Decomposition of Baking Soda

**Purpose:** The goal of this experiment is to determine by measurement which of three possible decomposition reactions occur when baking soda is heated. Your challenge is to determine the mass of baking soda and its decomposition products in order to decide what chemistry is taking place.

**Reference:** This experiment was first described by Jesse Bernstein and Jeff Bracken at the ChemEd Conference in 2003.

**Background:** Sodium bicarbonate (baking soda, properly known as sodium hydrogen carbonate) is used in the preparation of many foods. When it decomposes, carbon dioxide is produced, and this gas produces bubbles in the food that make it "lighter" (less dense). For instance, baking soda is often used in baking cakes, in order to make them "rise" as they are cooked. As the temperature of the cake batter reaches approximately 50 °C, the baking soda decomposes and carbon dioxide is released. Baking soda is especially important in making pancakes and waffles because the high cooking temperatures (350-400°F or 175-230 °C) cause the carbon dioxide to be liberated before the dough has set. Thus, we get a light and tasty finished product. Many people who are sensitive about the presence of "chemicals" in their food are surprised to learn that this chemical and its reaction products are essential to the preparation of foods that we eat all the time.

**Possible chemical reactions:**

\[
\text{sodium bicarbonate (solid)} \rightarrow \text{sodium hydroxide (solid)} + \text{carbon dioxide (gas)}
\]

\[
\text{sodium bicarbonate (solid)} \rightarrow \text{sodium oxide (solid)} + \text{carbon dioxide (gas)}
\]

\[
\text{sodium bicarbonate (solid)} \rightarrow \text{sodium carbonate (solid)} + \text{carbon dioxide (gas)} + \text{water (gas)}
\]

**Materials:**

- Baking soda
- Evaporating dish
- Ring stand
- Wire Gauze
- Iron Ring
- Metal Spatula
- Crucible tongs
- Balance
- Safety goggles!

Copyright 2007
Hal Harris
Procedure:
1. Write a brief description of the purpose of the experiment in your laboratory notebook.
2. Confer with your laboratory partner(s) to decide on a procedure for carrying out this experiment. After you have agreed upon a method that you believe will work, write a detailed description of it in your laboratory notebook, including a table into which your experimental data will be entered. Be sure to include every measurement that you intend to make, and use the appropriate units for each of them.
3. Show your procedure to your laboratory instructor, and get his or her approval before beginning any laboratory work.

Laboratory Report:
In addition to the purpose you have already written, your laboratory notebook must include the data you and your partner(s) have obtained. Balance each of the equations that represent the three possible decomposition equations. Use these equations to calculate the mass of the product that would be obtained, if each of those reactions occurs. Based upon your experimental results, which of the reactions do you believe is the correct one, and why?
Experiments are never without experimental error, and it is important that conclusions be based on more than a single measurement. Therefore, you should repeat the experiment at least twice, each time using a different amount of baking soda. You should report the experimental (percent) error in your results. Consider what could have caused any difference between your result and the predicted one. Give four possible sources for error in the experiment: two that would result in a error on the "high" side and two for an error on the "low" side. How accurate must the result be, in order to rule out the two incorrect reactions?

In your opinion, did your laboratory partners contribute fairly to the completion of this experiment? ______________. If not, describe any discrepancy. Turn in this sheet along with relevant pages from your laboratory notebook.

Your name ____________________
Laboratory partner(s) ________________  __________________
________________________  __________________