Answer on Question #59814 – Chemistry | Inorganic Chemistry

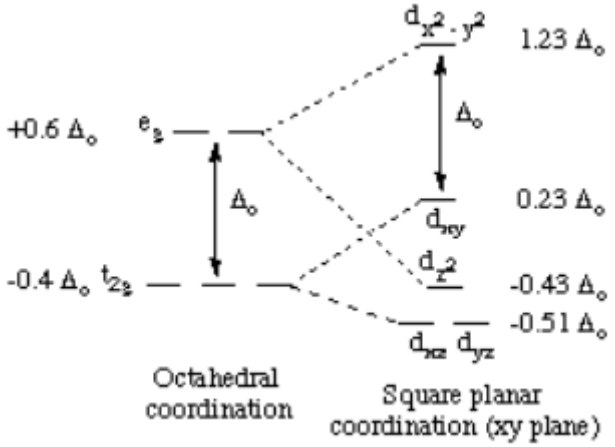
The Jahn-Teller Theorem was published in 1937 and states: "any non-linear molecular system in a degenerate electronic state will be unstable and will undergo distortion to form a system of lower symmetry and lower energy thereby removing the degeneracy ". It is actually applied to one type ligand complexes.

According to the Crystal Field Theory (as for different ligand complexes): The reason they split is because of the electrostatic interactions between the electrons of the ligand and the lobes of the d-orbital.

CFSE – the stability that results from placing a transition metal ion in the crystal field generated by a set of ligands. Owing to the splitting of the d orbitals in a complex, the system gains an extra stability due to the rearrangement of the d electrons filling the d levels of lower energy.

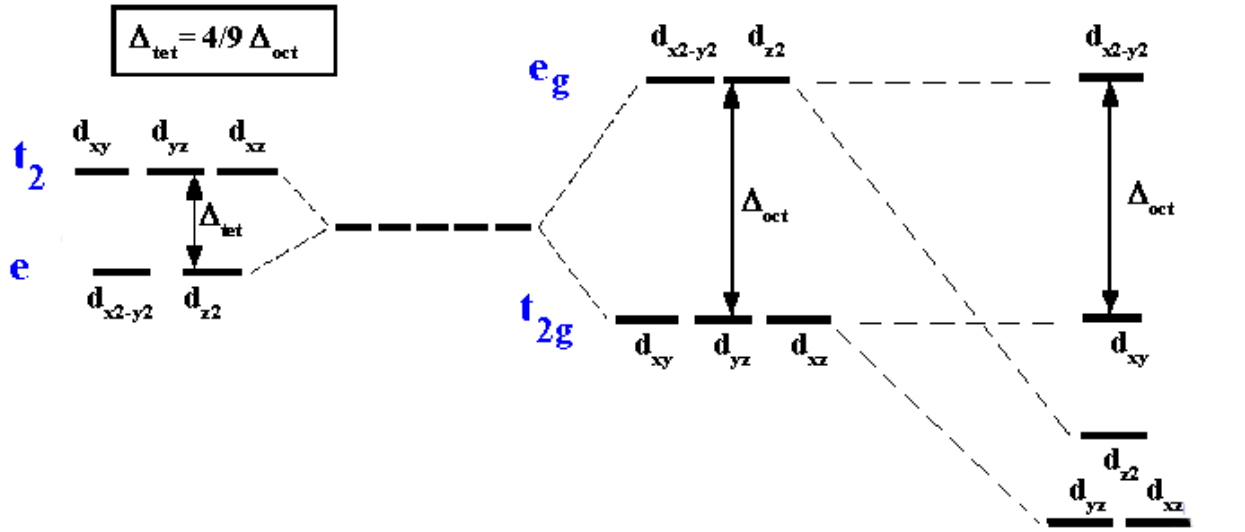
Square Planar Complexes

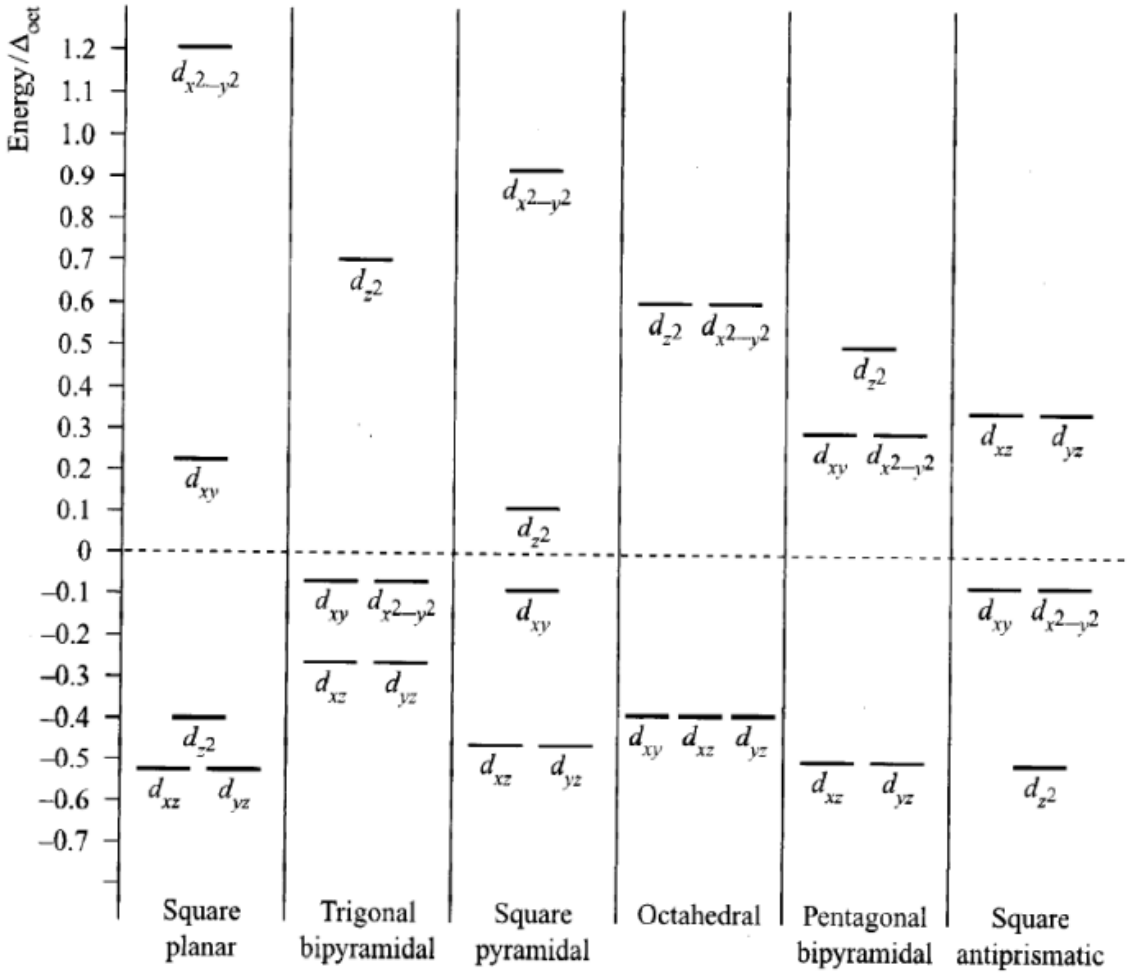
As ligands move away along the z-axis, d-orbitals with a z-component will fall in energy. The dz^2 orbital falls the most, as its electrons are concentrated in lobes along the z-axis. The d_{xz} and d_{yz} orbitals also drop in energy, but not as much. Conversely, the $d(x^2-y^2)$ and the d_{xy} orbitals increase in energy. The splitting diagram for square planar complexes is more complex than for octahedral and tetrahedral complexes, and is shown below with the relative energies of each orbital.



Other graphs clearly illustrate energy level of d-orbitals:

1.





2. **Figure 2 Crystal field splittings of d orbitals**