

Lab #5: Gravimetric Analysis of a Metal
Carbonate Lab Exercise

Chemistry II
10 points

Name: _____

Partner: _____

USE BLUE/BLACK INK!!!!

Date: _____ Hour: _____

Goal:

The goal of this lab is to determine gravimetrically the identity of a Group 1 metal carbonate using a double displacement reaction.

Introduction/Background:

A large variety of analytical techniques and procedures, ranging from instrumental methods such as spectroscopy and chromatography to more classical processes, such as qualitative and gravimetric analyses, have been created to help chemists identify unknown compounds. In this experiment, an unknown Group 1 metal carbonate, symbolized as M_2CO_3 , will be analyzed to determine the identity of the Group 1 metal, symbolized as M.

A known amount of soluble unknown carbonate will be dissolved in water to dissociate the compound into its ions. When a solution of calcium chloride is added to the metal carbonate solution, a precipitate of calcium carbonate forms. The precipitated calcium carbonate is then filtered, dried, and weighed. The moles of calcium carbonate are equal to the moles of the Group 1 metal carbonate (M_2CO_3) added to the original solution. Dividing the mass of unknown carbonate by the moles of calcium carbonate yields the molar mass, and thus the identity, of the Group 1 metal carbonate.

NOTE: This lab may extend to a second day.

Research questions: (If more room is needed to answer a question, additional pages may be attached.)

1) What does the word gravimetric indicate? _____

2) Metal carbonates are often hygroscopic and must be dried before being massed.

(a) What does hygroscopic mean? _____

(b) How will we ensure that our metal carbonate will be dry before massing it?

3) Which metals are considered part of Group 1? _____

4) Write the equation for the metal carbonate dissolving in water.

- 5) Write the full equation for the calcium chloride solution being added to the metal carbonate solution.
- 6) Write the net ionic equation for the reaction in question #5.
- 7) An unknown metal carbonate was analyzed gravimetrically. A student recorded the following data:

mass of crucible + M_2CO_3	12.627 g
mass of crucible	10.655 g
mass of M_2CO_3	1.972 g
mass of filter paper	0.598 g
mass of filter paper + $CaCO_3$	2.436 g
mass of precipitated $CaCO_3$	1.838 g

- (a) From the mass of calcium carbonate, calculate the moles of calcium carbonate.
- (b) Calculate the molar mass of the unknown M_2CO_3 by dividing the mass of the unknown metal carbonate by the number of moles of carbonate calculated above.
- (c) Calculate the molar masses of the first three Group 1 metal carbonates.
- (d) What is the identity of the unknown metal carbonate?
- (e) Calculate the percent error in the molar mass of the unknown metal carbonate.

- 8) Calculate the mass of calcium chloride dihydrate needed to prepare 2.0 L of 0.2 M calcium chloride solution.

Materials:

125 mL 0.2 M CaCl ₂	2 g unknown metal carbonate
1 cg balance	2 400 mL beakers
1 Bunsen burner	1 sparker
1 heat resistant pad	1 crucible
1 pair of crucible tongs	1 drying oven
1 glass funnel	1 funnel brush
1 piece of filter paper	2 glass stirring rods
1 250 mL graduated cylinder	1 ring stand
1 iron ring	1 clay triangle
1 medium scoop	1 microscop
1 watchglass	1 desiccator
1 stopwatch	1 10 mL beaker
1 250 mL beaker	

Hazards:

The student safety contract applies. The unknown metal carbonate is slightly toxic by ingestion. Calcium chloride solution is slightly toxic by ingestion and a mild irritant to skin, mucous membranes, and eyes.

Procedure:

1. Prepare crucible
 - a. physically and chemically crucible
 - b. heat for 3 minutes to drive off cleaning water
 - c. allow the crucible to cool in the desiccator
2. Prepare equipment during heating and cooling of crucible
 - a. physically and chemically clean the beakers, scoops, stirring rods, and funnel
 - b. dry the equipment
 - c. label the 10 mL beaker M_2CO_3 and initials
3. Mass 2 g of the metal carbonate
 - a. mass the empty, cool crucible
 - b. move the riders over 2 g
 - c. add chemical until the pointer points to zero
4. Heat the crucible + unknown
 - a. use gentle heat for 3 minutes
 - b. cool in the desiccator
5. Repeat steps 3 and 4 until mass no longer decreases
6. Make the metal carbonate into a solution
 - a. add the crucible contents to a 400 mL beaker

- b. add about 200 mL of distilled water to the beaker
 - c. stir to dissolve the unknown carbonate
7. Precipitate calcium carbonate
 - a. obtain about 125 mL of calcium chloride solution in a labeled 250 mL beaker
 - b. add the calcium chloride solution to the metal carbonate in the 400 mL beaker
 - c. allow the precipitate to settle for 5 minutes.
8. Mass a piece of filter paper.
9. Set up to filter
 - a. attach iron ring to ringstand
 - b. place funnel in iron ring
 - c. fold massed filter paper
 - d. place filter paper into funnel
 - e. use the second 400 mL beaker to filter into
10. Decant the liquid from the precipitation reaction into the filter using a stirring rod
 - a. make sure the liquid level stays below the top of the filter paper
 - b. when all but about 10 mL of the liquid has been transferred, swirl the beaker to suspend the precipitated calcium carbonate
 - c. transfer the suspension into the filter
 - d. rinse the precipitation beaker with distilled water
 - e. transfer the rinse water into the filter
11. When all of the precipitate has been transferred into the filter, rinse the solid with distilled water three times
12. Dry the precipitate
 - a. label the watchglass with initials
 - b. carefully remove the filter paper from the funnel with the microscop
 - c. transfer the filter paper to the watchglass
 - d. open the filter paper
 - e. place the watchglass and filter paper in the drying oven
 - f. after 10-15 minutes of heating, remove the watchglass and filter paper
 - g. use the microscop to break up the calcium carbonate into smaller particles
 - h. dry in the drying oven for an additional 5 minutes
13. Mass the cooled precipitate
14. Repeat steps 12 and 13 until the mass remains constant
15. Clean up

****RECORD DATA ON A SEPARATE SHEET****

Post-lab calculations and questions (answer on a separate sheet and attach):

- 1) Calculate the moles of precipitated calcium carbonate
- 2) Calculate the molar mass of the unknown carbonate (see research for details)
- 3) Identify the unknown carbonate. Explain your reasoning.
- 4) Calculate your percent error