

Sigma and Pi

Friday, 1 March 2024 2:42 pm

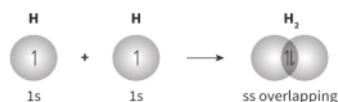
How does the orbitals produce bond angles?

Sigma bonds

Electrons are found in orbitals, when orbitals are filled with maximum number of electrons, the octet rule has been fulfilled and atoms are stable, and when it is empty, it gains or loses electrons (ionic bond) or it will share electrons so it can fulfil the octet rule.

When the different orbitals in an atom when the electrons they contain form a pair

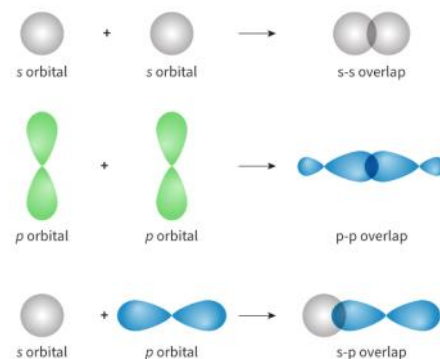
Single bond forms between s-orbitals



Bonds of atoms form when two orbitals overlap (When orbitals merge each other, covalent bond forms)

Sigma bond forms when orbital overlap is a head-on overlap

- Electrons are likely to be found in that overlapping shared space
- Single bonds that atoms form are always sigma bonds
- Represented in σ
- Head-on overlap includes axial overlap or end-to-end overlap
- Can be formed from the head-on overlap of s-s, s-p, p-p



Orbitals: where an electron is most likely to be found

Area of overlap: indicates the area where the probability of finding an electron is highest.

Pi bond

For double and triple bond molecules

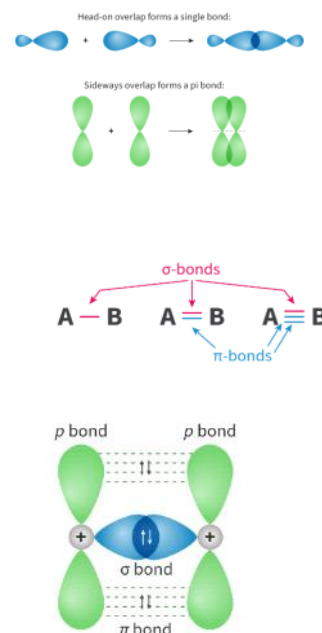
- The electron pair forming the double/triple bond can not lie in the same axial plane as the electron pair forming the sigma bond as they would repel each other: they must lie somewhere else between the two atoms.
- Only p-orbitals are used to form more bonds while keeping sigma bond
 - o Due to the shape of overlapping

Pi bond - if the orbital overlap is a sideways or lateral overlap

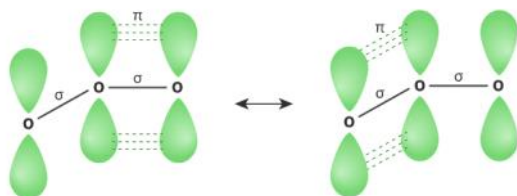
Pi bond found in double and triple bonds and have their electron density concentrated above and below the bond axis

Double bond is stronger than single bond, because single bond has sigma bond, and double bond has sigma bond and pi bond - pi bond is weaker than sigma bond in double bond

- Sigma bond has a stronger attraction between the electron pair and positive nuclei as there is only one electron = dense region on the inter-nuclear axis, located close to the nuclei
- Pi bond, the electron density is spread across two regions (above and below the inter-nuclear axis, and is found further from the positive charge of nucleus)



The pi bond in resonance



Bond form due to the overlap of orbital