Baking Soda Stoichiometry Lab Name: ____________________ Partner: ____________________

In this lab, you will combine your powers of observation, reasoning, equation balancing, and knowledge of stoichiometric calculations to earn a perfect 10 / 10 (hopefully).

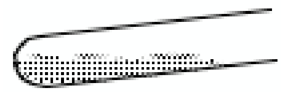
Procedure:

Data Table	

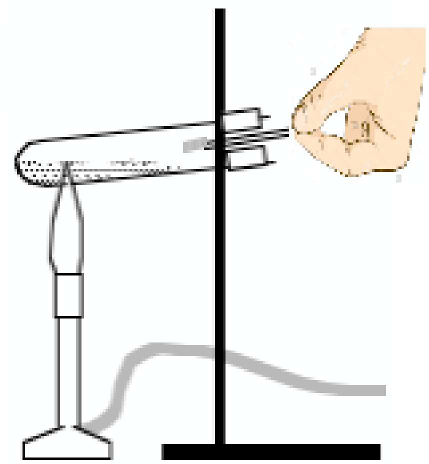
- 1. Obtain a large Pyrex test tube & weigh it on one of the scales in the front of the room. Record this mass in the table at right. Pyrex is a kind of glass that can be subjected to very high (and low) temperatures without shattering.

- 2. Go back to your lab station & place one large scoop of baking soda ($NaHCO_3$) into the test tube. Then, using the same scale as before, weigh the test tube with the baking soda. Record this mass in the data table. (You should be able to figure out the mass of the baking soda in the test tube.)

- 3. Holding the test tube nearly horizontal, shake the baking soda gently so that it spreads out a bit as shown:



- 4. Then tighten the test tube clamp gently around the test tube, just below the lip so that it is positioned nearly horizontally, about 20 cm above the lab desk as shown:



- 5a. Have one person put one drop of the green indicator solution on the end of the small swab. Then carefully hold the end in the mouth of the test tube as shown:
- 5b. Have another person light a burner and adjust it to a cool flame (vent closed) hitting the bottom half of the test tube as shown: This will initiate a chemical change (a sort of decomposition reaction) that breaks the $NaHCO_3$ down... not into its elements, but into <u>three separate compounds</u>.
- 5c. See if you can observe a distinct color change in the chemical indicator.
  - If a metal oxide like K_2O, Na_2O, or MgO is being produced, it will create a basic (alkaline) solution and turn the indicator blue.
  - If a nonmetal oxide like NO_2, SO_3, or CO_2 is being produced, it will create an acidic solution & turn the indicator yellowish.

What color does it become? ________ So, is the reaction producing a metal or nonmetal oxide? __________ Look at the chemical formula of the substance you are heating: $NaHCO_3$. So, what common oxide is being produced in the test tube? [ ]

6. What do you observe happening in the upper half of the test tube? ______________________________
   What common substance appears to be a second product of this reaction? [ ]

7. Move the burner occasionally to a different spot to ensure a **thorough heating** of the baking soda. Consider the substance that is left in the test tube... it may look just like the baking soda you started with, but it actually has been converted into something else: sodium carbonate. This is the third product. What is the correct formula for sodium carbonate? [ ] *(hint: look at your ion sheet & remember to balance charges)*

Now go down and answer questions 1-4 below, but keep an eye on the time. After you have been heating the test tube for 8~10 minutes, check the inside walls of the test tube. If there is still moisture, move the burner to drive out all the moisture. Then, turn off the burner and let the test tube cool for 5~6 minutes.

Questions:

1. You should have figured out from steps #5, 6, 7 above what the three products are. Write the unbalanced chemical

equation for the reaction that just took place: ____

Check it with the teacher to make sure you have it right, then go back & balance it. (Hint: it's very easy w/ small #'s)

2. Look back at your data table above. What mass of the $NaHCO_3$ did you start with in the test tube? ____________

3. Starting with that mass of $NaHCO_3$, use stoichiometry & the balanced equation to figure out what mass of sodium carbonate you should have ended up with in the test tube. **<u>Show work using dimensional analysis below:</u>**

4. So... assuming all the baking soda you started with got converted into sodium carbonate, what should the test tube & its contents weigh now? [ ]

This is your official prediction. Make sure it is correct. Your grade depends on it!

If your prediction is within...	then your grade will be...
0.03 g	10 / 10
0.10 g	9 / 10
0.20 g	8 / 10
0.30 g	7 / 10
0.50 g	6 / 10
1.00 g	5 / 10
5.00 g	4 / 10
10.00 g	3 / 10
20.00 g	2 / 10
50.00 g	1 / 10
otherwise you get a 0/10	

If your test tube has been cooling for 5~6 minutes, it is ready for the official weigh-in! Bring the test tube, along with this sheet containing your prediction above, up to the balances. *Your teacher* will weigh it on the same scale you used, but not show you the weight. They will tell you your grade based on how close your prediction was to the actual weight (see table at right). If you are satisfied with your grade, congratulations! You are done. If you are not satisfied, you can go back, correct your mistake and change your prediction for a 2nd attempt. The 2nd attempt will cost you 1 point, and you may end up with a lower score. So, only try the 2nd attempt if you are fairly sure you can correct any mistake you may have made the first time.

5. Observe the substance that remains left behind in the test tube; compare it to the sealed tube of $NaHCO_3$ at your lab station. Do you notice any slight difference between the two?
____

After you have finished all of the above, rinse out the test tube into the sink, then place it in the "used" bin at the back of the lab near the sink. Take a fresh (dry) test tube and place it in the clamp for the next group.

Follow-Up Questions:

6. If you hadn't heated up the test tube long enough, would that make your prediction too high, too low, or no effect?

Explain: ____

7. CO_2 is more dense than air. So why did the CO_2 you produced from the reaction rise upwards out of the opening

of the test tube? ____

8. Why did the water only condense on the upper half of the test tube? ______________________________

9. Using your original mass of baking soda ($NaHCO_3$) from question 2, calculate the mass of H_2O that was produced:
(show work):

10. Using your original mass of baking soda ($NaHCO_3$) from question 2, calculate the mass of CO_2 that was produced:
(show work):

11. Add the two masses from #9 and #10 above along with the calculated mass of sodium carbonate produced from

question #3: **#9** ___________ + **#10** ___________ + **#3** ___________ =

What total mass of products does this give? ________________

12. How does this mass (#11) compare with the initial mass of $NaHCO_3$ you put in the test tube??

13. If a person accidentally leaves a pan of oil on the stove, it might get so hot it will ignite. This is known as a grease fire. Pouring water on a grease fire is a bad idea, because the water (being more dense than the grease) will sink in the oil, expand rapidly in the heat, and splatter the grease thus spreading the fire. Pouring baking soda on a grease fire is a much better idea. Why?

14. Chemical reactions can be categorized as either ***exothermic*** (heat is given off by the reaction) or ***endothermic*** (heat is taken in by the reaction). What type of reaction is the decomposition of $NaHCO_3$? ____________________
How do you know this?