

Chemistry 140

Please have the following pages ready **before** class on Monday, February 4. Note that the different parts will be standard divisions in **all** lab writeups. For this particular writeup, please write an **abstract** and **paper-clip** it to the front of your individual writeup. The abstract and the carbon-copy pages of the write-up is due in class on **Monday, February 11**.

And this is what your lab notebook should look like:

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

Lab 3: Limiting reactants in a chemical equation

Part 1. Purpose

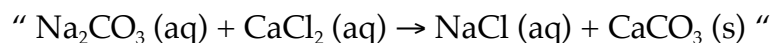
Write a one-sentence purpose for the main goal of this experiment.

Then, under that, copy the following:

“Other skills:

- Make a solution of a known concentration and volume following a recipe
- Isolate a precipitate by vacuum filtration”

Then, copy and **balance** the following chemical equation immediately under the purpose:



Part 2. Materials and methods

Sketch and label the following into your notebook. Instead of showing the equipment in isolation, sketch the setup you will be using, especially the vacuum filtration.

Equipment: 50 mL volumetric flask, electronic balance, spatula, graduated cylinder (?), volumetric pipet (?), beaker, Buchner funnel, filter flask, various tubing, ringstand, clamps.

Chemicals:

_____ M Na_2CO_3 solution
unknown concentration CaCl_2 solution

As a pre-lab exercise, perform the calculations (you may write them in this section) and complete the following recipe:

“To make a 50.00 mL of a _____ M solution of Na_2CO_3 :

To an empty, dry, clean 50 mL volumetric flask, add _____ g of sodium carbonate solid. Then fill the flask with distilled water, but not quite up to the calibrated line. Cap the flask and invert several times until the solid is dissolved. Remove the cap and add distilled water up to the calibrated line using a disposable pipet. Replace the cap and invert several times to ensure good mixing."

Make sure to get the molarity (_____ M) of the solution you and your partner will make from the instructor. Pay attention to sig figs!

Part 3. Procedure

Copy the following into your notebook, replacing the blanks with numbers and words as appropriate.

1. Make up 50.00 mL of _____ M sodium carbonate solution.
2. In a _____ mL beaker, mix 50.00 mL of your sodium carbonate solution and 60.00 mL of the unknown concentration calcium chloride solution. We used a _____ for measuring the calcium chloride solution.
3. Thoroughly mix the two solutions with a stirring rod or spatula; record any changes that indicate a reaction has taken place.
4. Set up the vacuum filtration, using the Buchner funnel, filter flask, tubing, ringstand and clamps.
5. Weigh a piece of filter paper that will fit in the Buchner funnel. Record the mass.
6. Place the filter paper in the funnel and wet it with distilled water. Turn on the water to get the aspirator to draw air through the funnel. You should be able to feel the vacuum if you press your palm on the top of the funnel.
7. Carefully pour the contents of the reaction beaker into the Buchner funnel and filter out the precipitate. Use a minimal amount of distilled water to rinse the beaker clean into the funnel.
8. Turn off the vacuum by removing the hose from the filter flask, **not by turning the water off**. Carefully remove the filter paper using the spatula; do not spill any of the precipitate. Place the filter paper on a watch glass. Break up as many of the clumps of precipitate as you can, to ensure thorough drying.
9. Clean all glassware and return to appropriate areas. The filtrate can be poured into the waste beaker in the hood.
10. Store the filter paper with the precipitate overnight at the instructor's direction.
11. After the precipitate is dry, record the mass of the filter paper and precipitate. Also record the appearance of the precipitate.

Waste disposal — All solids and the soiled filter paper should be placed in the solid waste beaker in the fume hood.

Part 4. Original data

For the sake of your being able to write (and make mistakes and cross-outs), you should make the squares in these tables larger when you copy them into your lab book.

Concentration of the sodium carbonate solution _____

Table 1:

Mass of filter paper (g)	
Mass of filter paper and precipitate (g)	
Mass of precipitate (g)	

I'd recommend enough columns for up to three trials.

Also, record your various observations here.

Parts 5 and 6. Calculated and group results

Calculate the number of millimoles of sodium carbonate you added to the reaction.

Calculate the mass of the precipitate and enter this, along with your sodium carbonate concentration, into the spreadsheet on the computer in the classroom.

Include the spreadsheet printout in your notebook.

After the spreadsheet is complete, plot the number of millimoles of sodium carbonate (x-axis) against the mass of precipitate obtained (y-axis) for all the groups in the class. You may use Excel or another spreadsheet program or plot the graph by hand, but whatever the case, you should include a **graph title**, **axis labels** complete with **units**, and **circled (or at least clearly marked) data points**. **Draw a smooth line/curve through the data points**; the line need not go through all of the data points.

Mark on the graph the point where sodium carbonate became the limiting reactant.

Calculate the concentration (in M) of the calcium chloride solution. Show **details** of how you used information from the graph to determine the unknown concentration.

Calculate the **expected yield** (in grams) of calcium carbonate for your reaction, now that you know what the unknown concentration of calcium chloride is.

Calculate the percent yield for your reaction. The formula for % yield is:

$$\% \text{ yield} = \left| \frac{\text{your yield} - \text{expected yield}}{\text{expected yield}} \right| \times 100\%$$

Part 7. Questions

1. Explain your choice of the point on the graph where sodium carbonate became the limiting reagent. In other words, how could you tell that was the point?
2. Though you did not calculate a standard deviation in this experiment, were there any data points that could be considered outliers? In general, how can you determine if there are outliers in this type of experiment?

Part 8. Conclusion

Answer the basic question: What is the concentration of the calcium chloride solution?

Follow-up questions:

- Was the plot of sodium carbonate millimoles versus grams of precipitate an effective way of determining the limiting reactant? Why or why not? Your discussion might include the ease of reading the graph and the presence of any outliers.
- What was your percent yield?
- Ninety percent yield on this type of precipitation reaction is considered good; how did you rate? If your yield was low, what might have caused a low percent yield in your case? Find specific procedural steps where the error might have occurred.

Abstract

Write a short (less than 100 word) summary of a major result of your experiment. Note that the thrust of the abstract is different from the purpose this lab had originally.

For this experiment, submit the information in the shaded area, word-processed, on a separate sheet of paper. The abstract should be stapled to the **front** of your lab report.

Your name and your partner's name, North Seattle Community College
THE LAB TITLE IN ALL CAPITALS

First sentence summarizes the reaction and how the product was collected.

Second sentence reports the percent yield for the reaction, and a description of the product.

Third sentence assesses the efficacy of the procedure in obtaining high yield. One or two causes of low yield may be listed here.