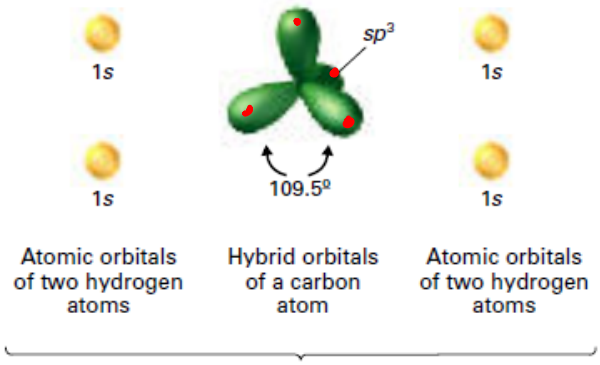
Hybridization Involving Single Bonds

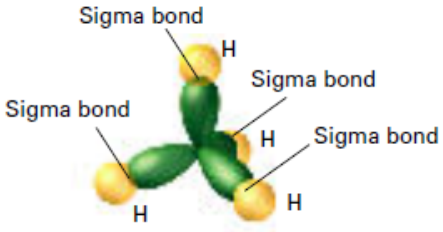
In **hybridization**, atomic orbitals mix to form the same total number of equivalent hybrid orbitals.

Ex. CH_4

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

C





Methane molecule

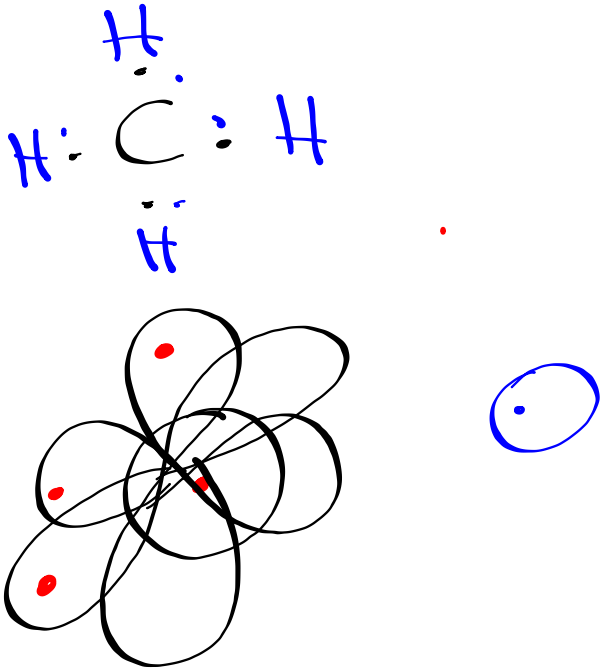
CH_4

$2p$ ↑ ↑ ↑

$2s$ ↑

$1s$ ↑↓

C



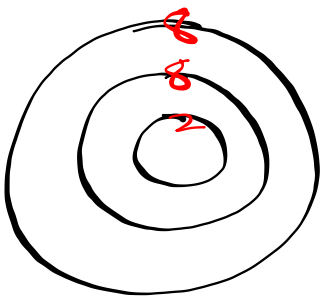
A.O.

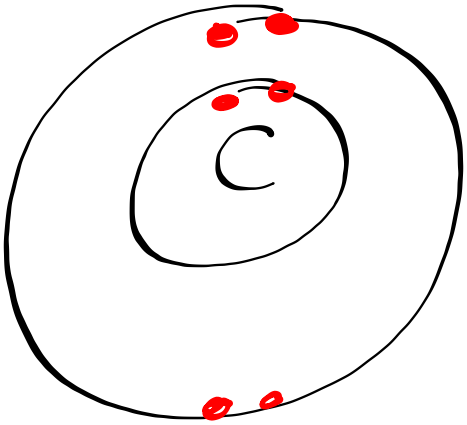
$S + p_x + p_y + p_z \longrightarrow$

M.O.

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

4σ





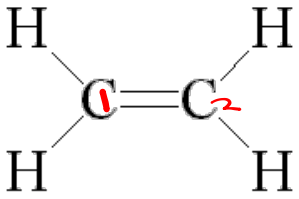
C → 6

$6p^+$

$6e^-$

Hybridization Involving Double Bonds

Ex. C_2H_4

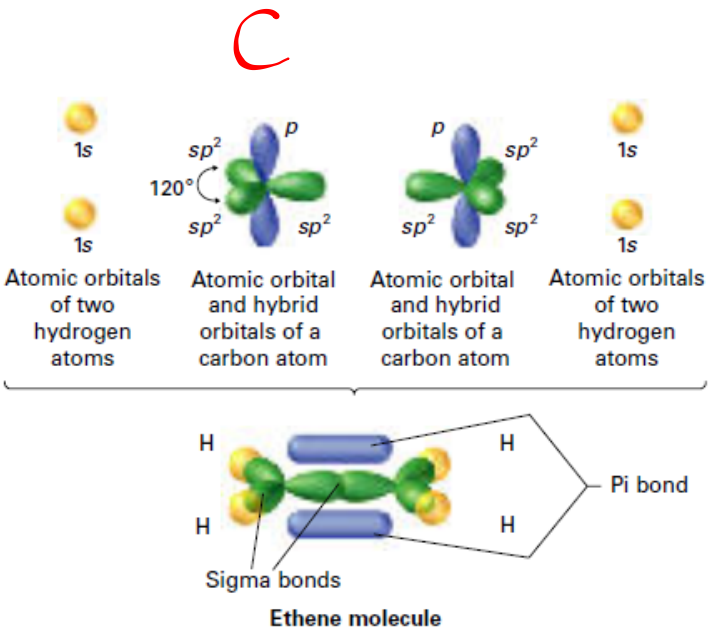


The one *2s* orbital and two *2p* orbitals of each carbon atom mix to form three sp^2 hybrid orbitals.

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.

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

3σ

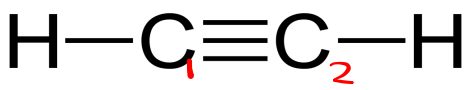
p_y p_y

$\downarrow$

π

Hybridization Involving Triple Bonds

Ex. C_2H_2



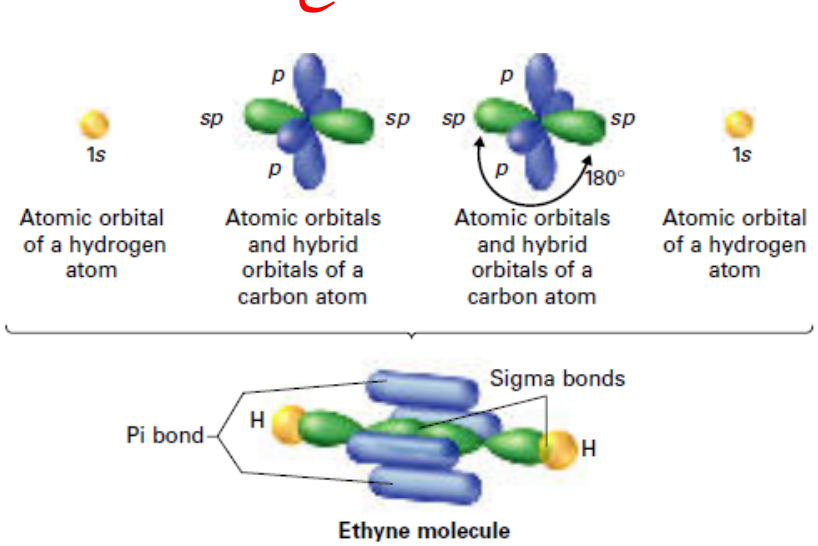
The one *2s* orbital and one *2p* orbitals of each carbon atom mix to form two *sp* hybrid orbitals for each carbon.

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.

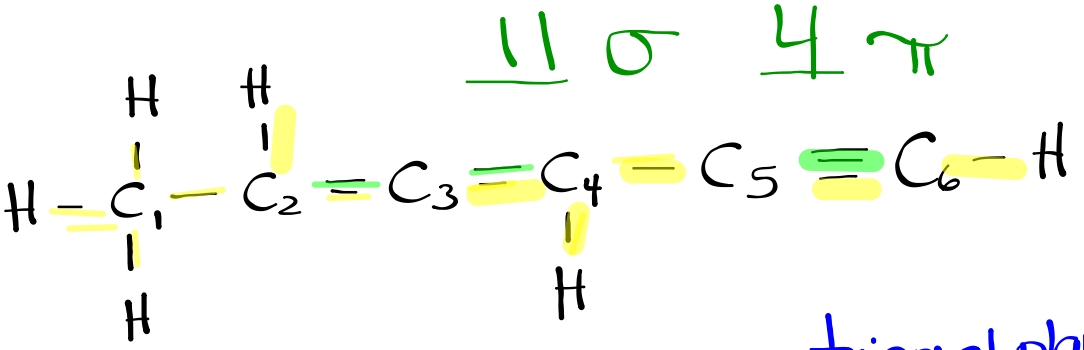
C



$S + p_x \longrightarrow \underbrace{Sp + Sp}_{2\sigma}$

p_y, p_z $\underbrace{p_y, p_z}_{2\pi}$

Determine the type of hybrid orbitals used for each of the following carbons atoms.



$C_1 \rightarrow sp^3$ tetrahedral

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

$C_2 \rightarrow sp^2$ trigonal planar

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

$C_3 \rightarrow sp$ linear

$s + p_x \rightarrow sp + sp$

$C_4 \rightarrow sp^2$ trigonal planar

$s + p_x + p_z \rightarrow$

$C_5 \rightarrow sp$ linear

$s + p_y \rightarrow sp + sp$

$C_6 \rightarrow sp$ linear

$s + p_z \rightarrow sp + sp$

Homework

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