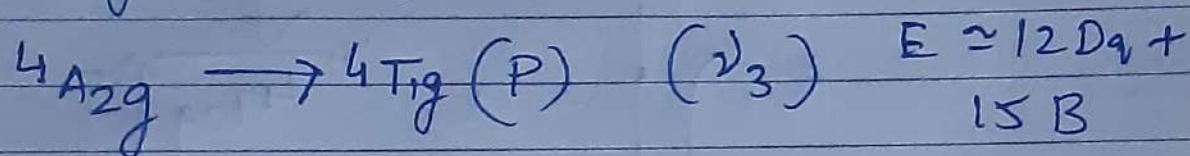
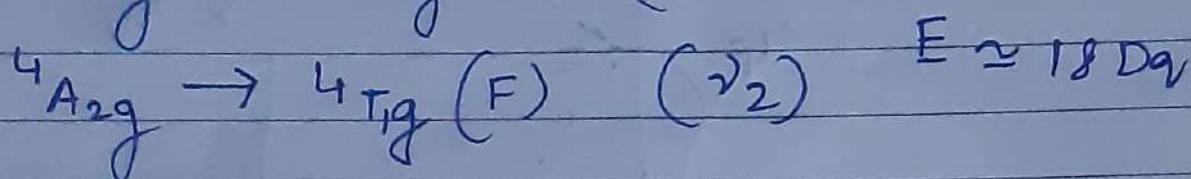
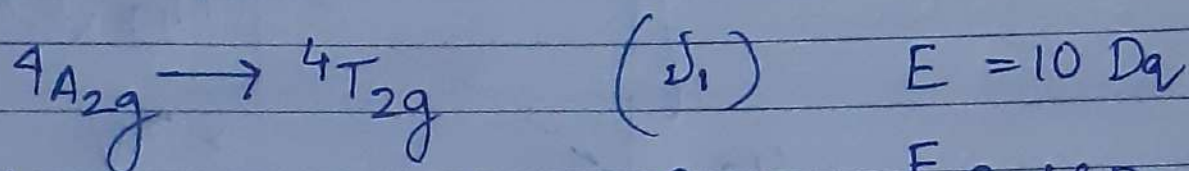


Case Study - 1

Let us Consider a Six-Coordinate Chromium (III) belongs to the $3d^3$ system and in an octahedral symmetry, the three transitions are expected. These are



Now, the complex hexaquo chromium (II) Chromium Chloride records three spin allowed transitions at 17400 cm^{-1} , 24600 cm^{-1} and 37800 cm^{-1} .

$$\text{Now, } \frac{\nu_2}{\nu_1} = 1.42 \quad \text{and} \quad Dq/B \approx 2.5$$

$$\text{Now, } E/B \approx 25$$

(By the help of T-B diagram) details are not discussed here

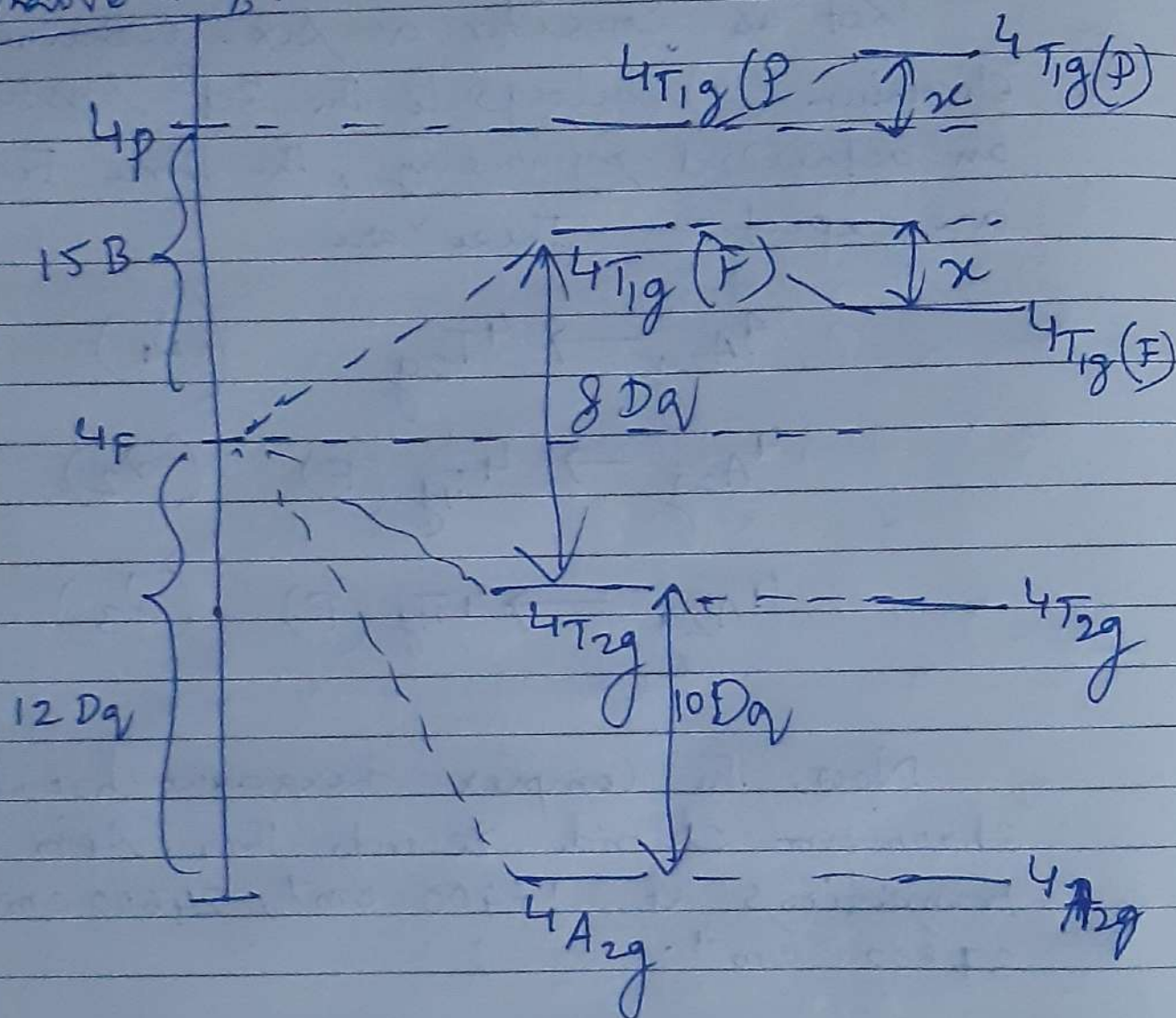
$$E = 17,400 \text{ cm}^{-1}$$

$$\text{Then } B = \frac{17400}{25} = 696 \text{ cm}^{-1}$$

$$\text{Hence, } 10 Dq = 17,400 \text{ cm}^{-1} \quad \left(\begin{array}{l} \text{lowest} \\ \text{energy} \end{array} \right)$$

$$\text{The nephelauxetic ratio } (\beta) = B/B_0 = 696/918 \approx 0.76$$

alternative way:-



Energy level diagram of d^3 Configuration.

Home task:-

For, $\nu_1 = 10Dq$, Calculate the value $1Dq$?
Then $\rightarrow 18Dq$

$$E(\nu_2) = 24,600 \text{ cm}^{-1} = 18Dq - x$$

$$x = 31,320 - 24,600 \\ = 6,720 \text{ cm}^{-1}$$

(By putting the value of $1Dq$ already discussed in previous class.)

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$$E [4A_{2g} \rightarrow 4T_{1g} (P)], \nu_3 \rightarrow 12D_q + 15B + x$$

(From the figure)

$$15B = \frac{10,200}{\cancel{10,200}} \text{ cm}^{-1}$$

$$\begin{aligned} \nu_3 &\Rightarrow 37,800 \text{ cm}^{-1} \\ x &\Rightarrow 6720 \text{ cm}^{-1} \end{aligned}$$

$$\text{or, } B = \frac{10,200}{\cancel{10,200}} \text{ cm}^{-1}$$

$$12D_q \Rightarrow 12 \times 1740$$

$$= \frac{\cancel{680}}{1} = 680$$

$$= \frac{\cancel{220,880}}{\cancel{1}} = 220,880$$

$$\text{Nephelauxetic (B) parameter} = \frac{680}{918} = \underline{\underline{0.74}} \quad 220,880 \text{ cm}^{-1}$$