Laboratory Report Instructions for

Preparation and Spectral Analysis of Cobalt(III) Ammine Complexes

Inorganic Chemistry (CHE-258)   Spring 2004   Gustavus Adolphus College

1. Write a balanced equation for the preparation of each of the complexes.

2. Calculate the percent yield of each of the complexes.

3. Decide, on the basis of the infrared spectra that are provided, which isomer of $[Co(NH_3)_5(NO_2)]Cl_2$ is N-bonded and which is O-bonded. The data that you need for the analysis can be found in the background part of the earlier experiment that you performed titled "Preparation and Analysis of Transition Metal Nitrite Complexes". Explain how you arrived at your conclusion.

4. Calculate the d-orbital splitting in kJ for each complex from the position of λ_{max} in the visible spectrum of the complex.

5. On the basis of your calculations from question 4, arrange the ligands H_2O, NH_3, Cl^-, N-bonded nitrite, O-bonded nitrite in order of increasing ligand field strength. Provide an explanation of the rationale that you used to arrive at your sequence.

6. Explain, to the extent possible with the compounds that you made, how one might tentatively arrive at a sequence of ligand field strengths based on the colors that you observed.

7. Calculate the molar absorptivity (formerly known as the extinction coefficient) for each complex, using the equation $A = \epsilon bC$ (Beer's Law), where A is the absorbance (read from the y axis of your spectrum), ϵ is the molar absorptivity, L is the path length (10 mm for the cells that you used) in cm, and C is the molar concentration.