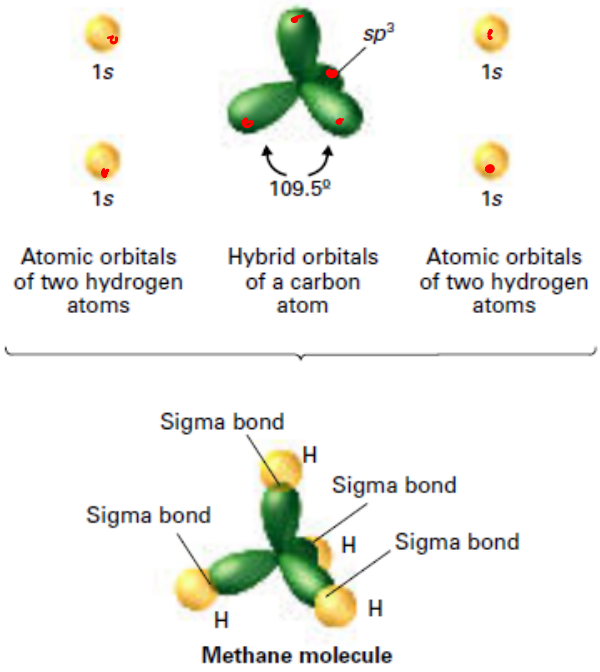
Hybridization Involving Single Bonds

In **hybridization**, atomic orbitals 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.



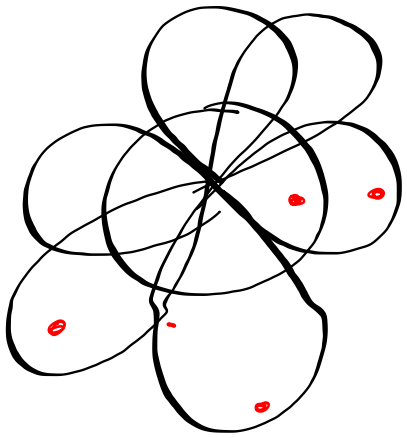
CH_4

$2p$ ↑ ↑ ↑

$2s$ ↑

$1s$ ↑↓

C → 6



A.O.

$S + p_x + p_y + p_z \rightarrow$

M.O.

$sp^3 + sp^3 + sp^3 + sp^3$

σ

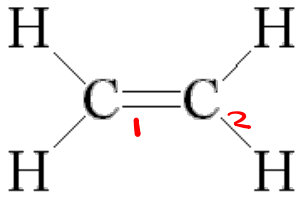
$S + p_x + p_z \longrightarrow \underbrace{sp^2 + sp^2 + sp^2}_{\sigma}$

p_y $\qquad$ $p_y \longrightarrow \pi$

↖ "leftover"

Hybridization Involving Double Bonds

Ex. C_2H_4

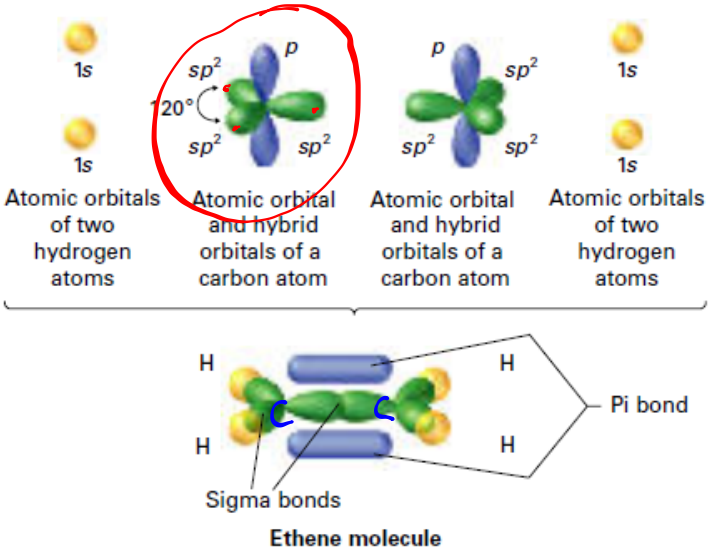


The one *2s* orbital and two *2p* orbitals of each carbon atom mix to form three sp^2 hybrid orbitals.

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.



Ethene molecule

Hybridization Involving Triple Bonds

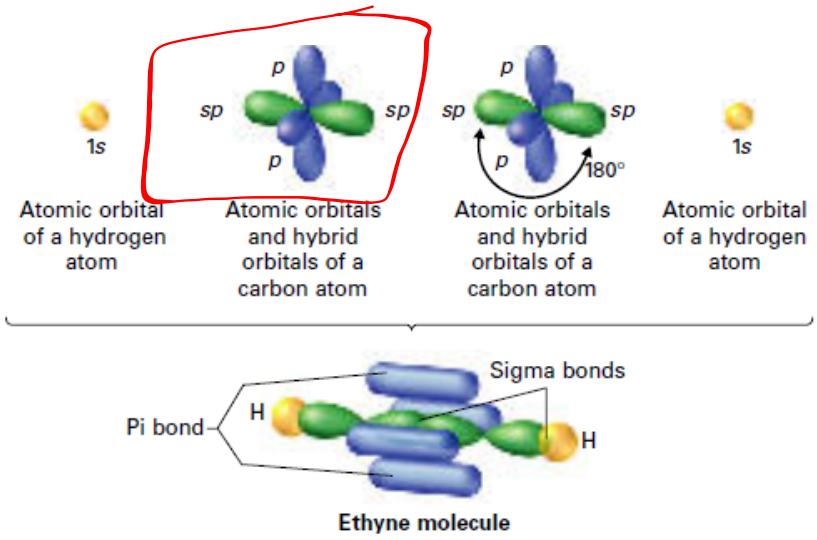
Ex. C_2H_2

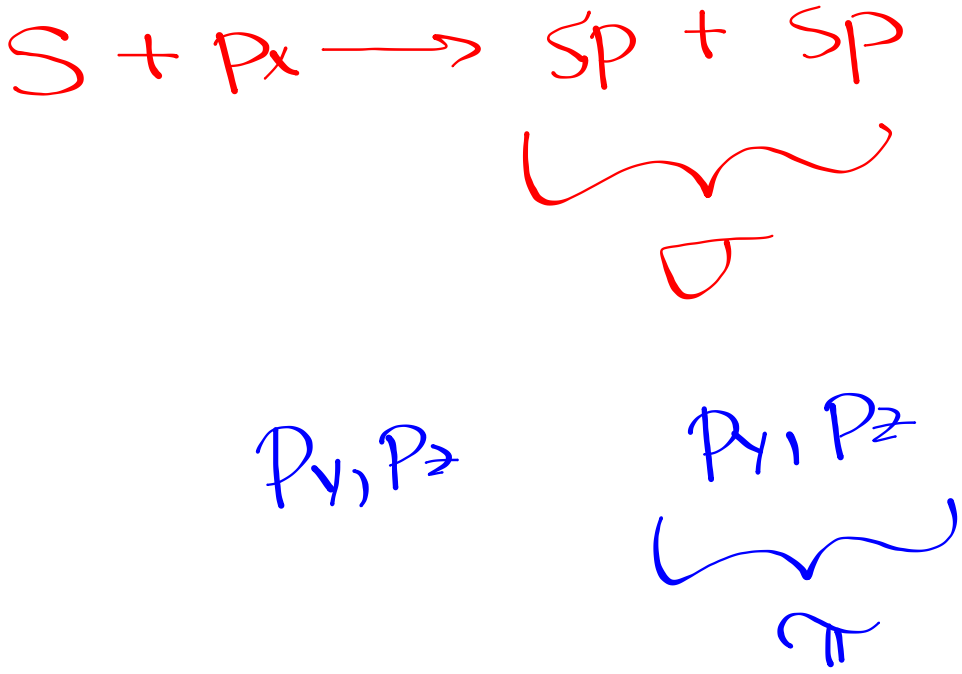
The one *2s* orbital and one *2p* orbitals of each carbon atom mix to form two *sp* hybrid orbitals for each carbon.

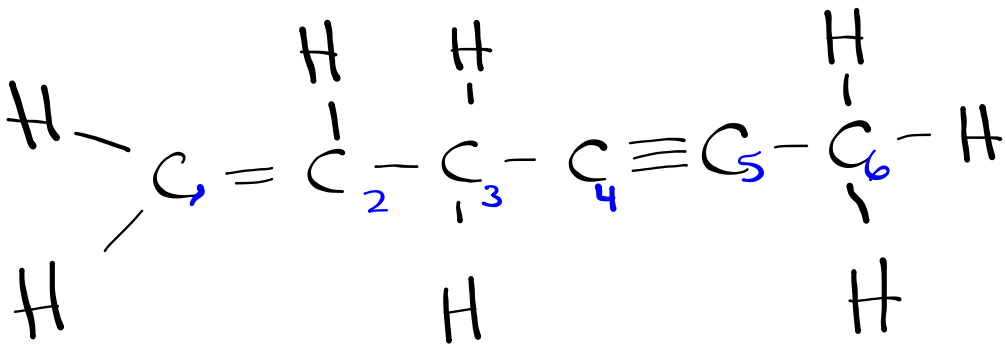
One of the *sp* orbitals overlap with the *1s* hydrogen orbital to form carbon-hydrogen sigma bonds.

The second *sp* orbital overlaps with the *sp* orbital from the other carbon to form a carbon-carbon sigma bond.

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




S + Px → Sp + Sp
σ
Py, Pz
Py, Pz
π



	C_1	C_2	C_3	C_4	C_5	C_6
Hybrid	sp^2	sp^2	sp^3	sp	sp	sp^3
σ/π	3/1	3/1	4/0	2/2	2/2	4/0
Shape	trig. planar	trig. planar	tetrahedral	linear	linear	tetrahedral

$C_1 \rightarrow s + p_x + p_y \rightarrow sp^2 + sp^2 + sp^2$

$C_2 \rightarrow s + p_x + p_y \rightarrow sp^2 + sp^2 + sp^2$

$C_3 \rightarrow s + p_x + p_y + p_z \rightarrow sp^3 + sp^3 + sp^3 + sp^3$

$C_4 \rightarrow s + p_x \rightarrow sp + sp$

Homework

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