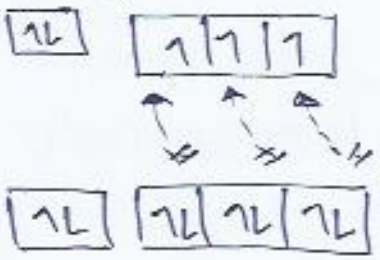
4- Tetrahedral molecule (Pyramidel)

Example: NH_3

$_7N$ $1s^2$ $2s^2$ $2p^3$

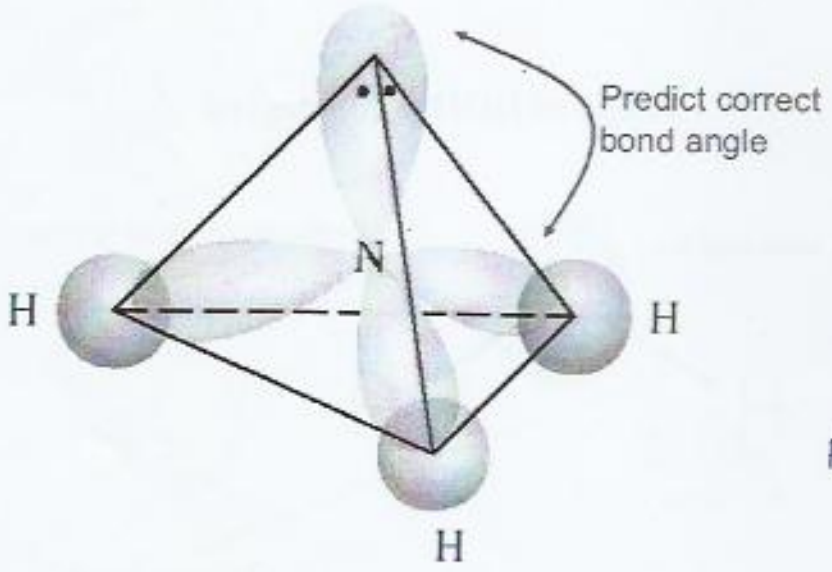


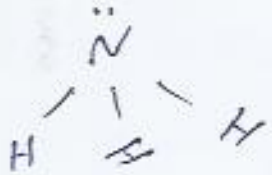
N-atom ground stat

~~N-atom excited stat~~

Hyperdization (sp^3)

Four hybrid orbitals type sp^3 تداخل interfere with three orbitals atoms of three H atoms to formation three covalent bonds type σ and cannot this hybrid orbitals participated for interfere that contain one pair electron, So NH_3 molecule is formed Tetrahedral with angle of 107 degree.





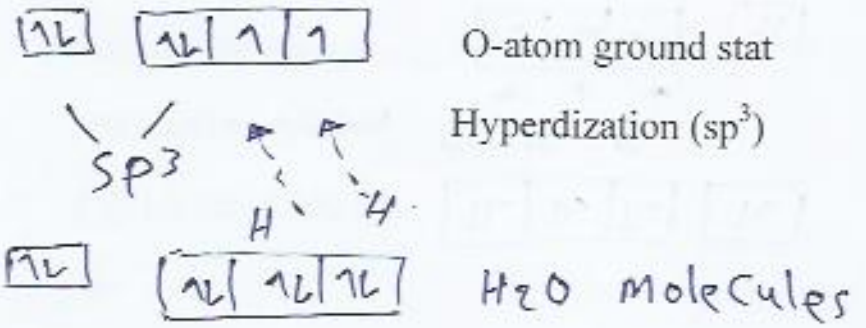
Angle of HNH = 107 degree

5- Tetrahedral molecule (V-Shape)

ملاحظة: NH_3 ، H_2O
لا توجد حالة مثارة

Example: H_2O

$_8O$ $1s^2$ $2s^2$ $2p^4$



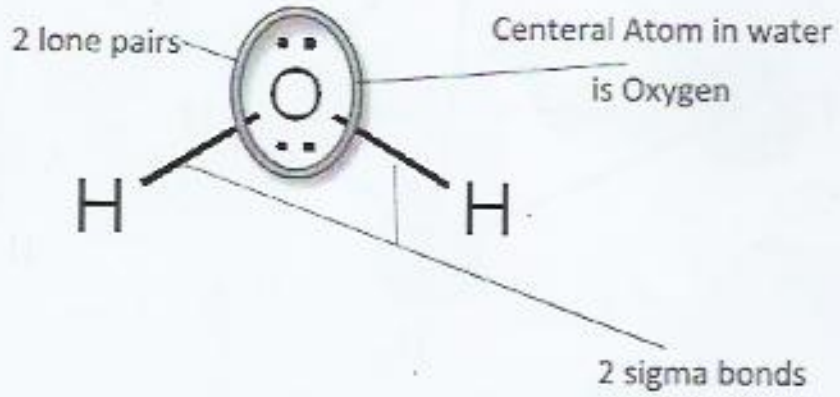
O-atom ground stat

Hyperdization (sp^3)

H_2O Molecules

Four hybrid orbitals type sp^3 interfere with two orbitals atoms of H atoms to formation two covalent bonds type σ and cannot this hybrid orbitals participated for interfere that contain two pair electrons, So H_2O molecule is formed irregular tetrahedral with angle of 105 degree.

Angle of HOH = 105 degree

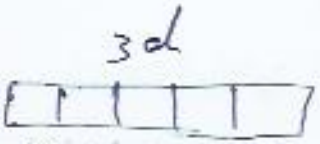


ثنائي الهرم المثلثي

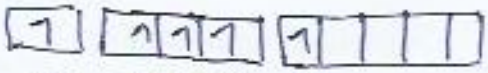
6- Trigonal bipyramid molecule

Example: PCl_5

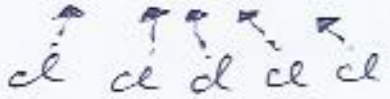
$_{15}P$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3P^3$ $3d$



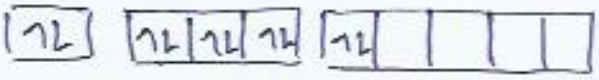
P-atom ground stat



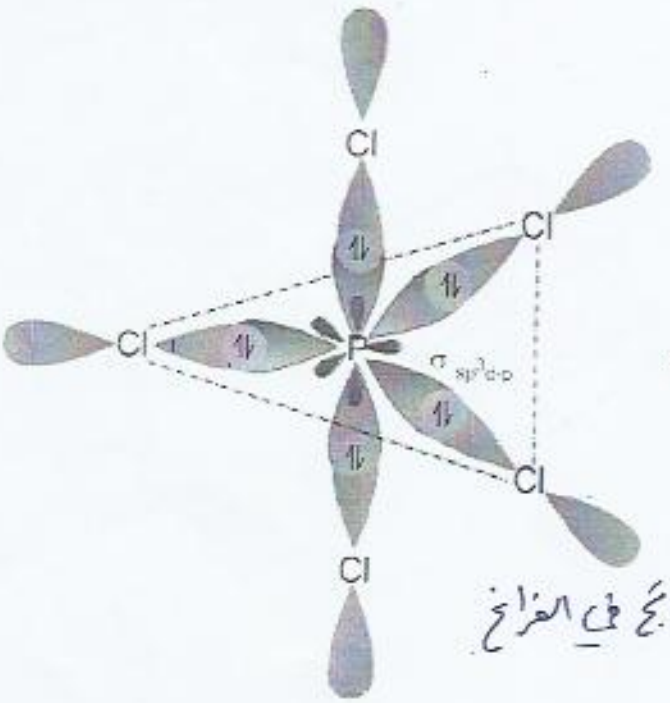
P-atom excited stat

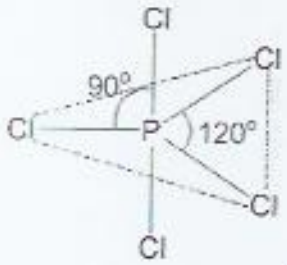


Hyperdization (sp^3d)



Five hybrid orbitals each is half filled overlap with p- orbital of each Cl atom, So PCl_5 molecule is formed Trigonal bipyramid .





٣ زوايا ١٢٥°

زاويتين ٩٥° اشكل الناتج في الفراغ

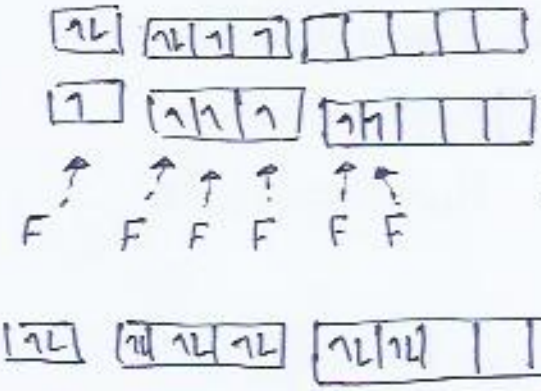
Trigonal bipyramidal structure of PCl_5

Angle = 90 and 120 degree

7- Octahydral molecule

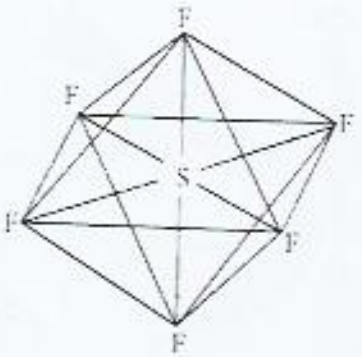
Example: SF_6

$_{16}S$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3P^4$ $3d$.



Octahydral molecule for SF_6

Six hybrid orbitals each is half filled overlap with p- orbital of each F- atom, So SF_6 molecule is formed Octahydral with angle 90 degree.



Conclusion:

1.Number of hybrid orbitals =

Number of σ + Number of lone pairs (n)

2.Geometrical shape of the molecule depend on the type of hyperdization.

Hyperdization	Number of electron pairs	Geometrical shape (Example)	Angle around central atom
sp	2	Linear ($BeCl_2$)	180
sp^2	3	Trigonal planar (BF_3)	120
sp^3	4	Tetrahedral (CH_4)	109.5
sp^3d	5	Trigonal bipyramide (PCl_5)	120, 90
sp^3d^2	6	Octahedral (SF_6)	90

3. If all hyperdization Orbital forming bonding pairs , regular structure is obtained.

4. If one or more hyperdization Orb. Occupied by lone pair – non-bonding- (n), distortion from the regular structure obtained as in:

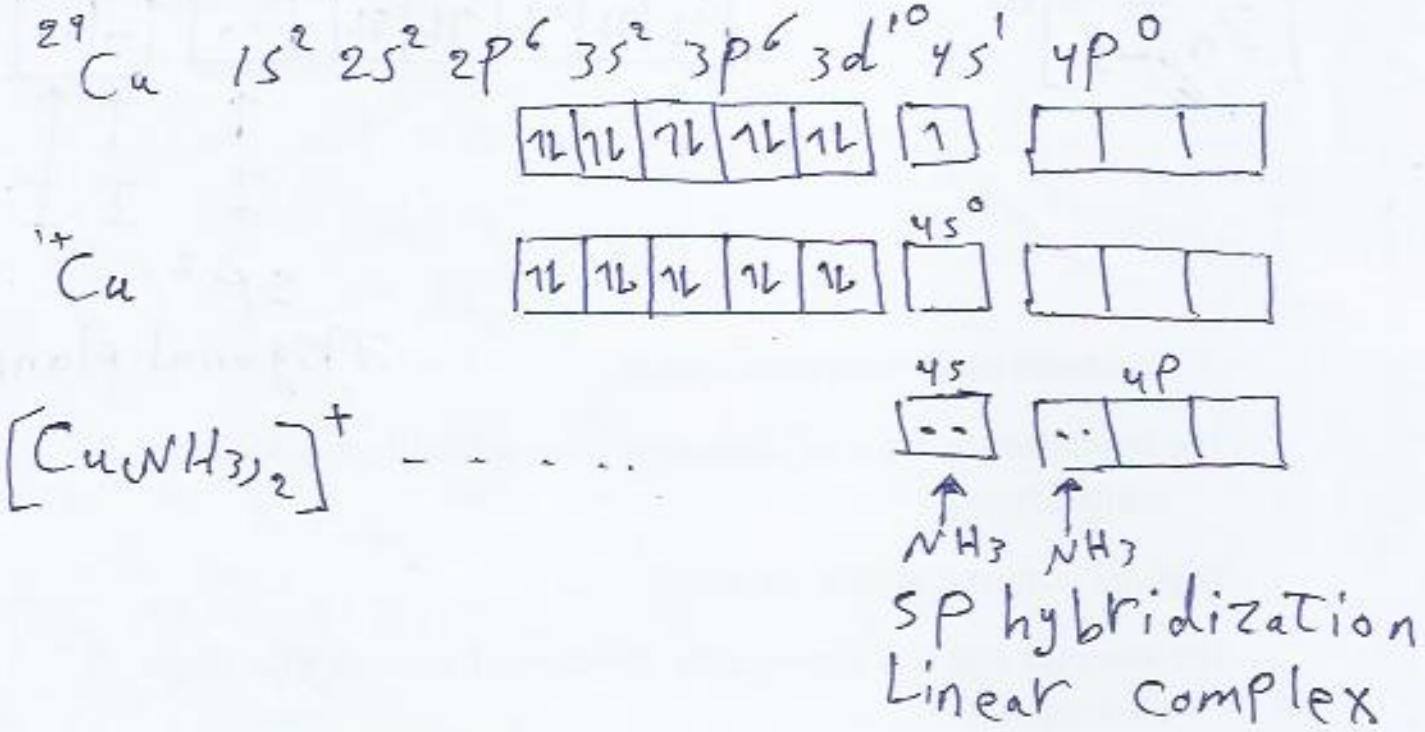
CH_4	NH_3	H_2O
Teh.	Pyramidel	V-Shape
HCH	HNH	HOH
109°	104°	105°

This is because non-bonding pair (n) occupied larger space so it repulse the bonding pairs, so the angle is reduced as in NH_3 . In H_2O two non-bonding orbitals the repulsion increases , so the angle is reduced more.

Valence bond theory نظرية اصرة التكافؤ

This theory is applied to the coordination compounds, which are closely related to the hybridization and geometrical shape of the central atom. This theory represents the metal orbitals in squares (or circles) to show the distribution electron of the outer shell of the metal (Lewis acid), which has the ability to accept a pair of electrons, (Lewis base) have the ability to give a pair of electrons and formation coordination bond between the ligand and the metal.

Example 1: The complex ion of the copper diamine $[Cu(NH_3)_2]^+$ the electronic structure of the outer shell of the copper and the electronic structure of the complex shall be as follows:



- Four electrons came from two ligands.

-The hybridization type sp formation from orbital type s with orbital type p .

-Linear complex ion shape.

-The complex ion is a diamagnetic because of absence of a single electron in it.