

Hybridization of Orbitals

Hybrid orbitals –

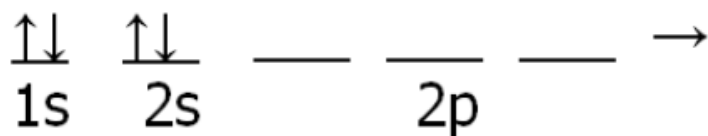
new orbitals formed from orbitals that mixed

have different shape from the original orbital

of hybrid orbitals on an atom =
atomic orbitals mixed

Types of hybridization:

1. sp hybridization:



uses 1 s and 1 p orbital (2 effective pairs of electrons)

has 2 sigma bonds and 2 pi bonds

has linear arrangement

example CO₂

electrons centered between the bonded atoms are called a σ (sigma) bonds

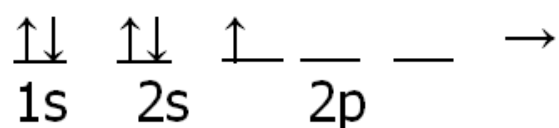
A sigma bond is basically a single bond.

π (pi) bonds are made up of electrons which are shared between 2 parallel p-orbitals

A double bond is basically one sigma bond and one pi bond.

A triple bond is one sigma bond and 2 pi bonds.

2. sp^2 hybridization:



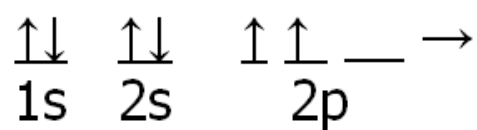
uses 1 s and 2 p orbitals (uses 3 effective pairs of electrons)

has 3 sigma bonds and 1 pi bond

has trigonal planar shape

example C_2H_4

3. sp^3 hybridization



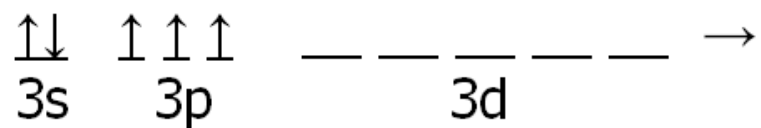
uses 1 s and 3 p orbitals (uses 4 effective pairs of electrons)

has 4 sigma bonds

has tetrahedral shape

example CH₄

4. sp³d hybridization



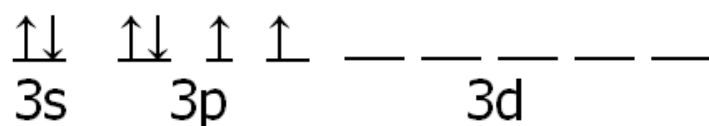
involves 1 d orbital, 1 s orbital,
and 3 orbitals (5 effective pairs
of electrons)

has 5 sigma bonds

has trigonal bipyramidal shape

example PCl_5

5. sp^3d^2 hybridization



Involves 2 d orbitals, 3 p orbitals, and 1 s orbital (6 effective pairs of electrons)

Has 6 sigma bonds

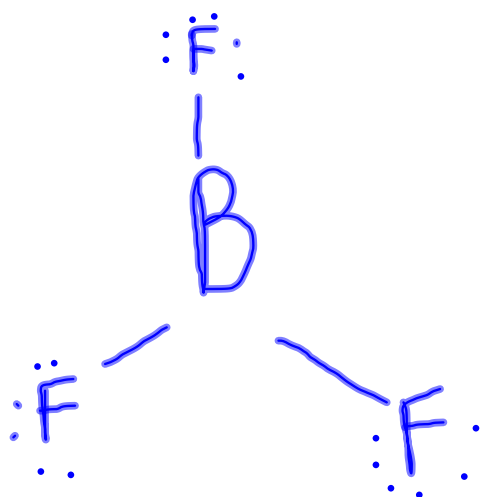
Has octahedral shape

Example: SF₆

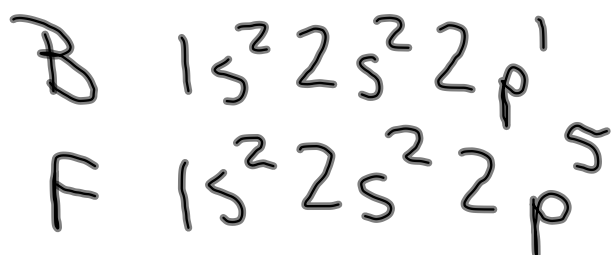
Why can't carbon undergo sp³d and sp³d² hybridization, while phosphorous and sulfur can?

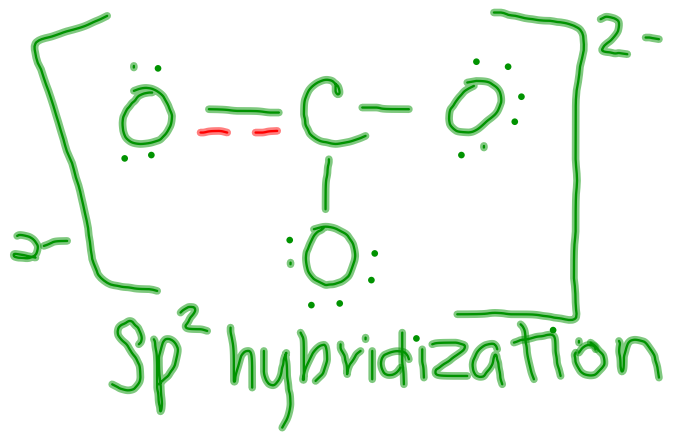
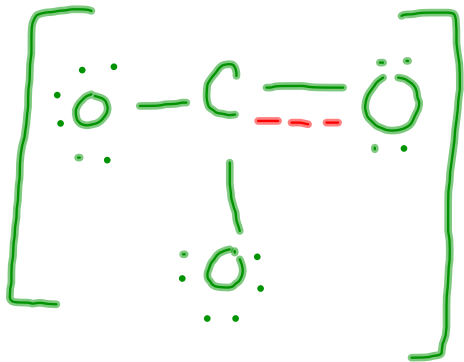
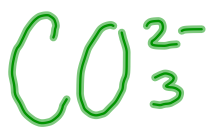
Class Examples: For each of the following draw the Lewis structure and give the expected hybrid orbitals and the number of sigma bonds and pi bonds.

BF_3 , CO_3^{2-} , TeF_4 , N_2 , C_2H_2



- sp^2 hybridization
 - 3 sigma \uparrow single, pi bond \uparrow double





3 hybrid orbitals
3 sigma bonds &
1 pi bond

