Introduction to Natural Science (2006/07)

Winter 2007 Quarter

Chemistry Lab IV: "What is that Mystery Compound?"

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You are provided with a mystery compound. We know that it is a metal nitrate. You are asked to conduct three experiments to determine the formula of the compound and its identity.
This is a lab practical (lab exam). You will use all the knowledge you have gained over the past two quarters. You will be graded on technique, accuracy, precision, ability to complete work in the allocated time, and your lab report.
Do the experiment and data analysis on your own. Lab Report is due on Monday (by 9 a.m.)

Experiment 1: Determination of the nitrate ion concentration in the mystery compound

A "stock solution" of your mystery compound was prepared by dissolving some of it in water. You are also provided 4 "known solutions" of known nitrate ion concentrations (these concentrations are written on the bottles). Because the nitrate ion absorbs light at 201 nm**,** we can use UV absorption spectroscopy to detect the nitrate ion.

Do a quantitative dilution of your "stock solution" by taking 10.00 mL of the "stock solution" and diluting it to 500.00 mL. Label the prepared solution as the "dilute solution" and with your name.

Record the concentrations of the 4 "known solutions". Determine the absorbance of the 4 "known solutions" and the "dilute solution" at 201 nm using the diode array spectrometer. Use this data and a calibration graph to determine the nitrate ion concentration of the "dilute solution". Use this information to calculate the concentration of the nitrate ions in the "stock solution".

Experiment 2: Determination of the metal ion concentration of the mystery compound

We will be determining the metal ion content in the mystery compound by a titration. The titrant is ethylenediaminetetraacetic acid (EDTA for short). The reaction between the metal ion (call it M^{n+}, where M is the metal and n is the charge) and EDTA is as follows.

$$M^{n+} + EDTA \rightarrow \text{a new compound (metal-EDTA complex)}$$

Recognize that there is 1:1 ratio between M^{n+} and EDTA when they react with each other.

Use the "stock solution" of the mystery compound for this titration. Obtain 25.00 mL of this solution, add the required buffer solution and add a couple of drops of the specified indicator (instructions given in class). Record the color. Titrate with EDTA (titrant) to the end point where you will see a color change. Record the volume of EDTA needed for the titration and the concentration of the EDTA solution. Use this information to determine the concentration of M^{n+} in the "stock solution".

Experiment 3: Flame Test

You are provided with the solid mystery compound. Do a flame test. Use your data from previous labs to determine the identity of the mystery compound.

Post lab should include all relevant calculations and a discussion of the following:
- Use the data from Experiments 1 and 2 to determine the formula of the mystery compound.
- Then determine the charge on the metal ion (i.e. what is "n" in M^{n+}?)
- Use information from Experiment 3 to determine the identity of the compound.
- Write out the chemical formula of your mystery compound to the best of your ability.
- Write a paragraph describing your final results and why you think your compound is what it is.
- Describe why was it necessary to do a quantitative dilution of your "stock solution" to prepare the "dilute solution" before determining the nitrate ion concentration?