

Purpose: To become familiar with common lab techniques by studying the relationship between concentration and the amount of light transmitted through a solution

Procedure:

Part A: The reaction between Sodium carbonate and copper sulfate

- ① Obtain about 15 mL of the unknown CuSO_4 solution in a 50 mL beaker and 12 mL of 0.1000 M Na_2CO_3 in a separate 50 mL beaker
- ② Precisely measure 10.00 mL of copper sulfate using a 10 mL graduated cylinder and transfer into a third 50 mL beaker. Rinse the graduated cylinder with deionized water and precisely measure 10.00 mL of sodium carbonate in the same beaker.
- ③ Swirl the contents of the beaker
- ④ Record the mass of the filter paper using an analytical balance. Fold a piece of filter paper into quarters and then open it up inside the funnel. Place the funnel in a 100 mL beaker and slowly pour the contents of the third 50 mL beaker onto the filter paper.
- ⑤ Once the liquid has passed through the filter paper (around 15 min), carefully remove the filter paper and its contents and place it on a watch glass that is labeled with your name. Place the labeled watch glass in the drying oven for 90 minutes. Allow it to return to room temperature before weighing the filter paper with the solid on the analytical balance.
- ⑥ Dispose of the filter paper and solid in the solid waste. Dispose of the sodium carbonate solution in the inorganic water bottle in the hood. Use the remaining unknown copper sulfate solution in Part B


Part B: Preparation of Samples to Generate standard Curve

- ① Obtain three cuvettes and make sure they are clean. If necessary, rinse the cuvettes thoroughly with deionized water.

- ② Fill one of the cuvettes with deionized water. Deionized water is the solvent in this experiment. It will therefore serve as the blank sample.
 - ③ Obtain about 20 mL of the 0.1000 M copper sulfate solution in a clean 50 mL beaker. Drain one of the other cuvettes thoroughly, rinse with approximately 0.5 mL of the copper sulfate solution. This is your undiluted copper sulfate sample solution.
 - ④ Use the remaining amount of the unknown copper sulfate solution to fill another cuvette. Drain the remaining cuvette thoroughly, rinse with approximately 0.5 mL of the unknown copper sulfate solution. This is your unknown copper sulfate sample solution.
 - ⑤ Place a cap on the cuvettes. Label them (on the benchtop or the ribbed sides of the cuvettes) with labeling tape. Wipe the outside of each cuvette with a Kimwipe to make sure that it is clean with no fingerprints.
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- ① Using a cleaned and conditioned 5 mL volumetric pipet, add 5.00 mL of undiluted copper sulfate sample solution to a clean 10 mL volumetric flask. Add deionized water so that the meniscus is on the 10 mL mark on the flask and invert the flask 20 times to ensure that it is well-mixed, this is your 50% copper sulfate solution.
 - ② Repeat the process starting with your 50% copper sulfate solution instead. The second dilution should be prepared from the first diluted solution and will have a concentration of 25% of the original stock solution.
 - ③ Repeat the process starting with your 25% copper sulfate solution instead. Ultimately, you should have three solutions with concentrations equal to 50.0%, 25.0%, and 12.5% of the original concentration of the stock copper sulfate solution.
 - ④ Be sure to label each diluted sample.

- ⑤ For each diluted sample, condition a cuvette with the solution (rinse with 0.5 mL of solution), and then fill it about 80% with the solution. Place a cap on the cuvettes and wipe the outside of the cuvettes with a Kimwipe. Label these cuvettes like you did for the previous 2 cuvettes.

Using the Spectrophotometer

- ① Connect the spectrophotometer to a powered USB port on the computer.
- ② Start LoggerPro on your computer. To calibrate the SpectoVis Plus, under the "Experiment" heading in the toolbar, select "Calibrate" and then "Spectrophotometer 1." This will turn on the light source; wait 90 seconds for the bulb to warm up.
- ③ Place the blank cuvette (filled with deionized water) in the spectrophotometer. Align the cuvette so that the clear side of the cuvette is facing the light source.
- ④ Follow the instructions in the dialog box to complete the calibration, and then click "OK".
- ⑤ Place your undiluted copper sulfate sample solution in the sample slot. Then, click "Collect." The spectrum of the solution should appear on the screen. Click on "Stop" to stop the data collection.
- ⑥ Click the configure spectrometer data-collection icon  in the toolbar menu. A dialog menu will appear. In the left-most column under "Collection mode" make sure the option "Absorbance vs. Concentration" is selected. The wavelength for λ_{max} will automatically be selected. Record this value in your notebook. Click on "OK" to continue.
- ⑦ Click on "Collect" and then "Keep." Enter the concentration of the sample (0.1000 M). Record the absorbance of this solution in your lab notebook.

- ⑧ Remove the sample from the slot and put in your 50% copper sulfate solution. After the reading stabilizes, click on "Keep," and then enter the concentration (it can be calculated from the previous concentration). Record this data in your lab notebook.
- ⑨ Repeat step 8 for the remaining samples. For the sample with the unknown concentration, do not click "Keep," just write down the absorbance value on the screen once the reading stabilizes.
- ⑩ After all samples are run, click "stop" to end data collection. Make sure you have recorded the absorbance values in your notebook.
- ⑪ Empty the cuvettes and beakers with the distilled solutions into your designated waste beaker. Pour all of your collected waste into the designated waste bottle in the hood. Thoroughly wash all glassware and cuvettes with soap and water, and rinse them with deionized water before returning them to the storage area. Do not use the brushes to clean the cuvettes; this could scratch the cuvettes.

Safety: Chemical splash goggles must be worn during lab.

Copper Sulfate solutions are irritants to skin and eyes. If spilled on skin, eyes, or clothing, immediately wash the affected area under running water for 15 minutes and notify TA.

Waste Disposal: All copper solutions should be discarded in the inorganic waste bottle in the hood. All solid copper waste should be discarded in the solid waste container in the hood.

Data and Observations

Paper filter mass: 0.3603 g

Dried mass: 0.4081 g

λ_{max} for solution: 820.7 nm

undiluted solution absorbance: 1.413

50% concentration absorbance: 0.690

25% concentration absorbance: 0.328

12.5% concentration absorbance: 0.166

unknown concentration absorbance: 0.519

