Laboratory Investigation Name _____

Chemistry: Form L5.6A Date _____ Period _____

Analyzing Double Replacement Reactions

PROBLEM

How can you identify and quantify the products of a double replacement reaction?

INTRODUCTION

Double replacement reactions occur between ionic compounds dissolved in water. There are no electrons lost or gained. Instead, dissolved ions switch places. When ionic compounds dissolve, the ions dissociate. Once the ions are separated in water, it is possible for them to reassociate, or form new associations. If one of the products that forms is insoluble, a precipitate will form, and the reaction will go to completion. In this laboratory investigation, you will collect the precipitate of a double replacement reaction, identify it, and measure its mass. The you will compare its observed mass to the expected value.

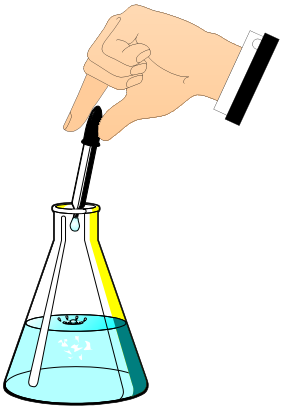
MATERIALS (*per group*)

balance; 50 mL beaker; calcium chloride solution (1 M); drying oven (optional); filter paper; 125 mL flasks (2); funnel; 25 mL graduated cylinder; medicine dropper; reference tables; sodium carbonate solution (2 M)

PROCEDURE

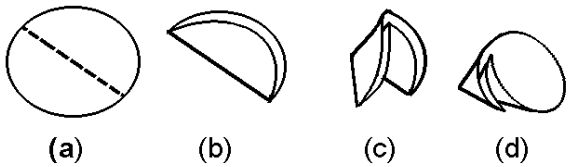
1. Using a graduated cylinder, measure exactly 25 mL of 1 M calcium chloride solution. Transfer the solution to a 125 mL flask.

2. Fill a small beaker partway with 2 M sodium carbonate solution. Using a medicine dropper, add the sodium carbonate solution to the calcium chloride solution in the flask one drop at a time. Note the precipitate that forms.

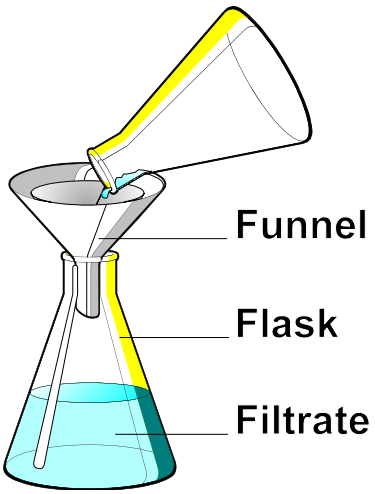


3. Keep adding sodium carbonate to the calcium chloride solution until no more precipitate forms. As the amount of precipitate decreases, it will become harder to see. Allow the precipitate to settle and look for cloudiness where the drops of sodium carbonate enter the calcium chloride solution.

4. Measure the mass of a piece of filter paper with a balance. Record the mass of the filter paper in the data table on the next page. Then, fold the piece of filter paper into a cone, as shown in the diagram below, by folding it into quarters and opening it up so one quarter is separated from the other three.



5. Place a funnel into a clean flask as shown in the diagram to the right. Put the cone shaped filter paper into the funnel. Swirl the flask containing the precipitate by the neck to mix the solution and the precipitate well. Pour the mixture through the filter paper.



6. Add sodium carbonate dropwise to the filtrate. If no precipitate forms, skip to the next step. Otherwise, keep adding sodium carbonate to the filtrate until no more precipitate forms. Then, place the funnel containing the precipitate into the empty flask and filter the mixture. Keep repeating this step until the

filtrate remains clear after addition of sodium carbonate.

7. Once all the precipitate has been collected, unfold the piece of filter paper and set it aside over night or place it in a drying oven until dry.

8. When the filter paper is dry, measure the mass of the filter paper plus the precipitate and record the mass in the data table below. Calculate the mass of the precipitate and record the result.

9. Calculate the mass of the reacting calcium chloride using the relationship $g = M \times L \times GFM$ and record the result. Based on your observations, write a balanced equation for the reaction in the CONCLUSION section below. Refer to the reference tables to determine which product is the precipitate. Then, using the exact amount of reactant from your data table below, fill in the mass-mass table below to determine the theoretical amount of product that should have formed.

10. Determine the absolute and the percentage error in the CONCLUSION section below.

OBSERVATIONS

[a] Mass of filter paper . . . . . _____

[b] Mass of filter paper plus precipitate . . . . . _____

[c] Mass of precipitate (**b**-**a**) . . . . . _____

[d] Mass of reactant (calcium chloride) . . . . . _____

CONCLUSIONS

1. Complete the following double replacement equation and balance it:

___Na_2CO_3 + ___$CaCl_2$ → _____ + _____

2. Which product is the precipitate based on *Table E* of the reference tables? _____

_____

3. Complete the factor label problem below using the data you gathered to determine the theoretical mass of the product.

$$(1)\, g_{CaCl_2} \times \frac{1\, mol_{CaCl_2}}{(2)\, g_{CaCl_2}} \times \frac{(3)\, mol_{\text{Precipitate}}}{(4)\, mol_{CaCl_2}} \times \frac{(5)\, g_{\text{Precipitate}}}{1\, mol_{\text{Precipitate}}}$$

(1) = observed mass of $CaCl_2$. _____
(2) = GFM of $CaCl_2$ . . . . . _____
(3) = Coefficient of precipitate _____
(4) = coefficient of $CaCl_2$ . . _____
(5) = GFM of precipitate . . . _____

[e] Theoretical amount of product . . . . . _____

4. Do an error analysis below:

[f] Absolute error (|**c**-**e**|) . . . . . _____

[g] Percentage error (**[f/e]×100**) . . . . . _____

5. How good were your results? What are some possible sources of error? _____

_____

6. Two ionic compounds, AB and CD, react in water. Write an equation showing the double replacement reaction that occurs. _____