Name:_____

Decomposition of Baking Soda

Introduction:

Baking soda, or sodium hydrogen carbonate ($NaHCO_3$), decomposes upon heating. The chemical reaction for this is described by one of the following three equations:

a) Sodium hydrogen carbonate (s) → sodium hydroxide (s) + carbon dioxide (g)

b) Sodium hydrogen carbonate (s) → sodium oxide (s) + carbon dioxide (g) + water (g)

c) Sodium hydrogen carbonate (s) → sodium carbonate (s) + carbon dioxide (g) + water (g)

The purpose of this experiment is to experimentally determine which one of these equations accurately describes the decomposition of baking soda. Using stoichiometry, you will determine how much solid product you would theoretically have left for each equation after decomposing 2g of baking soda and compare this with your experimental results.

Materials:

Baking soda (~ 2g)
Clamp stand
Ceramic triangle
Tongs
Crucible with lid
Ring clamp
Bunsen burner
Spatula

Safety:

- The crucible and ceramic triangle will get **very** hot over the course of the experiment.
- Please exercise **extreme** caution when handling any hot objects, especially the Bunsen burner – make sure that it is stable and not leaning over.
- Be careful about getting any clothing or hair near the Bunsen flame – tie back long hair and roll up long sleeves.
- Use tongs to handle the hot crucible – first remove the lid and set it aside, then grab the crucible by its lip. Do **not** attempt to use the tongs to grab the crucible by its sides as it tends to slip that way.

Procedure:

1) Weigh out the empty crucible. Write this down as **w1** = _____g.

2) Weigh out about 2g of baking soda in your crucible (you do not have to be exact). Break up any clumps using the spatula – you should have a fine white powder. Write down the weight of the crucible and baking soda as **w2** = _____g.

3) The mass of baking soda, **w3** = w2 – w1 = _____g.

4) Set up your apparatus according to **figure 1**. The ring clamp should be lowered enough so that the crucible will be placed in the heart of the Bunsen flame during the experiment.

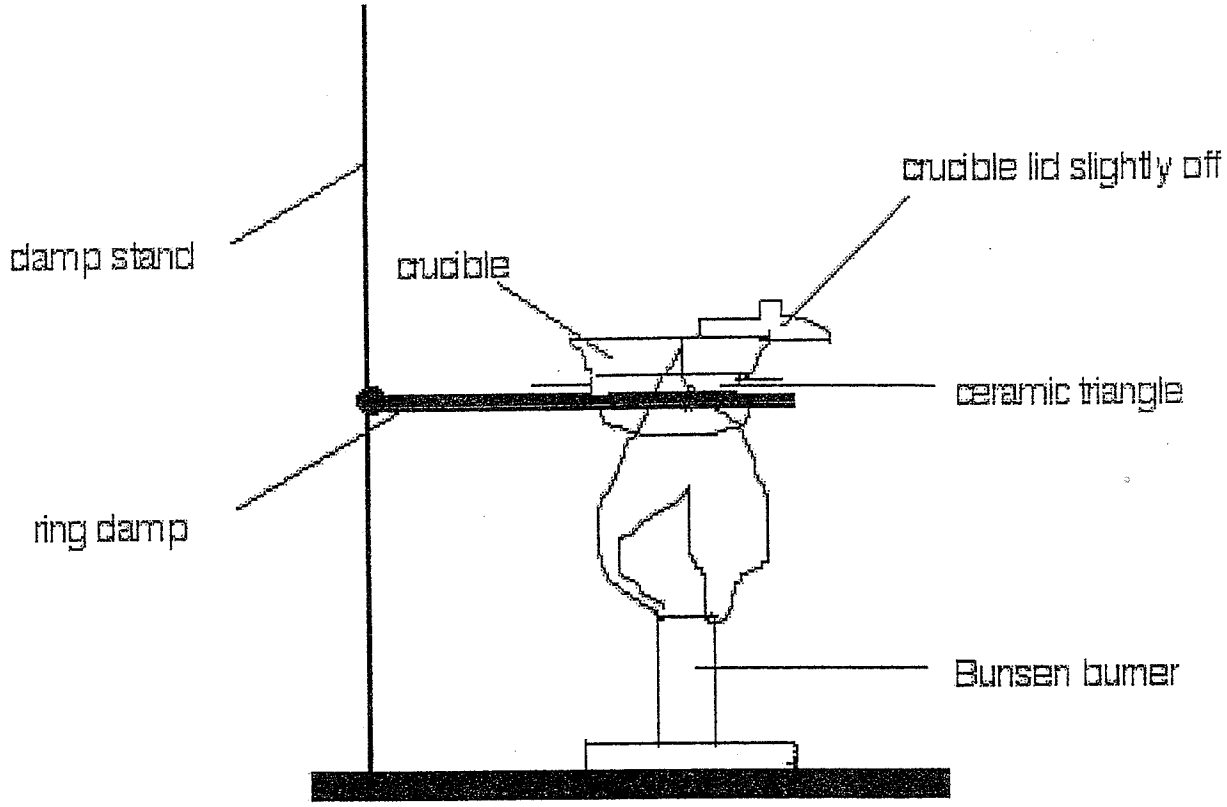

Figure 1

5) Heat the crucible for about 10 minutes. Using the tongs, remove the crucible according to the directions in the safety section and weigh it. Use the spatula to break up any clumps that may have formed. Now heat the crucible for another minute or two – has the mass changed? If so, then heat it for another minute or two and repeat as necessary. Once you reach a constant mass, record the mass of the crucible and product as **w4** = _____g.

6) The mass of your product should be **w5** = w4 – w1 = _____g.

7) Do more than one trial, preferably three if time permits.

You now know the mass of sodium hydrogen carbonate you started off with (**w2**) and the mass of solid product left over after decomposition (**w5**). Please answer the following questions.

1) Write out **balanced** chemical equations for the three possible decomposition reactions listed in the introduction.

a)

b)

c)

2) How many moles of sodium hydrogen carbonate did you start off with? Hint: the molar mass of $NaHCO_3$ is 84.01g/mol.

3) Theoretically, what **mass** of solid product would you be left with for each of your three equations, based off the moles of sodium hydrogen carbonate you started off with? Hint: the molar masses of Na, O, C and H are 22.99g/mol, 16.00g/mol, 12.01g/mol and 1.01g/mol respectively.

a)

b)

c)

4) Using **w5**, which equation (**a**, **b** or **c**) was correct?

5) Assuming that your theoretical and actual results are not exactly the same, account for any sources of error. Please do not just say "human error" or "experimental error".

6) Why did we leave the crucible lid slightly off - why not just close the crucible completely? There is more than one answer to this question.

7) Using your answer to question 4, how many grams of sodium hydrogen carbonate would you need to collect 0.002 mol of carbon dioxide?

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