Answer on the question #56607 - Chemistry - General Chemistry

Question:

A d1 octahedral complex is found to absorb visible light, with the absorption maximum occurring at 503 nm. Calculate the crystal-field splitting energy, Δ, in kJ/mol.

Solution:

The crystal-field splitting energy is equal to the energy of transition of the electron, that is linked to the wavelength of the emitted light λ as follows:

$$\Delta = E = \frac{hc}{\lambda}$$

where h is the Planck constant, $6.62*10^{-34}$ m^2 kg s^{-1}, and c is the speed of light, $3*10^8$ m s^{-1}.

$$\Delta = \frac{6.62 \cdot 10^{-34}(m^2 kg\ s^{-1}) \cdot 3 \cdot 10^8 (m\ s^{-1})}{503 \cdot 10^{-9}\ (m)} = 3.95 \cdot 10^{-19}(m^2 kg\ s^{-2}) = 3.95 \cdot 10^{-19}\ J$$

This value is the splitting energy per ion. To convert it to J per mol, we should multiply it by Avogadro number, 6.022*1023 mol-1:

$$\Delta = \ 3.95 \cdot 10^{-19}\ \cdot 6.022 \cdot 10^{23} = 237.9\ kJ\ mol^{-1}$$

Answer: 237.9 kJ mol^{-1}