

HYBRIDISATION:

Formation of single molecules could be explained adequately by overlap of atomic orbitals

but formation of molecules of carbon present problems of greater magnitude, having no solution with earlier theory. To explain fully the tendency of these atoms to form bond and the shape or geometry of the molecules a new concept called "hybridisation" is introduced. It may be defined as "the process of mixing of different orbitals of the same atom, having same or nearly same energy to give equivalent orbital is called hybridisation". The new equivalent orbitals thus formed are called hybrid orbitals.

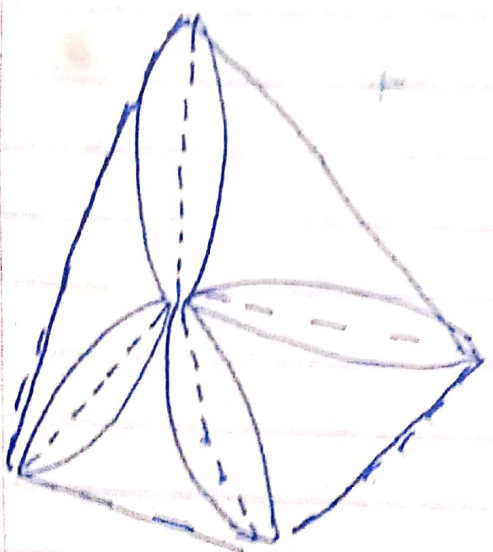
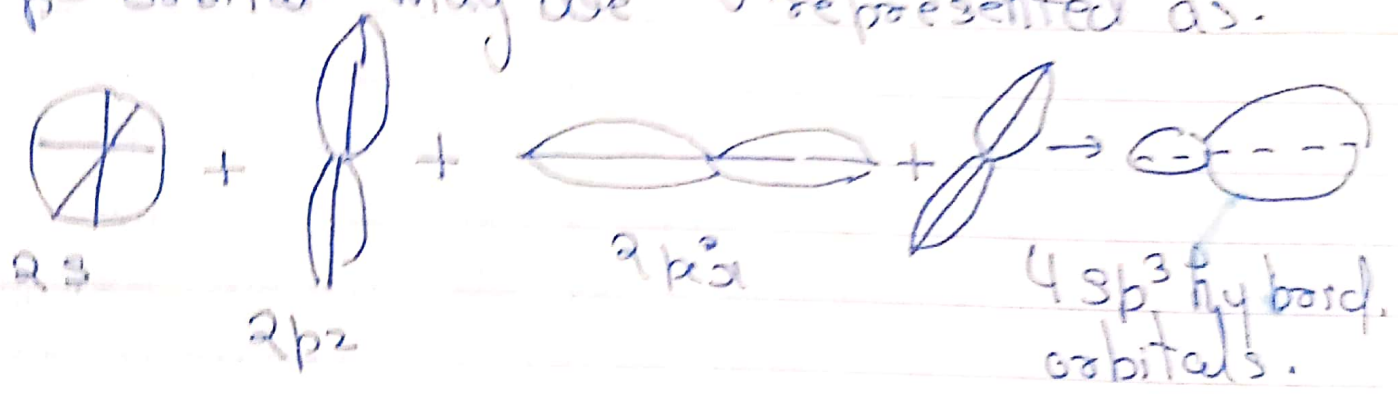
Types of hybridisation:-

The types of hybridisation depend upon the number and nature of the orbitals undergoing hybridisation. The different types of hybridisation are:-

- (a) sp^3 hybridisation.
- (b) sp^2 hybridisation.
- (c) sp hybridisation.

(a) sp^3 hybridisation: When one s and three orbitals of the same atom mix together four equivalent sp^3 hybrid orbitals are formed. The phenomenon of formation of four equivalent sp^3 hybrid orbitals are called sp^3 hybridisation. Since mixing of orbital takes place in space four hybrid

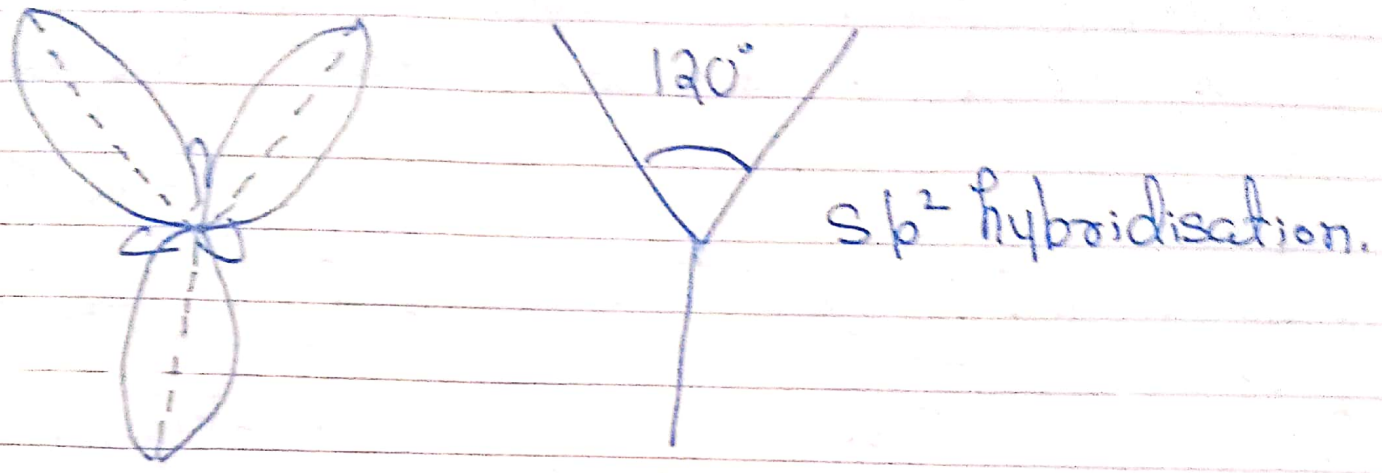
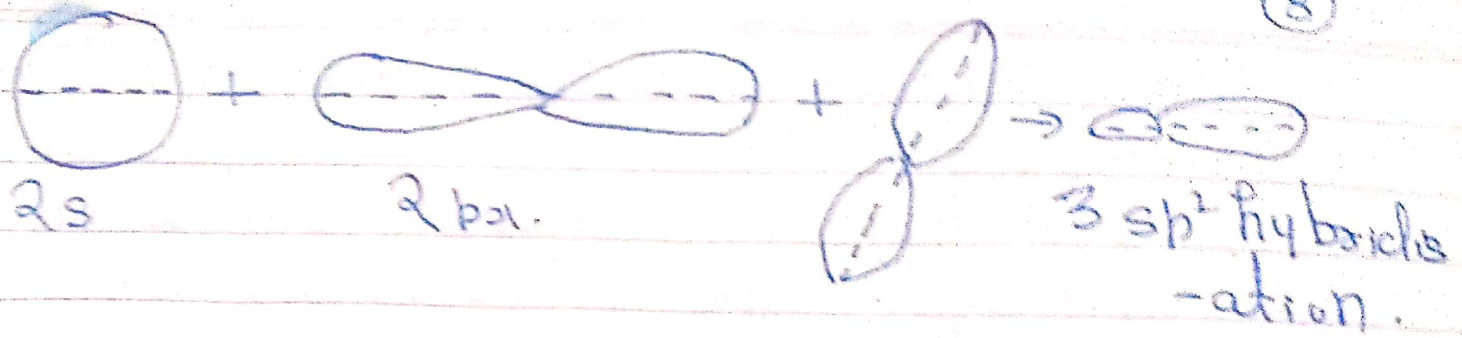
orbitals, could also be in space. An arrangement in space, that keeps them, farthest apart is that of a tetrahedron. The bond angle is found to be $109^\circ 28'$. Each sp^3 hybrid orbital has $\frac{1}{4}$ s character and $\frac{3}{4}$ p character. This type of hybridisation, occurs in saturated compounds, of carbon. Overlap of these hybrid orbital with sp^3 of other hybrid orbitals along the nucleus axis results in the formation of σ bonds. The mixing of one s and three p orbitals may be represented as.



4 sp^3 hybrid orbitals.
(Tetrahedral)

(b) sp^2 hybridisation. When one s and two p.

orbitals of the same atom mix up, three sp^2 hybrid orbitals are formed and phenomenon is called sp^2 hybridisation. As the three orbitals undergo hybridisation, lie in a plane. So do new orbitals. They have to lie farthest apart as they are directed at an angle of 120° a plane which can happen if they are directed at an angle of 120° to one another. It is for this that sp^2 hybrid orbitals are called trigonal hybrid and process is called trigonal hybridisation. Each sp^2 hybrid orbital possess $\frac{1}{3}$ s character and $\frac{2}{3}$ p character. At each of three sp^2 hybridised carbon, there is still an unhybridised half-filled p-orbital. sp^2 hybrid orbital by head on, in plane overlap form σ -bonds whereas unhybridised (half-filled) p-orbitals at each sp^2 hybridised carbon can only combine by side wise overlap and therefore forms a bond different from σ -bond which is known as π bond. Compounds having double bonds in the molecules usually have sp^2 hybridised carbon atom e.g. ethylene, benzene, etc. The mixing of one s-orbital and two p-orbitals may be represented as:-



ei. s - p hybridisation. lead to dsp² hybrid.

The mixing of one s and one p orbital lead to dsp² hybrid orbitals known as s-p hybrid orbitals. The process is called sp hybridisation. Orbitals thus generated are the steps of electrons which have a tendency to repel and be farther apart. In order to do so, the new orbitals arrange themselves along a line linear and must have an angle of 180°. Each sp hybrid orbital has 50% s-character and 50% p-character. The sp hybrid orbital by co-axial overlapping with sp as other hybrid orbitals.

(9)

σ bond. At each of the sp -hybridised carbon atom, there are still two unhybridised unhybridised carbon p orbitals which may only overlap side wise giving two π bonds. This type of hybridisation is usually in compounds having triple bond like acetylene.

The mixing of one s and p orbital may be represented as:-

