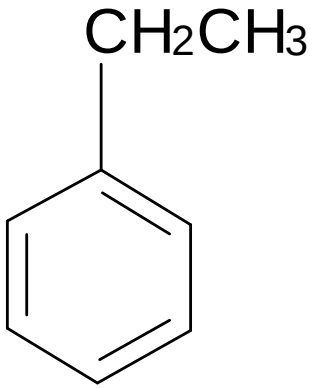
$$H_3C{-}C{\equiv}C{-}CH_3$$

2-butyne

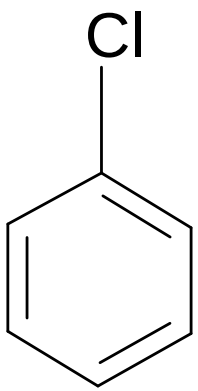
Aromatic hydrocarbons
Benzene is the parent of this family



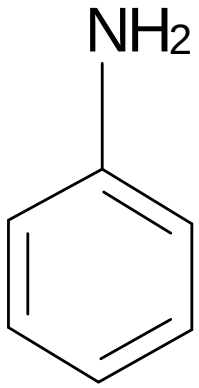




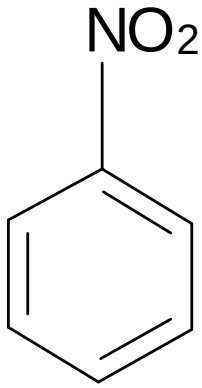
ethylbenzene



chlorobenzene

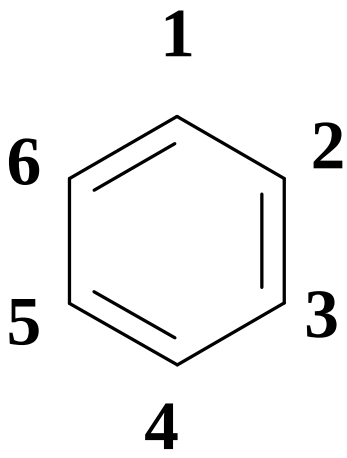


aminobenzene



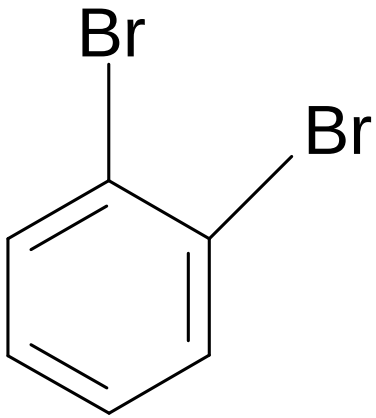
nitrobenzene

More than one substituent, number the ring as follows:



1,3-dibromobenzene

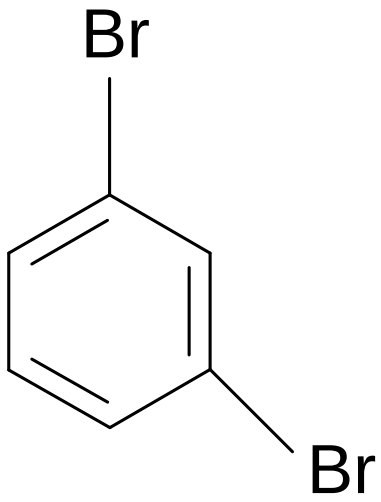
(*m*-dibromobenzene) ***meta***

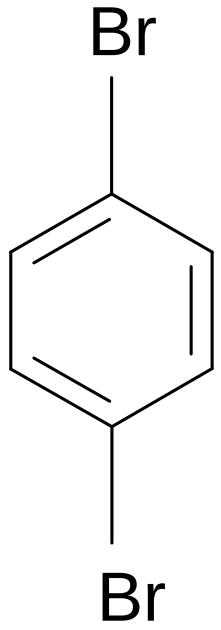


1,2-dibromobenzene

(*o*-dibromobenzene)

ortho





1,4-dibromobenzene

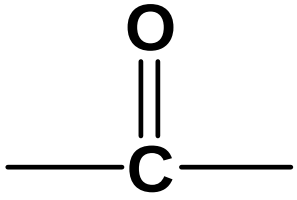
(*p*-dibromobenzene)

para

Organic compounds

Alcohols: R—OH

Carbonyl compounds



Carboxylic Acids R—COOH

Esters RCOOR