

Thermochromic Proposal 1

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*All work must be **very neat and organized**. If you need to organize your thoughts, please use a separate sheet of paper. Proposals are a **group effort**. Please submit the completed document as a PDF to the **Thermochromic Proposal 1** D2L DropBox folder before the scheduled end of lab.*

1. In a complete, well-written sentence, summarize in your own words the **overall goal(s)** for the *Thermochromic Project*.

Our overall goals for the Thermochromic Project are to develop an understanding of the behavior of colored cobalt (II) coordination complexes and their distinct color changes at temperatures just above 0 degrees Celsius, ex. 1 degrees Celsius.

2. In your own words, the **goal for this first session** of the *Thermochromic Project* is...

Our goals for the first session of the Thermochromic Project are to develop a strategy to observe distinct color transitions from Room Temperature (RT) to freezing using different ratios of $\text{CoCl}_2[\text{EtOH}]_2$ to $\text{CoCl}_2[\text{EtOH}]_2$. We used ratios within 5:1 and 1:1 range.

3. **Cobalt Chloride Alcohol Volume Ratio Exploration Results.** Clearly summarize the **key results** from your systematic qualitative exploration of the cobalt chloride alcohol volume ratios (CoCl_2 in EtOH to CoCl_2 in MeOH) and temperature on the directionality and extent of the reaction. You should prepare and test at least **seven different cobalt chloride alcohol ratios** – you may find volume ratios within the 5:1 to 1:1 (CoCl_2 in EtOH to CoCl_2 in MeOH) range worth exploring. The recorded temperature observations must be succinct, but complete, clear, and well organized.

Table 1: Cobalt Chloride Alcohol Volumes and Temperature Observations

Volume Ratio of CoCl_2 in EtOH to CoCl_2 in MeOH	Volume of $\text{CoCl}_2(\text{EtOH})_2$ (mL)	Volume of $\text{CoCl}_2(\text{MeOH})_4$ (mL)	Total Volume (mL)	Color at Room Temperature	Color in the Ice Bath
5:1	3.33	0.66	4	Darker Blue	Purplish Blue
4:1	3.20	0.80	4	Slightly Lighter Blue	Bluish Purple
3:1	3.00	1.00	4	Light Blue	Pinkish Purple
2:1	2.86	1.14	4	Brightly Light Blue	Bright Purple/Lilac
1:1	2.00	2.00	4	Lavender	Bright Pink
1.5:1	2.40	1.60	4	Very Light Lavender	Not as Bright Pink
2.5:1	3.25	0.75	4	Bright Blue	Bluish Purple

Additional Observations:

The 3:1 vial was a slightly lighter color than the 2.5:1 vial. This could be due to the ratio being off. All the other vials matched up with their concentration levels and there was a clear distinct pattern from light to dark based on the ratios used.

4. **Proposal 1.** Based on your qualitative exploration, **propose a plan**, and **justify each step** to characterize the thermochromic behavior by determining K_c at $\approx 0^\circ\text{C}$ ($5 - 7^\circ\text{C}$) and room temperature (RT), then infer the signs of ΔH_{rxn} and ΔS_{rxn} for the reaction. Please NUMBER your procedural steps.

Procedural Step	Justification based on data/observations, or technical instructions, or conceptual understanding
<ol style="list-style-type: none"> 1) Gather 7 mL glass vials. 2) In two plastic 20 mL vials, collect the cobalt chloride concentrations that have ethanol and methanol. 3) Calculate the amount of mL each ratio divides the total of 4mL into. 4) Using a micro pipette, we then put the calculated volumes into each vial, starting with the 100 -1000 microliters pipette to put the ethanol before the methanol. 5) After micro pipetting the ethanol, we then micropipette the methanol into the respective vials. 6) Shake the vials lightly and let it rest for one minute. 7) Record the color of each vial, noting the different ratios and comparing them to the other ratios. 8) Place the vials in the ice bath for ten minutes. 9) While waiting for the ice bath, set up the spectrometer to record the wavelength and absorption levels once we are done with the ice bath. 10) Take the vials out of the ice bath and record their colors. Compare with the room temperature colors. 11) Place the solutions in cuvettes to undergo the spectrometer. 12) Calculate the concentrations using Beer's Law. 	<ol style="list-style-type: none"> 1) One vial for each ratio that we are observing. 2) Ethanol should be blue in color and methanol should be pink in color. Putting the concentrations in the vials will allow us to do the micro pipetting at our table instead of under the hood which is obstructive to our peers. 3) This gives us the amount of each concentration that needs to go into one of the seven vials. For example in the 3:1 ratio vial, we had 3mL of Ethanol and 1mL of Methanol 4) The 100 -1000 microliters micropipette gives us the range we need to accurately control the volume placed into each vial. We started with the ethanol as it gave us a benchmark of how much was going into each vial and this allowed us to start over if any mistakes were made as we could see if there were vials that had more than another but were not supposed to base on the calculated ratios. 5) We now put the methanol in to give us our final concentrations of the ratios. 6) This is done to ensure that both solutions are thoroughly mixed and then the resting lets the solution set and for any reactions to finish taking place. 7) We record the color to have a baseline to compare to later after we have put the vials in the ice bath. By comparing them to the other ratios, we are able to get an understanding of the progression of colors from a higher ratio to a lower ratio. 8) The ice bath will give us the visualization that we need to see the color change from room temperature to freezing. 9) The spectrometer will allow us to record the absorption levels as well as the wavelength so that we can calculate the concentration levels of each vial later on. 10) Comparing the colors will allow us to see if there were any distinct changes between room

temperature and the freezing. This should also give us the opportunity to see the changes happening in the vials base on the temperatures.

- 11) Here we record the absorption levels and wavelength of the respective solutions.
- 12) This will give us the concentrations of each solution.