



Basic Physical Chemistry I

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Q12

Explain Goodenough-Kanamori rule for $d^3 - d^8$ configuration in O_h symmetry for both 180° and 90° cases. Further, confirm the same results for $d^8 - d^3$ cases.

Q13

For O_h symmetry, confirm the following direct product relation using character table.

$$E \times T_1 = T_1 + T_2$$

Q14

Absorption spectra of $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$, and $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ ions are shown in Figure.

- (1) Assign the peaks of ν_1 and ν_2 for d^6 low-spin configuration. That is, explain the excitation processes in these peaks by using Tanabe-Sugano diagram.
- (2) Determine crystal field splitting Δ and Coulomb interaction energy B .
- (3) Confirm that the ligand field strength obeys the *Spectrochemistry* series.

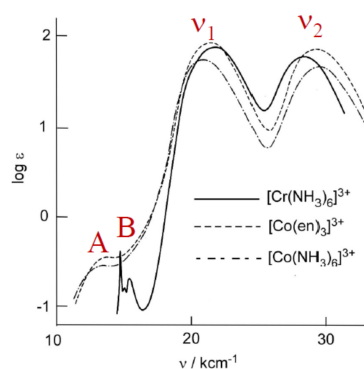


Fig: Electron absorption spectroscopy of Co complexes.

Q15

Describe 45 cases in d^2 configuration for free ions with term symbol (spectrum term). For each configuration, add the term symbol.

Q16

Prove the following relation: Optical transitions are arrowed only in the cases that the difference of orbital angular momentum is ± 1 .

$$\Delta L = \pm 1$$

Q17

Prove the ‘Lambert-Beer law’. Do not forget to mention the units for each parameter.

Q18

Solve the 5×5 determinant for crystal field splitting shown in p. 25.

Q19

Confirm the relationship between eV and cm^{-1} units.

Q20

Plot the ligand field stabilized energy (LFSE) from d^1 to d^9 . Horizontal and vertical axes should be d electron number and LFSE, respectively.