Answer on Question # 73503 - Chemistry - Inorganic Chemistry

Among the following, the compound that is both are diamagnetic and colored is- 1) K2Cr2O7 (2) (NH4)2 [TiCl6] (3) VOSO4 (4)K3[Cu(CN)4] ((please solve with details))

Solution

Diamagnetic compounds have only paired d-electrons of the central atom (transition metal). The electron configurations of the central atoms are:

Cr^{+6} [Ar] $3d^0$ $4s^0$

Ti^{+4} [Ar] $3d^0$ $4s^0$

V^{+4} [Ar] $3d^1$ $4s^0$

Cu^{+1} [Ar] $3d^9$ $4s^0$

Since V^{+4} and Cu^{+1} ions have odd number of electrons, these compounds are paramagnetic, whereas Cr^{+6} and Ti^{+4} are diamagnetic.

The partially full d-orbitals in transition metals have energy splittings that happen to lie in the visible range and are colored. However, the comounds of Cr^{+6} and Ti^{+4} is not the case, d-orbitals of these ions are empty. Therefore, if we consider d-d transitions only, the both should be colorless. Although it is known that $K_2Cr_2O_7$ forms a colored solution, In this compound oxygen has extra lone pairs to donate to chromium so there is actually charge tranferred spectra and not d-d transition.

Answer: $K_2Cr_2O_7$.