

## Chemistry 140

I have been neglecting your development of the ability to write a procedure. For this lab, prepare the procedure section as well as you can ahead of time. Make a photocopy of it. You and your partner will then give your procedure copies to another partnership, who will, in turn, give you their procedures. Perform the procedures exactly as stated on the procedure you are given (you may alternate runs using the different procedures). Then mark any omissions or errors on the copy of each procedure, and score the procedure out of 5 points.

Please have Parts 1 through 4 ready **before** class on Wednesday, October 25. For this particular writeup, no abstract is needed. carbon-copy pages of the write-up is due in class on **Monday, November 6.**

Your name, your partner's name, date of experiment

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### Lab 5: The standardization of an unknown concentration sulfuric acid

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#### Part 1. Purpose

To standardize a diprotic acid using a known concentration base solution.

Please write the balanced chemical equation of the titration of sulfuric acid with sodium hydroxide solution.

#### Part 2. Materials and methods

Chemicals needed: unknown concentration sulfuric acid; known concentration sodium hydroxide; indicator

Glassware needed: 50 mL buret (and buret clamp); 10 ml volumetric pipet; Erlenmeyer flasks and beakers as needed.

#### Part 3. Procedure

Write a procedure for standardizing sulfuric acid, 10.000 mL at a time. The point is, you will be giving a copy of the procedure to some other person in the class to follow exactly.

Some points you should include:

- The name of the indicator to be used.

- A “quick and dirty” run to approximate the volume of base you will need in subsequent more carefully measured runs.
- Does a diprotic acid change what you will be looking for at the endpoint?
- What is the “end” of the experiment? Need a criterion like “two successive acid concentration calculations that differ by less than 5%”.
- Don’t forget the sharing of data; each group should report the average of the two “good” runs.

#### Part 4. Original data

Might this look similar to what you did in Experiment 4? In fact, incorporate any improvements you wanted to make in your data table from last time; it might be double-spacing rows, or adding units, or whatever.

Since this is a diprotic acid, note any differences in appearance between this titration and the one in the previous experiment.

#### Part 5. Calculated results

Provide a calculation of the molarity of the sulfuric acid for one of the “good” runs. Pay attention to significant figures.

#### Part 6. Group results

Make a table of all groups’ average sulfuric acid concentrations. Calculate the mean and standard deviation for the class. Note outliers and assess whether your results are within the two-sigma range.

#### Part 7. Questions

1. If the acid in this experiment were monoprotic (e.g., HCl) of the concentration that you calculated in part 5, how would the volume of base dispensed changed? Be quantitative about this answer.
2. Given the answer to the previous problem, give a paragraph-long sketch of how you could determine whether an unknown acid you are given is a monoprotic, diprotic or triprotic acid. Hint: assume that you have some hydrochloric acid on hand.

#### Part 8. Conclusion

Start by stating your sulfuric acid concentration. Assess your confidence in the correctness of your number. Explain how standardization is different than a simple titration. Finish by giving some significant sources of error in the experiment.

