

Molecular Orbitals

Molecular orbitals are formed when the atomic orbitals of two (or more) different atoms are joined together. The orbitals are then spread across all of the atoms that contributed the atomic orbitals.

The same number of molecular orbitals are formed as there were atomic orbitals joined together, and their net energy is the same.

Bonding molecular orbitals

- have electron density between the atom
- are lower in energy than the original atomic orbitals
- when these orbitals are occupied by electrons, it holds the atoms together, forming a bond

Nonbonding molecular orbitals

- may occur when three or more atomic orbitals are combined
- have the same energy as the original atomic orbitals
- electrons occupying these orbitals do not stabilize or destabilize the molecule

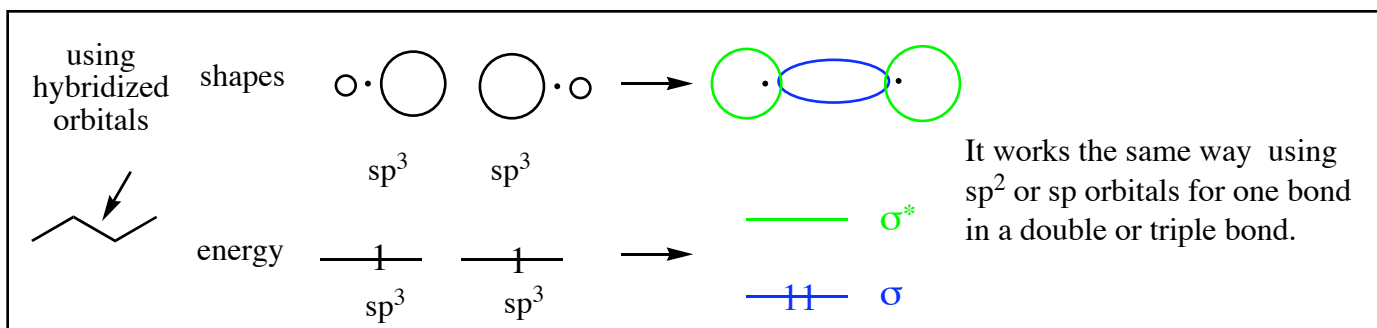
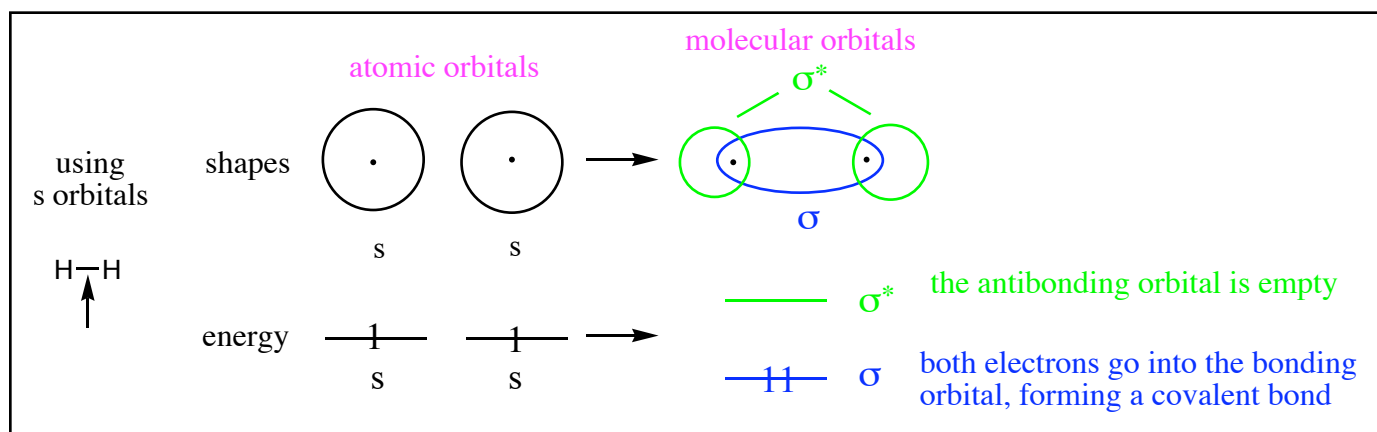
Antibonding molecular orbitals

- have electron density which is not between the atoms (there is a node between the atoms)
- are higher in energy than the original atomic orbitals
- if these orbitals are occupied by electrons, it pulls the atoms away from each other and weakens or prevents bonding

Sigma orbitals (σ) are formed when s, sp^3 , sp^2 , or sp orbitals are combined. A sigma bonding orbital and a sigma antibonding orbital are formed. They are radially symmetric (the same all the way around).

Single bonds are always sigma bonds.

One of the bonds in a double or triple bond is always a sigma bond.



Pi orbitals (π) are formed when p orbitals are combined. A pi bond orbital and a pi antibonding orbital are formed; if an odd number of orbitals are combined, a nonbonding orbital may also be formed. Pi orbitals are not radially symmetric (not the same all the way around).

