

Hybridization of Orbitals

Hybrid orbitals –

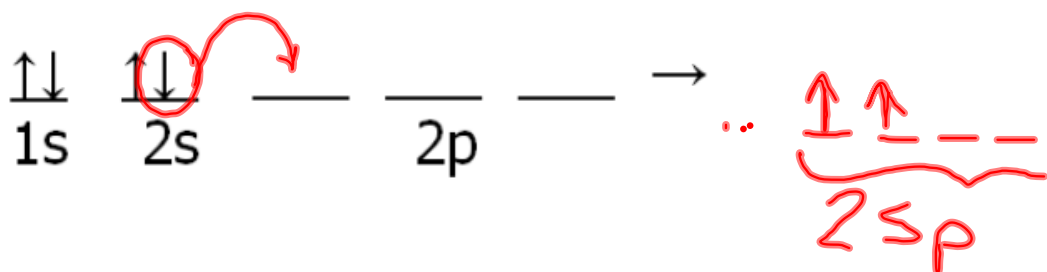
new orbitals formed from orbitals that mixed

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

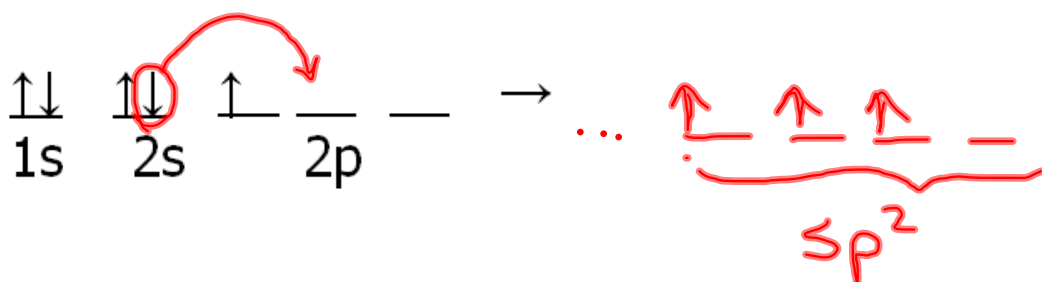
✗ A sigma bond is basically a single bond.

✗ 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:



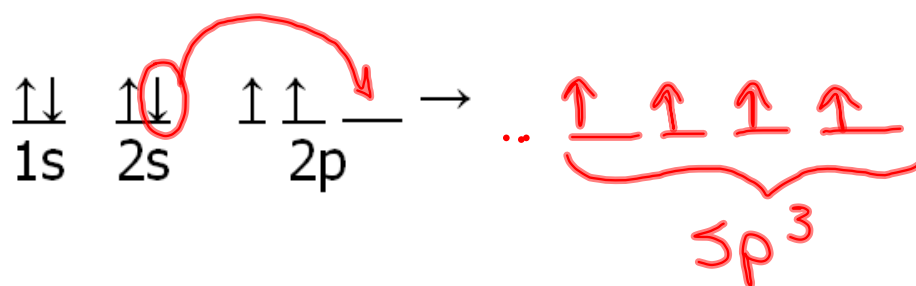
uses 1 s and 2 p orbitals (uses 3 effective pairs of electrons)

* has 3 sigma bonds and 1 pi bond

has trigonal planar shape

example C₂H₄

3. sp³ hybridization



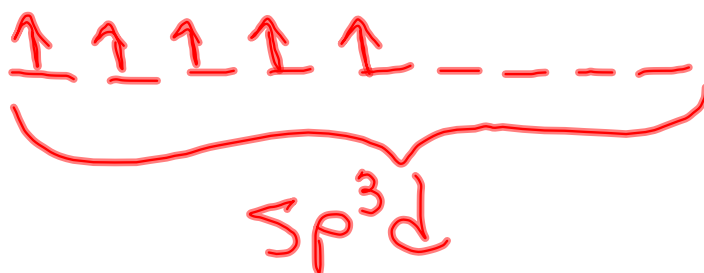
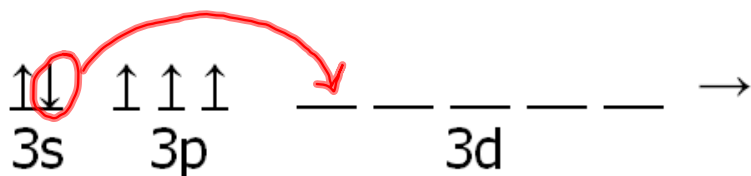
uses 1 s and 3 p orbitals (uses 4 effective pairs of electrons)

* has 4 sigma bonds

has tetrahedral shape

example CH₄

4. sp³d hybridization



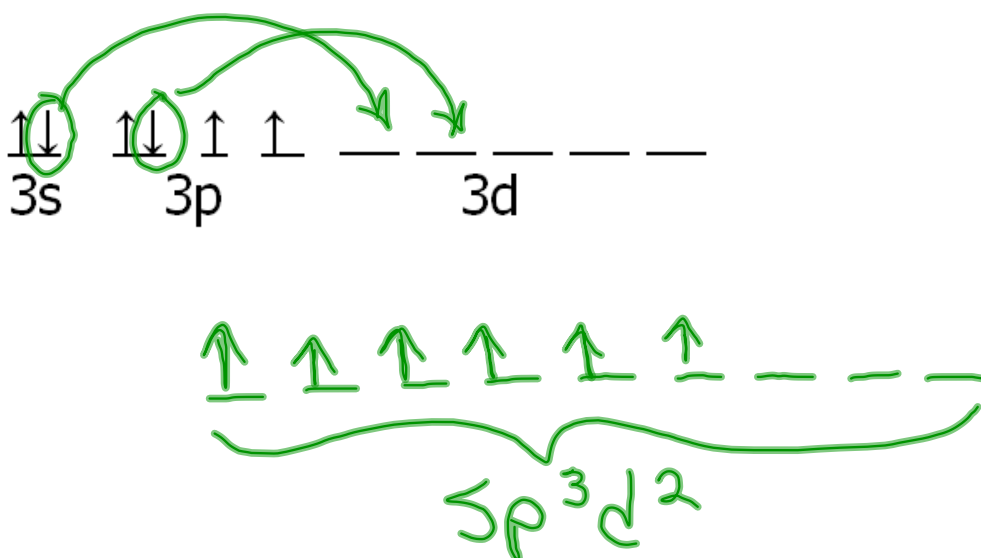
involves 1 d orbital, 1 s orbital,
and 3 orbitals (5 effective pairs
of electrons)

* 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.

