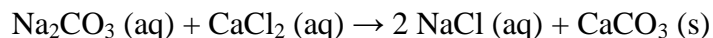


Name: _____

Lab 8. Limiting Reactant

Introduction

In this lab, you will study the yield of the precipitation reaction between sodium carbonate and calcium chloride.



You and your classmates will combine different amounts of sodium carbonate and calcium chloride and measure the yield of the precipitated calcium carbonate product.

Materials

Buchner funnel and collar	Filter paper
Filter flask	Weigh boats
Spatula	Calcium chloride
Sodium carbonate	Centigram balance
Two beakers (50-ml or 150-ml preferred)	50-mL graduated cylinder
Stirring rod	Distilled water
Wash bottle	

Procedure

1. Receive your assignments from your instructor for the masses of calcium chloride and sodium carbonate to use.

Reaction

2. Place a small beaker on the centigram balance. Tare the balance. Measure out approximately the desired quantity of solid calcium chloride into the beaker. Record the mass of calcium chloride in the Data Table.
3. Repeat the previous step with sodium carbonate.
4. Measure out about 20.0 mL of distilled water in a graduated cylinder. Add it to the beaker containing the solid calcium chloride. Stir until the solid dissolves.
5. Repeat the previous step with 20 mL distilled water and the sodium carbonate.
6. Pour one of the solutions into the other. Stir to mix. Allow to stand for five minutes to allow the precipitate to develop.

Isolating the Product

7. Find the mass of a circle of filter paper and a weigh boat. Record in the data table.
8. Set up the Buchner funnel in the filter flask.

9. Turn on the water aspirator to draw a vacuum. Place the circle of filter paper in the funnel and moisten with a squirt of distilled water from the wash bottle. Make certain that the paper adheres to the bottom of the funnel with no gaps.
10. Pour your reaction mixture into the funnel. Rinse the beaker with water from the wash bottle and add the rinse water to the filtering mixture.
11. Allow the mixture to filter until the product on the paper is solid and not a paste.
12. Remove the vacuum hose from the side arm of the filter flask or remove the funnel from the flask to break the vacuum.
13. Turn off the water aspirator.
14. Transfer the filter paper and product to the weigh boat. Place in the drying oven to dry overnight.

Finding the Yield

15. Find the mass of the dry weigh boat with filter paper and product using the centigram balance. Record the mass in the Data Table.

Calculations

1. Calculate the molar masses of calcium chloride, sodium carbonate, and calcium carbonate.
CaCl₂: _____ Na₂CO₃: _____ CaCO₃: _____
2. Subtract the mass of the filter paper and weigh boat from the mass of the filter and weigh boat with product to find the mass of the product alone. Enter in the calculations table
3. Use the molar masses of calcium chloride, sodium carbonate, and calcium carbonate to convert the masses of those compounds to the number of moles. Enter in the calculations table.
4. Find the theoretical yield of product by converting the moles of the limiting reactant to moles of product.
5. Find the percent yield of product by dividing the actual moles of product by the theoretical yield and multiplying by 100%.

Analysis

Combine the data taken by all students in the class. Make a tabular spreadsheet in Google Sheets containing the data, in the format

Experiment ID	moles Na ₂ CO ₃	moles CaCl ₂	moles CaCO ₃
---------------	---------------------------------------	-------------------------	-------------------------

Select the data in the spreadsheet, and Insert Chart. Then, in the Chart Editor, select in the Chart Type menu “column chart” to make a bar graph of the molar amounts of the reactants and product in all of the experiments. Selecting the chart and copying it will allow you to paste it into a document.

Questions

1. (1 point) Why weren't you asked to find the molar mass of the sodium chloride product of the reaction?
2. (4 points) Identify the sources of errors and uncertainties in the measurements you took in this lab. For each error, identify if the error would increase or decrease your estimate of the yield of calcium carbonate product.
3. (2 points) What determines the yield of product in this reaction?

Report

Turn in this lab sheet with the data and calculations tables completed. In a document (a Google doc will work nicely), show the column plot generated by your spreadsheet and answer the questions.

Scoring

In lab	10 points	Of course, I expect you to behave safely, responsibly, and respectfully to your colleagues. Your lab score is awarded for keeping your work station neat and using careful lab technique.
Data	4 points	½ point each entry for each table.
Calculations	7 points	2 points for the molar masses of the reagents, and ½ point each entry for each table.
Graph	2 points	The graph should clearly and accurately present the class data.
Questions	7 points	Points as given above.

Tables**Experiment 1****Data**

mass CaCl_2	
mass Na_2CO_3	
mass filter paper + weigh boat	
mass filter paper + weigh boat + product	

Calculations

moles CaCl_2	
moles Na_2CO_3	
mass CaCO_3 actual	
moles CaCO_3 actual	
moles CaCO_3 theoretical	
percent yield	

Experiment 2**Data**

mass CaCl_2	
mass Na_2CO_3	
mass filter paper + weigh boat	
mass filter paper + weigh boat + product	

Calculations

moles CaCl_2	
moles Na_2CO_3	
mass CaCO_3 actual	
moles CaCO_3 actual	
moles CaCO_3 theoretical	
percent yield	