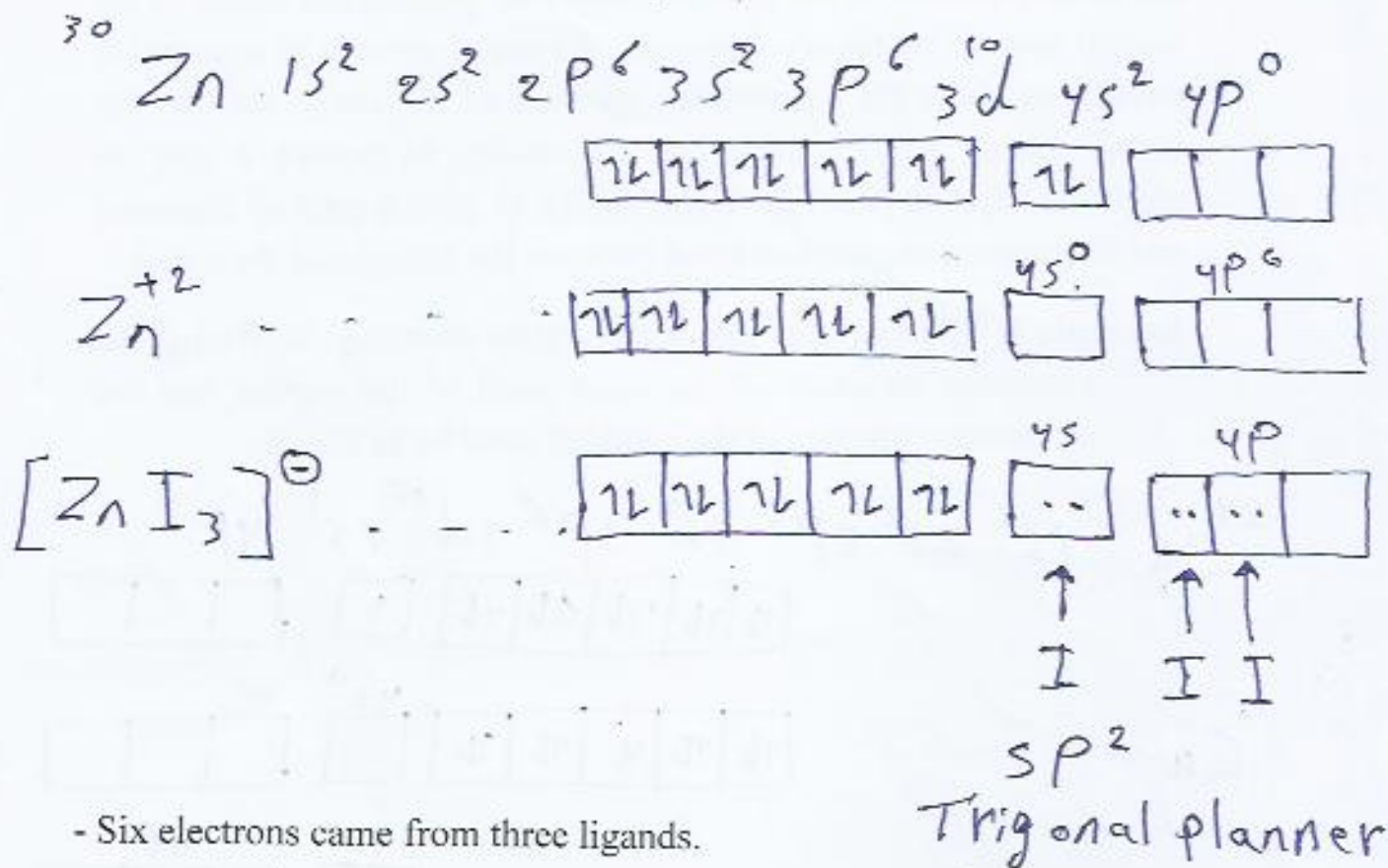
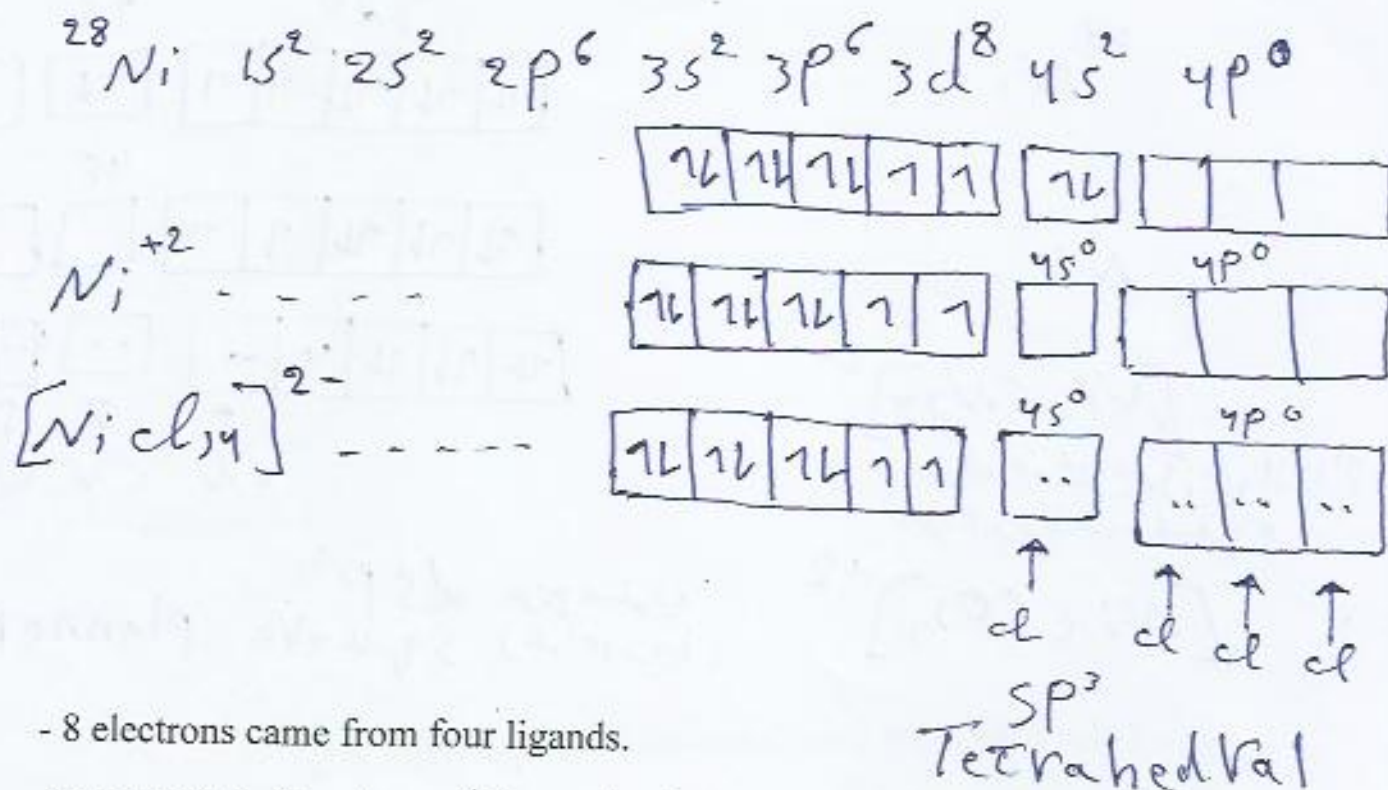


**Example 2:** The complex ion of the triiodo zinc (II)  $[ZnI_3]^-$  the electronic structure of the outer shell of zinc metal and the electronic structure of the complex shall be as follows:



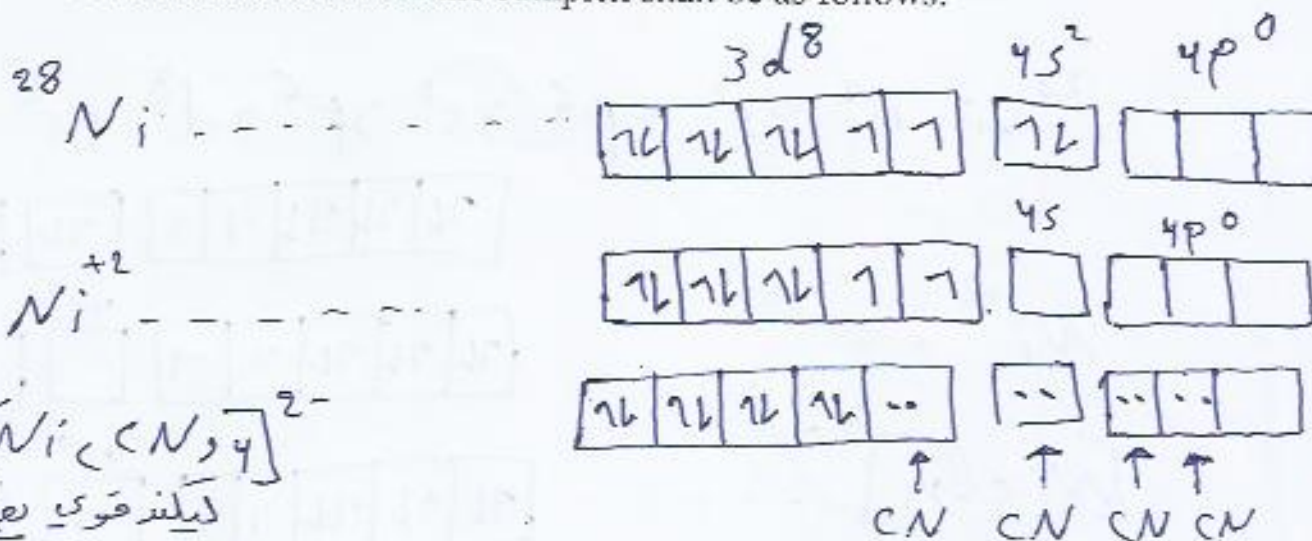
- Six electrons came from three ligands.
- The hybridization type  $sp^2$  formation from orbital type s with two orbitals type p .
- Trigonal planner complex ion shape.
- The complex ion is a diamagnetic because of absence of a single electron in it.

**Example 3:** The complex ion of the nickel(II) tetrachloro  $[\text{NiCl}_4]^{2-}$  the electronic structure of the outer shell of nickel and the electronic structure of the complex shall be as follows:

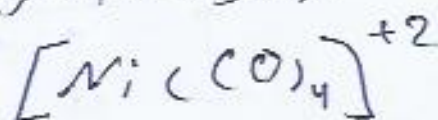


- 8 electrons came from four ligands.
- The hybridization type  $sp^3$  formation from orbital type s with three orbitals type p.
- Tetrahedral complex ion shape.
- The complex ion is a paramagnetic because of presence pair electrons non paired.

**Example 4:** The complex ion of the nickel(II) tetracyanid  $[\text{Ni}(\text{CN})_4]^{2-}$  the electronic structure of the outer shell of nickel and the electronic structure of the complex shall be as follows:



$[\text{Ni}(\text{CN})_4]^{2-}$   
 كاتيون قوي يعطي بل ازدواج  
 الإلكترونات المفردة



$dsp^2$  مربع مستوي  
 Square planer (مربع مستوي)

- 8 electrons came from four ligands.
- The hybridization type  $dsp^2$  formation from orbital type d and one orbital from s with two orbitals type p .
- Square planer complex ion shape.
- The complex ion is a diamagnetic because of absence of a single electron in it .

صقعات النيكيل  
 اذا كانت دايامغناطيه = مربع مستوي وصقعات النيكيل  
 بارامغناطيه = رباعي السطوح



**Note:**

The single electrons of d remained as they were in the complex  $[\text{NiCl}_4]^{2-}$  while they became double in the complex  $[\text{NiCN}_4]^{2-}$  that is, the type of ligand has an important effect in this case where CN is a strong ligand because it makes single electrons In the complex that is formed paired. While the ion chlorine ligand is weak because it cannot make single electrons paired.

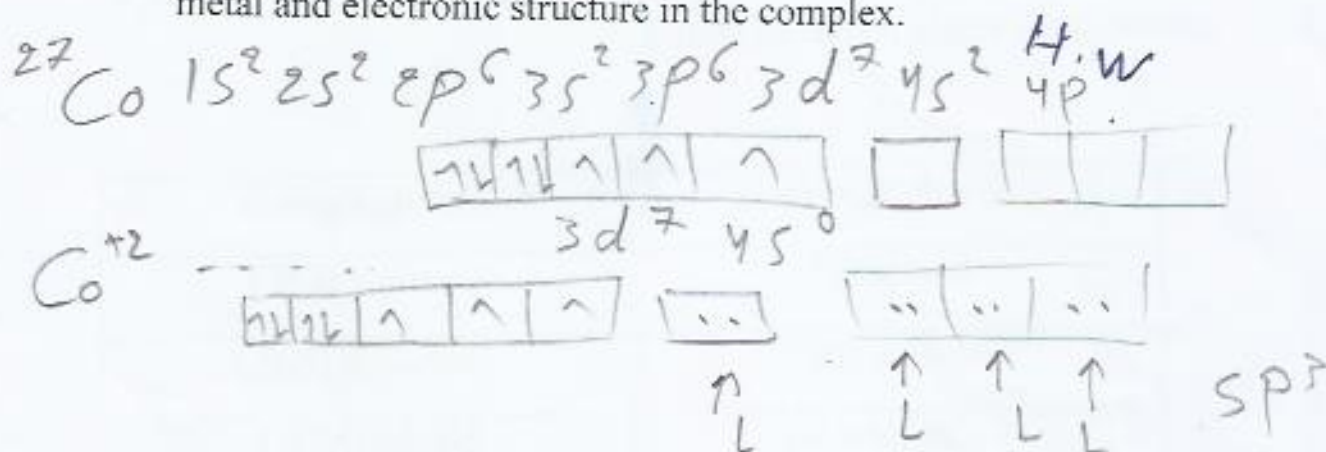
Weak ligands	Strong ligands
Iodide ( $\text{I}^-$ )	Cyanide ( $\text{CN}^-$ )
Bromide ( $\text{Br}^-$ )	Ammonia ( $\text{NH}_3$ )
Chloride ( $\text{Cl}^-$ )	Nitrite ( $\text{NO}_2^-$ )
Fluoride ( $\text{F}^-$ )	Carbonyl ( $\text{CO}$ )
Hydroxide ( $\text{OH}^-$ )	
Water ( $\text{H}_2\text{O}$ )	

**Example:**

Write the type of complex hybridization that contains cobalt where it represents  $[\text{CoL}_4]^{2+}$  (The ligand hybridization is defined as 1):

① إذا كان الليغند ضعيف

1 - The first case: The electronic structure of the outer shell of cobalt metal and electronic structure in the complex.



Note that according to this structure, single electrons are equal to 3 and hybrids of the type  $sp^3$ .

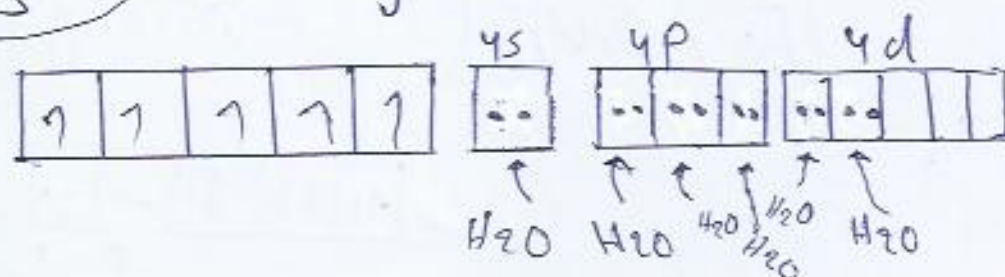
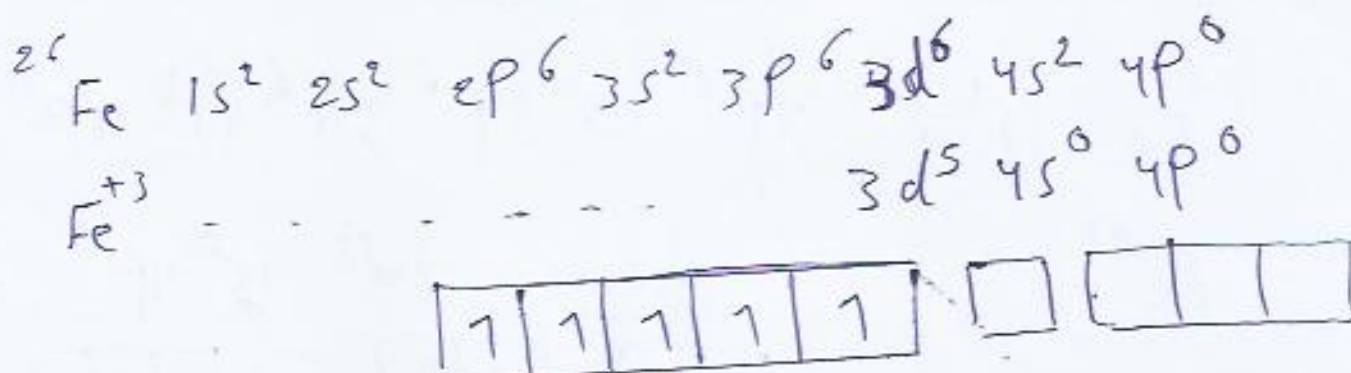
البنية الهندسية  $sp^3$   
رباعي السطوح (شكل الأيون المعقد)

إذا كان الليغند قوي

2 - The second case: The electronic structure in the complex:

The number of single electrons equals one and the hybridization of a type  $dsp^2$

**Example:** The complex ion of the iron (III)  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  the electronic structure of the outer shell of iron and the electronic structure of the complex shall be as follows:



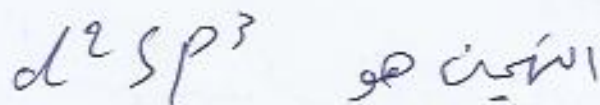
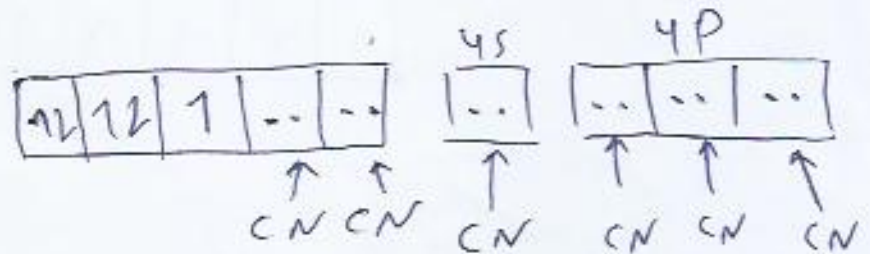
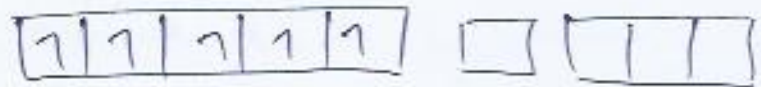
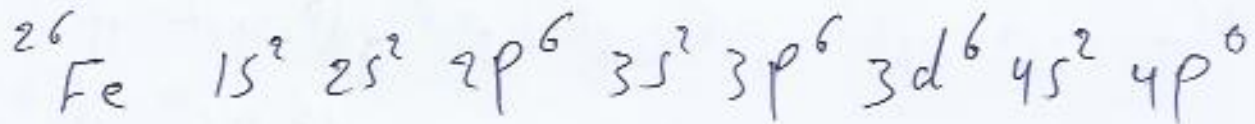
التهجين  $sp^3d^2$

هذا المعقد ليس معقدات الاوربييتالات الخارجية لاننا لم نستخدم  
اوربييتالات خارجية للذرة المركزية

- 12 electrons came from six ligands.
- The hybridization type  $sp^3d^2$  formation from orbital type s and three orbital from p with two orbitals type d.
- Octahedral complex ion shape.
- The complex ion is a paramagnetic because of presence pair electrons non paired.
- Weak ligand.



**Example:** The complex ion of the iron (III)  $[\text{Fe}(\text{CN})_6]^{3-}$  the electronic structure of the outer shell of iron and the electronic structure of the complex shall be as follows:



مقدار الارتباط الداخلي

- 12 electrons came from six ligands.
- The hybridization type  $d^2sp^3$  formation from orbital type s and three orbital from p with two orbitals type d .
- Octahedral complex ion shape.
- The complex ion is a paramagnetic because of presence pair electrons non paired.
- Strong ligand.