Answer on Question #44604 - Chemistry - Inorganic Chemistry

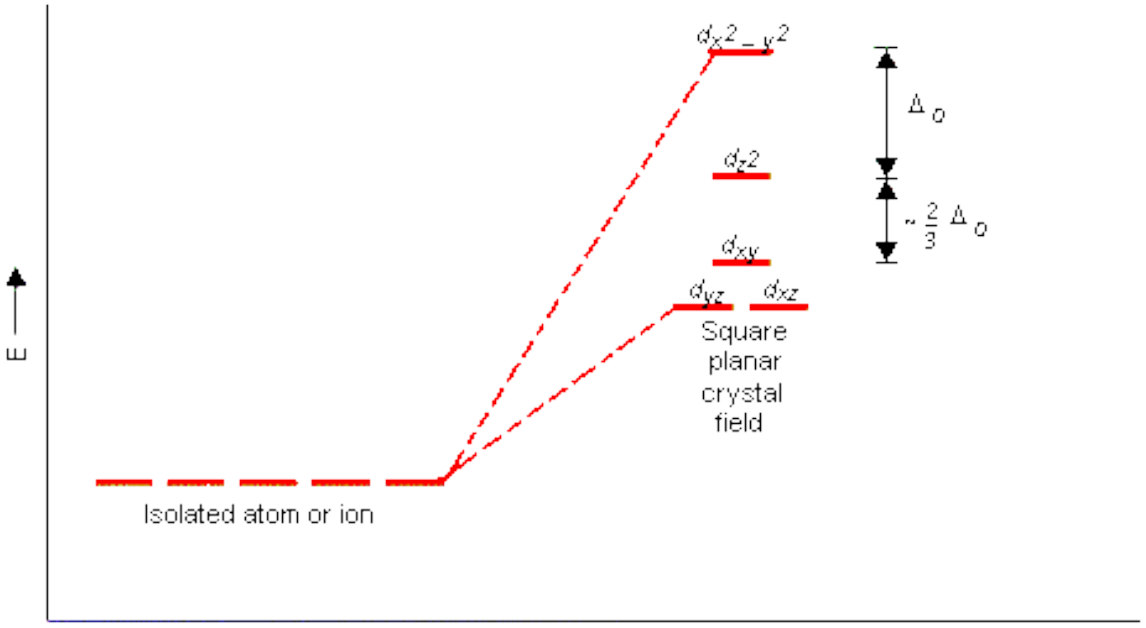
Question:

I have some doubts in coordination compounds. Well I was making the structure of [Ni(CN)4]2- and lost my mind. If we work according to the crystal field theory then (Ni)2+ is d8 configuration which means it will have 2 unpaired electrons in the t2 orbitals. While if we work according to the valence bond theory then the 2 unpaired electrons of Ni2+ have to pair up in presence of strong ligand CN- meaning there are no unpaired electrons. How is this possible? Which is correct? Sorry for my poor English. Hope you reply soon :)

Answer:

Four-coordinate nickel(II) complexes exhibit both square-planar and tetrahedral geometries. The tetrahedral ones, such as $[NiCl_4]^{2-}$, are paramagnetic; the square-planar ones, such as $[Ni(CN)_4]^{2-}$, are diamagnetic.

Compound $[Ni(CN)_4]^{2-}$ according to crystal field theory has square planar geometry geometry. It means that ligands are situated in the tops of the square. D-orbitals of metal cation in this case split into four sublevels.



Ni^{2+} has configuration $[Ar]3d^8$. It means that 8 electrons are on d-orbitals. As CN^- is a low-spin ligand, energy between splited levels is high and electrones are paired.