

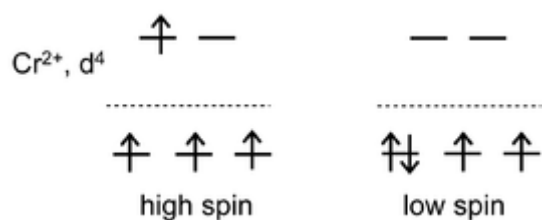
Question:

For the $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Cr}(\text{CN})_6]^{4-}$ ion has energy difference value (del zero) are 17830 cm^{-1} and 26280 cm^{-1} . The pairing energy is 23520 cm^{-1} . State which complex is high spin or spin. And calculate magnetic moment of each.

Answer:

The energy of the ion in cyanide complex is lower (26280 cm^{-1}) than the pairing energy, so it is low-spin complex. Hydro complex is a high-spin, as chromium ion has enough energy to make its electrons unpaired.

The diagram for $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Cr}(\text{CN})_6]^{4-}$ relatively:



The magnetic moment is defined as:

$$\mu = \sqrt{n(n+1)}(B.M.), \text{ where } n \text{ is the number of unpaired electrons, B.M. is Bohr magneton.}$$

For $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$:

$$\mu = \sqrt{4(4+1)}(B.M.) = \sqrt{20}(B.M.)$$

For $[\text{Cr}(\text{CN})_6]^{4-}$:

$$\mu = \sqrt{2(2+1)}(B.M.) = \sqrt{6}(B.M.)$$