4.6.1. Types of hybridisation

There are many types of hybridisations. The three major types of hybridisation are sp^3, sp^2 and sp. The process of mixing up of one 's' orbital and three 'p' orbitals to get four orbitals of equivalent energy, which are directed to the four corners of a regular tetrahedron is called sp^3 hybridisation. The process of mixing up of one 's' orbital with two 'p' orbital to form three equivalent orbitals which are coplanar is called sp^2 hybrid orbitals. The bond angle is 120^0. The process of mixing up of one 's' orbital and one p orbital to get two orbitals of same energy which are directed along a line is called sp hybridisation. The bond angle is 180^0.

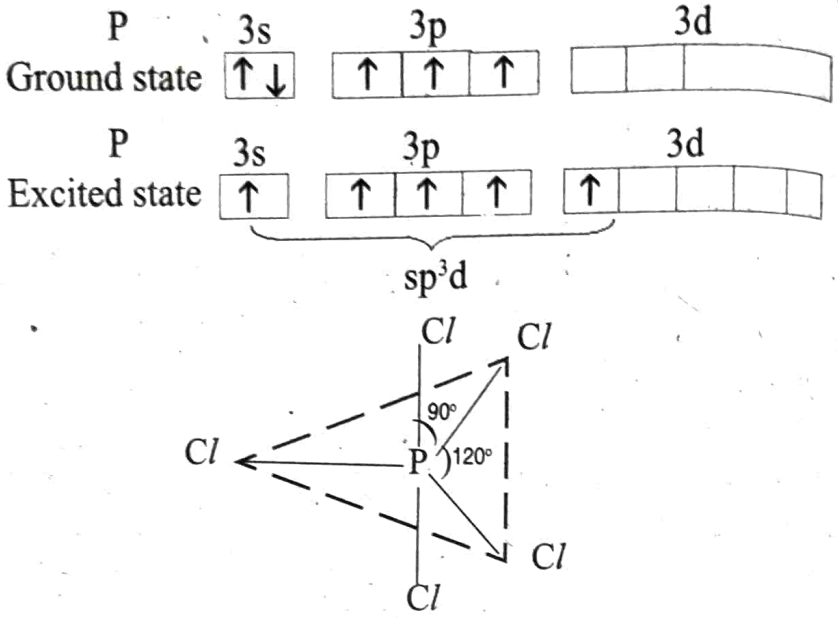
4.6.2. Other examples of sp^3, sp^2 and sp hybridisation

- **sp^3 Hybridisation in C_2H_6 molecule:** In ethane molecule both the carbon atoms assume sp_3 hybrid state. One of the four sp_3 hybrid orbitals of carbon atom overlaps axially with similar orbitals of other atom to form sp^3-sp^3 sigma bond while the other three hybrid orbitals of each carbon atom are usedin forming sp^3–s sigma bonds with hydrogen atoms.
- **sp^2 Hybridisation in C_2H_4:** In the formation of ethene molecule, one of the sp^2 hybrid orbitals of carbon atom overlaps axially with sp^2 hybridised orbital of another carbon atom to form C–C sigma bond.
- **sp Hybridisation in C_2H_2 :** In the formation of ethyne molecule, both the carbon atoms undergo sp-hybridisation having two unhybridised orbital i.e., $2p_y$ and $2p_x$.

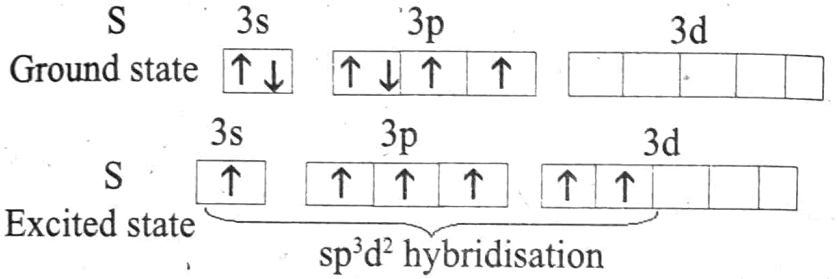
4.6.3. Hybridisation of elements involving d-orbitals

sp^3d hybridisation: In PCl_5, the hybridisation of P is sp^3d. It involves the intermixing of one s - orbital,

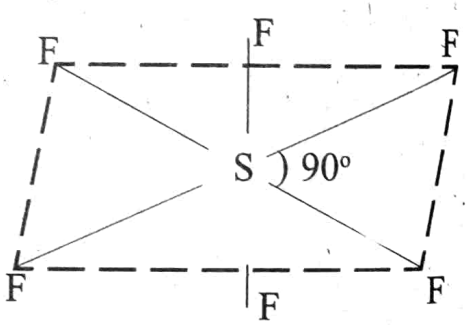
three p - orbitals and one d - orbital to form five hybridised orbitals of equal energy and identical shape. These five hybrid orbitals will overlap with the half filled 3p orbitals of five chlorine atoms. Thus, the shape of PCl_5 is trigonal bipyramidal.



sp^3d^2 hybridisation: Sulphur in SF_6 exhibits sp^3d^2 hybridisation. The electronic configuration of sulphur is,



This hybridisation involves the mixing of one s- orbital, three p- orbitals, and two d - orbitals to form six hybridised orbitals, directed towards the six corners of an octahedron.



dsp^2 and d^2sp^3 hybridisation: In the case of dsp^2 hybridisation there is the intermixing of one s-orbital, two p -orbitals and one d -orbital of the inner shell to form four hybridised orbitals having equal energy and identical shape. These hybridised orbitals are directed to the corners of a square. e.g. $[Ni(CN)_4]^{2-}$ d^2sp^3 hybridisation involves the intermixing of two d-orbitals in the inner shell, one s-orbital and three p-orbitals to give six hybridised orbitals of equal energy and identical shape, directed towards the corners of a regular octahedron. These vacant hybridised orbitals will overlap with the filled orbitals of NH_3 in $[Co(NH_3)_6]^{3+}$.

4.7. Molecular Orbital Theory

MO theory was put forward by Hund and Mulliken. The main postulates are as follows.

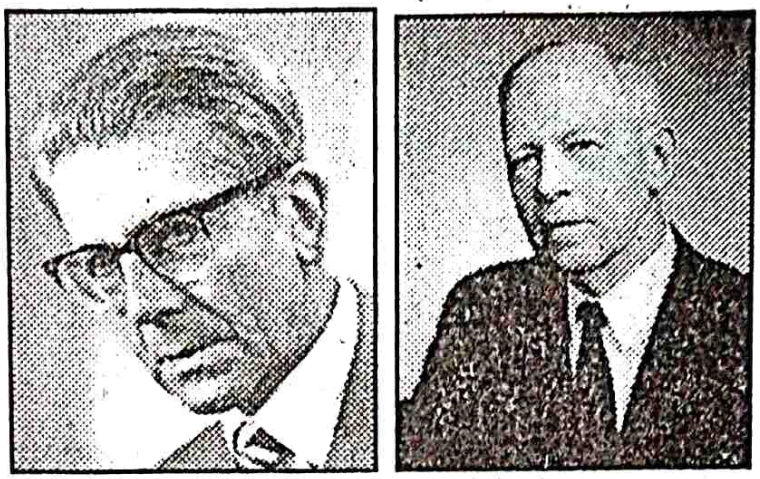
(i) In molecules, the electrons are present in a special type of orbitals called molecular orbitals.

(ii) Molecular orbitals are formed by the combination of atomic orbitals of nearly same energy and proper symmetry.

(iii) Molecular orbitals are associated with the nuclei of all the atoms in the molecule.

(iv) The number of molecular orbitals formed is equal to the number of combining atomic orbitals.

(v) The molecular orbitals are also filled in accordance with Pauli's exclusion principle, Hund's rule and Aufbau principle.



Hund and Mulliken proposed the molecular orbital theory