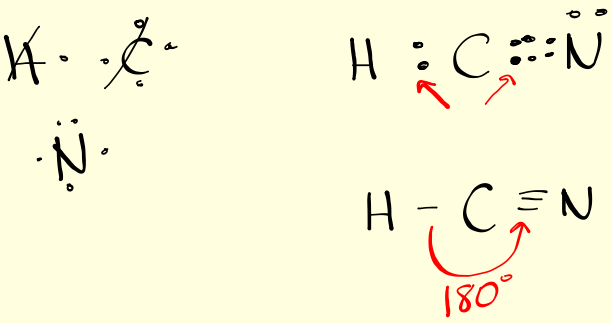
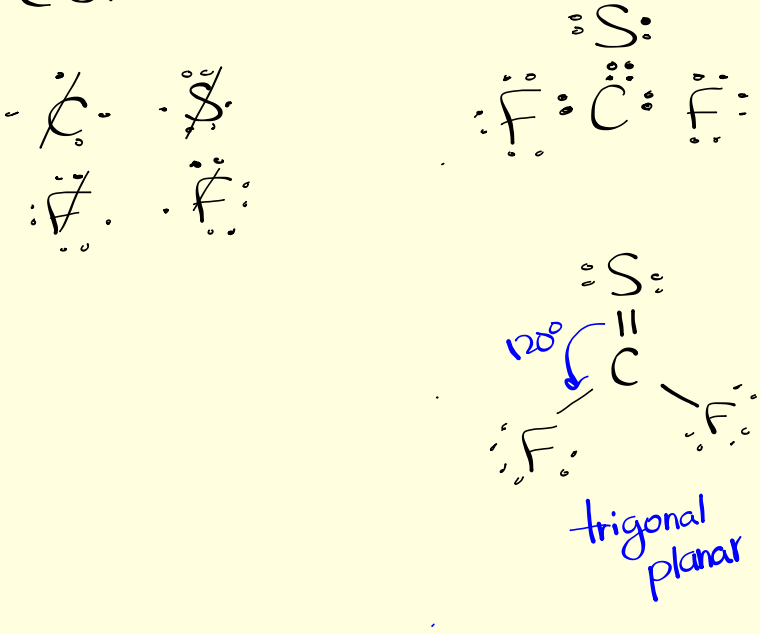
# VSEPR

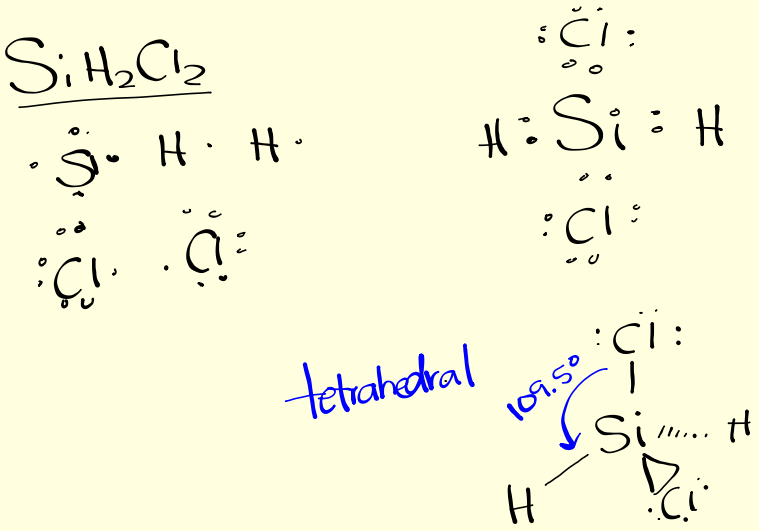
HCN

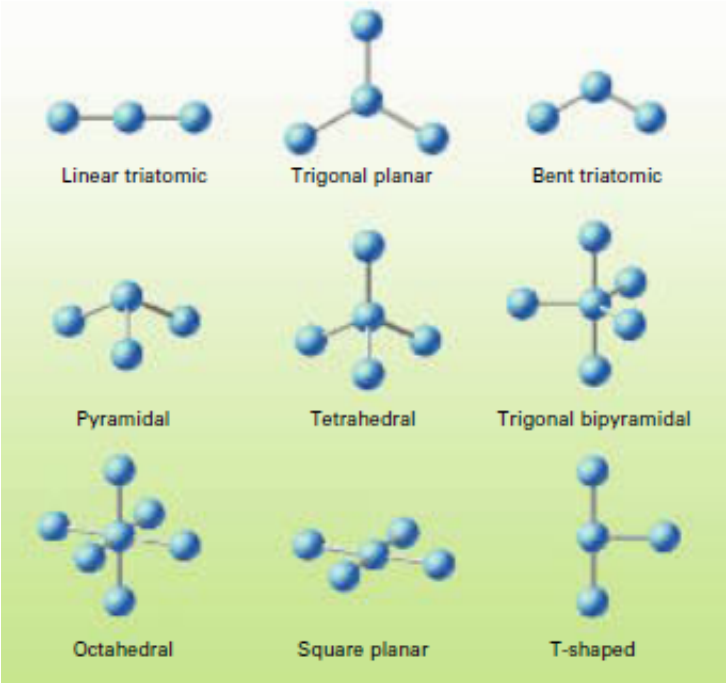



$CSF_2$




$SiH_2Cl_2$




Linear triatomic
Trigonal planar
Bent triatomic
Pyramidal
Tetrahedral
Trigonal bipyramidal
Octahedral
Square planar
T-shaped

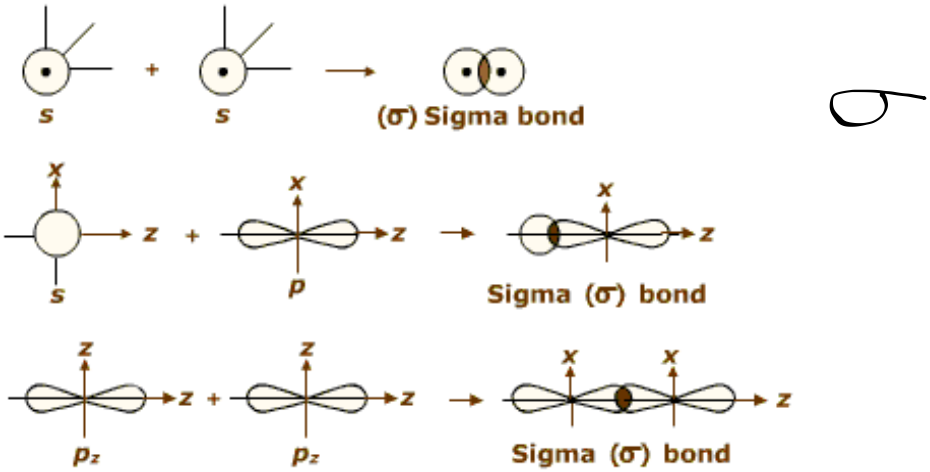
# Molecular Orbitals

When two atoms share electrons to form a molecule, their atomic orbitals combine to produce molecular orbitals.

When the orbital is filled with two electrons, it is called a **bonding orbital**.

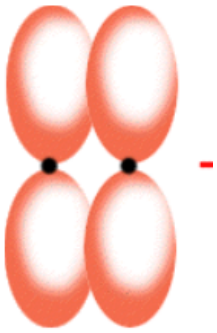
**Sigma bond**

Bond that forms when two atomic orbitals overlap head-on.
-strong bond



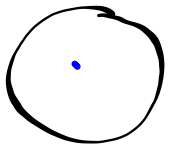

**Pi bond**

Bond that forms when two atomic orbitals overlap side-by-side.
-orbitals overlap less than in sigma bonds, thus the bonds are weaker than sigma bonds.



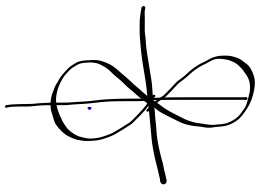
$3p$ ---
$3s$ —
$2p$ ---
$2s$ —
$1s$ —

S

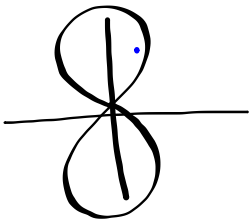


P

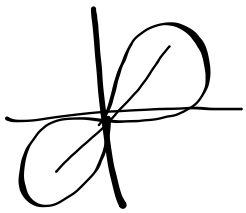
$p_x$



$p_y$



$p_z$

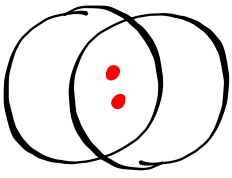


$H_2$

$1s^1$ $1s^1$

H· H·

H : H

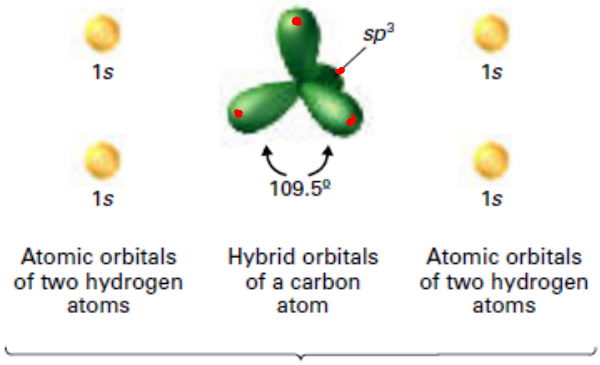


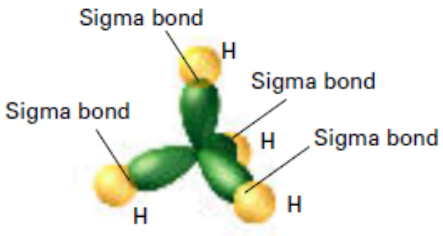
## Hybridization Involving Single Bonds

In **hybridization**, atomic orbitals (s, p) mix to form the same total number of equivalent hybrid orbitals.

Ex. $CH_4$

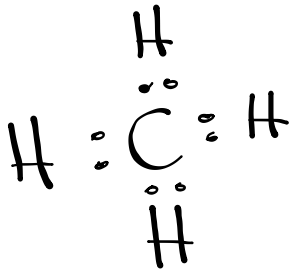
The one *2s* orbital and three *2p* orbitals of a carbon atom mix to form four $sp^3$ hybrid orbitals.

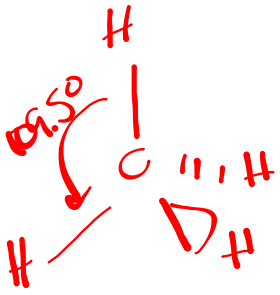



Methane molecule

$CH_4$





$2p\ 1\ 1\ 1$

$2s\ 1$

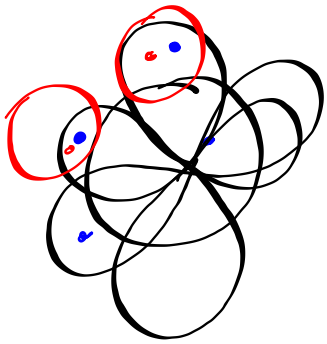
$1s\ 1\downarrow$

C

$\cdot\dot{C}\cdot$

$1s\ 1$

H



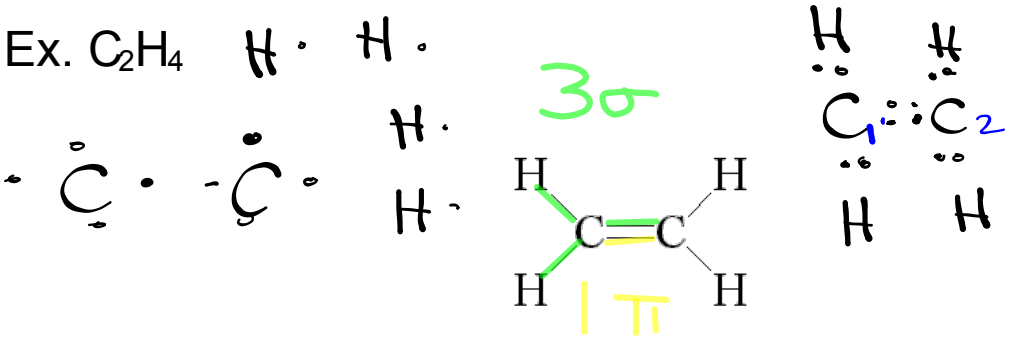
A.O. M.O.

$S + p_x + p_y + p_z \longrightarrow sp^3 + sp^3 + sp^3 + sp^3$

4σ

## Hybridization Involving Double Bonds

Ex. $C_2H_4$

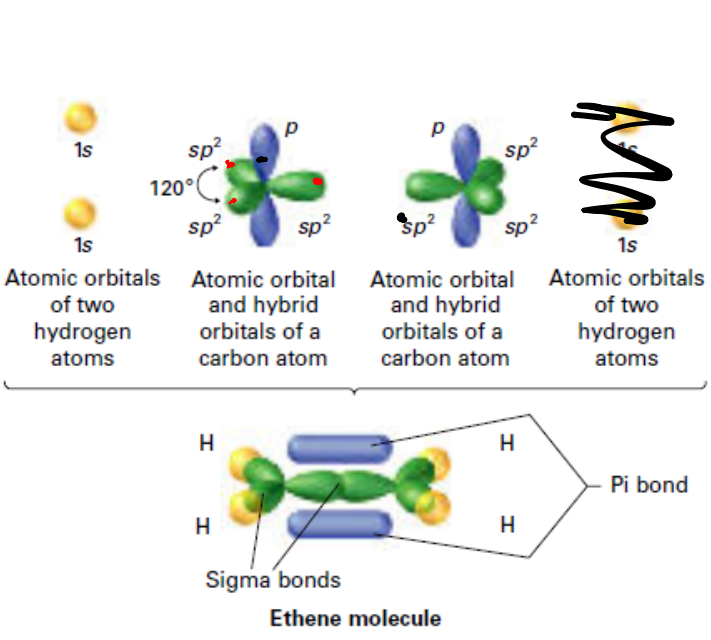



The one *2s* orbital and two *2p* orbitals of each carbon atom mix to form three $sp^2$ hybrid orbitals.

Two of the $sp^2$ orbitals overlap with the *1s* hydrogen orbital to form carbon-hydrogen sigma bonds.

The third $sp^2$ orbital overlaps with an $sp^2$ orbital from the other carbon to form a carbon-carbon sigma bond.

The non-bonding *2p* orbitals overlap side-by-side to form a carbon-carbon pi bond.



A.O. M.O.

$S + p_x + p_y \rightarrow sp^2 + sp^2 + sp^2$

$3\sigma$

"leftover"

$p_z$ $p_z$

$\downarrow$

$\pi$