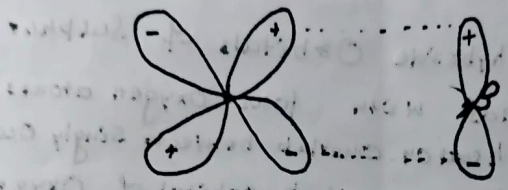
Formation of dπ - pπ bonds

The multiple bonding, those involving d-orbital plays important role in the chemistry of metals and non-metals.

There may be sideways overlap between d-orbital of one atom and p orbital of the other resulting in the formation of dπ - pπ bond

The $d_{x^2-y^2}$ and d_{z^2} orbitals take part in such overlaps as they may have more π - interactions than the other d-orbitals.



d-Orbital dπ-pπ Bond P-Orbital

On moving from left to right in any Period of Periodic Table, (Modern), the effective nuclear charge increases. This result- in the contraction of diffused 'd' orbitals and stronger π - overlap.

Si < P < S < Cl

Increasing ability to form dπ - pπ bond.

As we know that the formation of dπ - pπ bond occurs due to lateral overlapping between d-orbital of the central atom and p orbital of the terminal atom of a molecule take part, which result in the formation of dπ - pπ bond.

Most of the tetrahedral species like ClO_4^- SO_4^{2-} and PO_4^{3-} have dπ - pπ bonds.

Also in a multiple bonded molecule if sum of bond pair and lone pair is equal to 4, 5, or 6 the bond will be dπ - pπ bond. In such cases the central atom use its all 'p'- orbital for hybridisation and then only 'd' orbital available to overlap with p-orbital of the adjacent atom to provide dπ - pπ bond.

Example :- In SO_4^{2-}, the sulphur atom is in sp^3 hybridise state.

S → [Ne] $3s^2 3p^4 3d^0$ (In ground state)

'S' atom in excited state.

16 S → [Ne] ↑↓ | ↑ | ↑ | ↑ | ↑ | (3s, 3p, 3d)

sp^3 hybridisation → sp^3

Next atom Oxygen

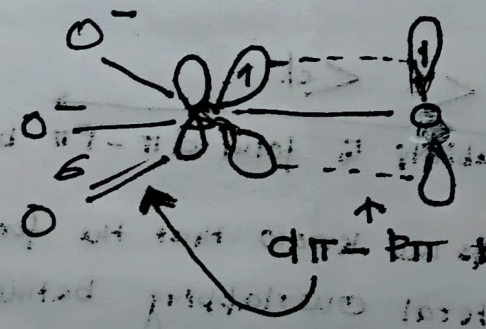
$_{8}O \rightarrow 1s^2\ 2s^2\ 2p^4$

$\rightarrow [He]\ 2s^2\ 2p^4$

[He] ↑↓ (2s) ↑↓ ↑ ↑ (2p)

The four sp^3 - hybrid Orbitals of Sulphur forms 6 bonds with four Oxygen atoms as a result of head on overlap between singly occupied sp^3 - orbital of Sulphur and p-orbital of Oxygen.

Now, the two singly occupied d-orbitals of Sulphur undergo Sideway overlap with singly occupied p-orbitals of two of the Oxygen atoms forming $d\pi - p\pi$ bond.



$d\pi - p\pi$ bonds are also present in ClO_4^-, PO_4^{3-}, $R_2S{=}O$, H_3PO_4, H_3PO_3 etc.