Purpose
The purpose of this experiment is to determine the limiting and excess reagents and calculate the theoretical yield of a product by analyzing lab data.

Introduction
The reaction between baking soda and vinegar produces water, sodium acetate dissolved in water and gaseous carbon dioxide. For the purposes of this lab you will assume that there are .0249 mol of acetic acid available to react in each reaction. Use this information to answer the pre-lab questions.

Pre-Lab
1. When baking soda (sodium bicarbonate) and vinegar (acetic acid) react together they form sodium acetate, water and carbon dioxide. Write the balanced chemical equation for this reaction.

2. Convert each of the following from moles to grams of baking soda:

   Trial 1
   0.0150 mol baking soda

   Trial 2
   0.0200 mol baking soda

   Trial 3
   0.0350 mol baking soda

Materials
Graduated cylinder
3 erlenmeyer flasks
White vinegar
Baking soda
Balance
Procedure
1. Gather materials, clean any dirty glassware.
2. Measure out the three amounts of baking soda you calculated from pre-lab #2 into three weigh boats. Record these measurements.
3. Measure 30.0 mL of white vinegar into each Erlenmeyer flask. A total of 90.0 mL of vinegar will be required for each group (30.0 mL per flask).
4. Take the mass of each flask containing vinegar, and record these measurements.
   **Be sure to label your flasks!**
5. Pour the measured baking soda for Trial 1 into one of the flasks containing 30 mL of acetic acid. Record your qualitative observations of the reaction in the table titled “Qualitative Observations” below.
6. Take the mass the flask and its contents after the reaction occurs. Record these measurements.
7. Repeat procedural steps 5 and 6 for Trials 2 and 3.
8. Clean up your materials, and begin calculation questions.
   **All chemical waste can poured down the sink with running water.**

Data
In the space provided below, create a data table including a properly labeled title and axes. Record qualitative data in the table provided to the right.

<table>
<thead>
<tr>
<th>Qualitative Observations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Questions/Calculations

1. Calculate the change in mass for each trial. Record these calculations in Table 1.

Table 1

<table>
<thead>
<tr>
<th>Change in mass (g)</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
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</thead>
<tbody>
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2. What is the cause of the change in mass?

_____________________________________________________________________
_____________________________________________________________________

3. According to the balanced equation, what is the mole ratio of baking soda to vinegar?

4. a) Predict the theoretical yield of carbon dioxide gas produced in each trial assuming baking soda is the limiting reactant. Show unit conversions.

b) Predict the theoretical yield of carbon dioxide gas produced in each trial assuming acetic acid is the limiting reactant. Show unit conversions.

c) Determine the limiting reactant in each trial. Explain your answer.

_____________________________________________________________________
_____________________________________________________________________

Trial 1

Trial 2

Trial 3

Change in mass (g)
5. In which flask are there excess reactants? **Explain your answer.**

__________________________________________________________________________

__________________________________________________________________________

**Additional Questions**

1. In another trial, Ms. Lamey used 30 mL of acetic acid containing .0249 moles of acetic acid. If she reacted 3.00 g of baking soda, calculate the following:
   a) The limiting reactant showing unit conversions.

   b) The theoretical yield of carbon dioxide gas produced.

   c) Ms. Lamey calculates the change in mass to be 1.46 g. Calculate the percent yield of carbon dioxide gas.

   d) Identify the reactant in excess and calculate the mass of excess reactant that remains in the flask.