

AX_5	Square planar	Zero	XeF_4
	See saw	Non zero	$SF_4, TeCl_4$
	Trigonal bipyramidal	Zero	PCl_5
AX_6	Square pyramidal	Non zero	$BrCl_5$
	Octahedral	Zero	SF_6
AX_7	Distorted octahedral	Non zero	XeF_6
	Pentagonal bipyramidal	Zero	IF_7

(2) Every ionic compound having some percentage of covalent character according to Fajan's rule. The percentage of ionic character in compound having some covalent character can be calculated by the following equation.

$$\text{The \% ionic character} = \frac{\text{Observed } \mu}{\text{Theoretical } \mu} \times 100.$$

(3) The trans isomer usually possesses either zero dipole moment or very low value in comparison to *cis*-form



Fajan's rule

The magnitude of polarization or increased covalent character depends upon a number of factors. These factors are,

(1) **Small size of cation** : Smaller size of cation greater is its polarizing power i.e. greater will be the covalent nature of the bond.

(2) **Large size of anion** : Larger the size of anion greater is its polarizing power i.e. greater will be the covalent nature of the bond.

(3) **Large charge on either of the two ions** : As the charge on the ion increases, the electrostatic attraction of the cation for the outer electrons of the anion also increases with the result its ability for forming the covalent bond increases.

(4) **Electronic configuration of the cation** : For the two ions of the same size and charge, one with a pseudo noble gas configuration (i.e. 18 electrons in the outermost shell) will be more polarizing than a cation with noble gas configuration (i.e. 8 electrons in outer most shell).

Valence bond theory or VBT

It was developed by Heitler and London in 1927 and modified by Pauling and Slater in 1931.

(1) To form a covalent bond, two atoms must come close to each other so that orbitals of one overlaps with the other.

(2) Orbitals having unpaired electrons of anti spin overlaps with each other.

(3) After overlapping a new localized bond orbital is formed which has maximum probability of finding electrons.

(4) Covalent bond is formed due to electrostatic attraction between radii and the accumulated electrons cloud and by attraction between spins of anti spin electrons.

(5) Greater is the overlapping, lesser will be the bond length, more will be attraction and more will be bond energy and the stability of bond will also be high.

(6) The extent of overlapping depends upon: Nature of orbitals involved in overlapping, and nature of overlapping.

(7) More closer the valence shells are to the nucleus, more will be the overlapping and the bond energy will also be high.

(8) Between two sub shells of same energy level, the sub shell more directionally concentrated shows more overlapping. Bond energy : $2s-2s < 2s-2p < 2p-2p$

(9) *s*-orbitals are spherically symmetrical and thus show only head on overlapping. On the other hand, *p*-orbitals are directionally concentrated and thus show either head on overlapping or lateral overlapping. Overlapping of different type gives sigma (σ) and pi (π) bond.

Sigma (σ) bond	Pi (π) bond
It results from the end to end overlapping of two <i>s</i> -orbitals or two <i>p</i> -orbitals or one <i>s</i> and one <i>p</i> -orbital.	It result from the sidewise (lateral) overlapping of two <i>p</i> -orbitals.
Stronger	Less strong
Bond energy 80 <i>kcal</i> s	Bond energy 65 <i>kcal</i> s
More stable	Less stable
Less reactive	More reactive
Can exist independently	Always exist along with a σ -bond
The electron cloud is symmetrical about the internuclear axis.	The electron cloud is above and below the plane of internuclear axis.

Hybridization

The concept of hybridization was introduced by Pauling and Slater. Hybridization is defined as the intermixing of dissimilar orbitals of the same atom but having slightly different energies to form same number of new orbitals of equal energies and identical shapes. The new orbitals so formed are known as hybrid orbitals.

Characteristics of hybridization

(1) Only orbitals of almost similar energies and belonging to the same atom or ion undergoes hybridization.

(2) Hybridization takes place only in orbitals, electrons are not involved in it.

(3) The number of hybrid orbitals produced is equal to the number of pure orbitals, mixed during hybridization.

(4) In the excited state, the number of unpaired electrons must correspond to the oxidation state of the central atom in the molecule.

(5) Both half filled orbitals or fully filled orbitals of equivalent energy can involve in hybridization.

(6) Hybrid orbitals form only sigma bonds.

(7) Orbitals involved in π bond formation do not participate in hybridization.

(8) Hybridization never takes place in an isolated atom but it occurs only at the time of bond formation.

(9) The hybrid orbitals are distributed in space as apart as possible resulting in a definite geometry of molecule.

(10) Hybridized orbitals provide efficient overlapping than overlapping by pure *s*, *p* and *d*-orbitals.

(11) Hybridized orbitals possess lower energy.

How to determine type of hybridization : The structure of any molecule can be predicted on the basis of hybridization which in turn can be known by the following general formulation,

$$H = \frac{1}{2}(V + M - C + A)$$