

Name:

Period:

Seat#:

**Required Sections:** (Refer to R-15 for guidelines and requirements. Make note of any specific changes given by your teacher in class.)

**Prelab:** Purpose, Prelab Questions, Materials, Reagent Table, Procedures, and set up Data Tables before you get to class.

**During Lab:** Data section – Fill out your data table that is already set up from the prelab.

**Post-lab:** Calculation section, Discussion Questions Section (both done in lab notebook), Post-Lab Two Pager (done on separate worksheet).

## **REMINDER - USE R-15 TO ENSURE YOU FOLLOW ALL GUIDELINES/EXPECATIONS/ REQUIREMENTS**

### **Background**

Gravimetric analysis is a quantitative analysis method in which a substance of interest is separated from a mixture by converting it into a new product that can be separated from the mixture. Once the new product is separated from the mixture then it can be weighed. The mass of the new product can be used to work backwards to determine how much of the substance of interest was in the original mixture.

There are many methods of gravimetric analysis, the most common is to utilize the solubility rules of compounds to force the precipitation of the desired substance. Once the substance has precipitated then it can be filtered, dried and weighed.

Typically, the mixture is dissolved in water to make an aqueous solution. Then a reagent is added that will form an insoluble compound with the desired substance, while leaving the rest of the constituents soluble. The insoluble precipitate is often washed or purified to remove contaminants, and then is dried.

Errors during a gravimetric analysis process are often related to the purity of the product, incomplete precipitation, poor filtration methods/technique, or insufficient drying of precipitate.

In this experiment a mixture of NaCl and Na<sub>2</sub>CO<sub>3</sub> will be analyzed to determine the percentage of Na<sub>2</sub>CO<sub>3</sub> in the mixture. The mixture will be dissolved in water, an excess of CaCl<sub>2</sub> will be added to precipitate the carbonate ion as CaCO<sub>3</sub>. An excess of CaCl<sub>2</sub> is used to try to ensure all the carbonate gets precipitated. The CaCO<sub>3</sub> will be filtered, washed, dried and it's mass determined. From the mass of the CaCO<sub>3</sub> formed and the mass of the original sample, the percent of Na<sub>2</sub>CO<sub>3</sub> in the mixture is calculated. Because the results are based on the mass of a product, this procedure is classified as a gravimetric analysis.

### **Prelab Questions** - Remember to paraphrase the questions into your answers, not copy them!

1. What is the difference between qualitative and quantitative analytical methods?
2. Is there any other ion, besides calcium, that could be used in this procedure? If so, why would this ion work?
3. If the calcium carbonate is not dry when its mass is determined, will the calculated percent of Na<sub>2</sub>CO<sub>3</sub> in the mixture be too high or too low? Explain.
4. Write a balanced chemical equation for the reaction that takes place between the Na<sub>2</sub>CO<sub>3</sub> and CaCl<sub>2</sub>.
5. Write the *net ionic* equation for the reaction in Question 4 to emphasize which ions are actually participating in the reaction. Include phases! Separately, list any spectator ions.
6. A NaCl/Na<sub>2</sub>CO<sub>3</sub> mixture had a mass of 2.054 g. When the mixture was dissolved in water and the carbonate precipitated as calcium carbonate using the method described in the prelab with CaCl<sub>2</sub>, the precipitate had a mass of 1.135 g. Perform the following calculations. Make sure to include units everywhere, use sig figs appropriately, use proper dimensional analysis when necessary, etc. Show your work just like your teacher would!
  - a. Calculate how many grams of Na<sub>2</sub>CO<sub>3</sub> were present in the mixture.
  - b. Calculate the percent of Na<sub>2</sub>CO<sub>3</sub> in the mixture.
7. Watch this video and jot down notes so I know you actually watched it 😊  
It goes over the lab technique you will be using.  
It is important you show up knowing what to do so you can finish on time! <https://youtu.be/1E4YmuSY4Ek>



### **Materials** - Remember that a \* means it should be in your reagent table!

#### Chemicals

- \* Mixture of NaCl and Na<sub>2</sub>CO<sub>3</sub> in a vial (~2 g of mixture)
- \* 0.40 M CaCl<sub>2</sub> solution, 80mL

#### Equipment

- Beaker, 250 mL
- Buchner Funnel w/ Filter Flask
- Graduated cylinder, 100 mL
- Glass stir rod
- Metal scoopula
- Filter paper, qualitative
- Weigh boat
- Digital scale
- Drying oven
- Wash Bottle with DI H<sub>2</sub>O

[Google Folder with Most MSDS Files](https://tinyurl.com/2cyva3ku)

<https://tinyurl.com/2cyva3ku>

To help speed up your reagent table!



[Flinn's MSDS Website](https://www.flinnsci.com/sds/)

<https://www.flinnsci.com/sds/>

For anything that isn't in my Google folder.



**Procedure** – Remember to make a flow chart, include diagrams/drawings of steps/equipment etc. Google “flow chart procedures” if you are not familiar with how to make a flow chart. You aren’t just drawing boxes around all your sentences!

- 1) Mass the mixture while it is still in the vial with the lid still on. Record the mass.
- 2) Pour the NaCl/Na<sub>2</sub>CO<sub>3</sub> mixture into the 250 mL beaker.
- 3) Take the mass of the empty vial with the lid on and record your mass.
- 4) Add about 30 mL of distilled water to your NaCl/Na<sub>2</sub>CO<sub>3</sub> mixture in the 250 mL beaker. Stir with the glass rod to help the mixture dissolve. Add a little more water if the mixture doesn’t dissolve well.
- 5) Add 80 mL of 0.40 M CaCl<sub>2</sub> to the dissolved NaCl/Na<sub>2</sub>CO<sub>3</sub> mixture. Swirl to allow precipitate to form.
- 6) Label a clean, dry weigh boat. Put class period and lab bench number clearly.
- 7) Put the dry piece of filter paper into the weigh boat. Record the mass of them together.
- 8) Set up your Buchner funnel, filter flask set up and connect it to the aspirator on the sink.
- 9) Using the DI water bottle, gently wet the filter paper so it sticks onto the bottom of the funnel better.
- 10) Pour your precipitate mixture into the filter paper slowly and gently. Be careful not to allow it to reach the edges of the filter paper so you don’t lose product under the edge of the paper.
- 11) As you filter, use a little water from your wash bottle to rinse down the sides of the beaker. Filter all of your solution and beaker rinse water.
- 12) Once all of your solution has been filtered, gently rinse the precipitate on your filter paper with your squirt bottle. This step removes any excess spectator ions that might be trapped on the filter paper with your precipitate.
- 13) Gently remove your filter paper with precipitate from the funnel (using the metal scoopula) and leave it on the labeled weigh boat to dry overnight (precipitate side up). Your teacher will place it in the drying oven after class.
- 14) The next day, take and record the mass of your weigh boat with the filter paper with precipitate. Be careful not to crumble and lose the precipitate.

### Disposal and Cleanup

Your teacher will provide disposal and cleanup instructions.

**Data Table** - Remember to use enough space, make it look professional, etc!

Make your own data table! Remember, you need to make sure your data table has all required elements! A sample is provided to the right. You will need to add a descriptive title, units on all rows/columns, and a spot for qualitative data, etc. The one shown here is not adequate!

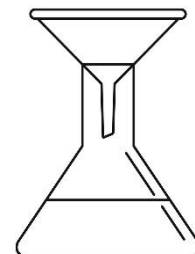
Mass of vial + NaCl/Na <sub>2</sub> CO <sub>3</sub> salt mixture	Sample
Mass of empty vial	
Mass of salt mixture used	
Mass of labeled weigh boat with dry filter paper	
Mass of weigh boat + filter paper + precipitate after drying overnight	
Mass of CaCO <sub>3</sub>	

**Calculations** - Show all calculations, use proper dimensional analysis, units everywhere, proper sig figs, etc.

1. Calculate the number of grams of Na<sub>2</sub>CO<sub>3</sub> in your original mixture.
2. Calculate the number of grams of NaCl in your original mixture.
3. Calculate the percent of Na<sub>2</sub>CO<sub>3</sub> and the percent of NaCl in your original mixture.  
Be sure to obtain the accepted % from your teacher so you can complete your Post Lab Two Pager assignment

**Post Lab Discussion Questions** - Do not recopy the questions, just paraphrase them into your answer.

1. Using the specific number of grams of Na<sub>2</sub>CO<sub>3</sub> in your mixture, calculate exactly how many mL of your 0.40 M CaCl<sub>2</sub> you would have needed to precipitate the CO<sub>3</sub><sup>2-</sup>. Did you use that exact amount, less, or more during the lab?
2. Why is an excess of calcium chloride added to precipitate the carbonate? In other words, why are we using extra?
3. Why is it necessary to wash the precipitate with DI water? Would it be ok to use tap water? Why or why not?
4. Why isn’t calcium fluoride used to precipitate the carbonate?
5. Sketch the diagram (to the right) into your lab notebook. Turn it into a “particle diagram” showing where the Na<sup>+</sup>, Cl<sup>-</sup>, CaCO<sub>3</sub> particles are. Are they on the filter paper or in the flask?
6. If you boiled off the water from your flask and weighed what was left, would it match the mass of sodium chloride you calculated in Calculation Q #2? Would it be more than, less than, or equal to what you calculated? Why?
7. “Numismatics” is the scientific study of money and its history. Since 1965 American dimes have been made of 75% copper and 25% nickel. Before 1965 dimes were made of copper and silver. Using the data table below, calculate what percent of the pre-1965 dimes were silver. The dimes were dissolved in acid and then precipitated by adding sodium chloride.



Mass of dime	2.8357 g
Mass of dry filter paper	0.7942 g
Mass of AgCl precipitate and filter paper	4.1860 g
Mass of AgCl	
% Composition of Ag in AgCl	
Mass of Ag in AgCl sample	
% Ag in dime	

