**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_Period\_\_\_\_\_\_\_\_**

**STOICHIOMETRY LAB (Virtual)**

**Purpose**: a) predict the mass of product formed from a chemical reaction

 b) compare the actual experimental mass of product with the predicted (theoretical) mass

**Background Information:**

In this lab, you will react a precisely measured amount of solid sodium bicarbonate (NaHCO3) with an excess of aqueous hydrochloric acid (HCl). The result is actually a DOUBLE REPLACEMENT reaction followed immediately by a DECOMPOSITION reaction:

 Double replacement: NaHCO3(s) + HCl(aq) 🡪 NaCl(aq) + H2CO3(aq)

 Decomposition: H2CO3(aq) 🡪 CO2(g) + H2O(l)\_\_\_\_\_\_\_\_\_\_

We can “add” these together to get: **NaHCO3 (aq) + HCl (aq) 🡪 NaCl(s) + CO2(g) + H2O(l)**

**Materials**: 100 mL beaker, watch glass, glass stir rod, hot plate, wash bottle, balance, sodium bicarbonate, hydrochloric acid (HCl), bromothymol blue

**Procedure**:

**Watch this video (** <https://www.youtube.com/watch?v=vjVrIFScsls> **) to see the lab being conducted. After you have watched the video, carefully read the procedures below. Data has been recorded for you. Watch the video again if you need to!**

1. Measure the combined mass of the beaker and watch glass. Be sure each is clean and dry.
2. Now, place only the beaker on the balance. “Zero” the balance. Please ask if you do not know how to do this. Using a scoopula, add approximately 2.00 grams of sodium bicarbonate (NaHCO3) to the beaker. Record the exact mass of the sodium bicarbonate in your data table.

3. Add approximately 5 mL of distilled water to the beaker. Swirl or stir with a glass stir rod until all or

 most of the sodium bicarbonate is dissolved.

4. Add two drops of bromothymol blue to the beaker. Swirl to mix. Bromothymol blue is an indicator

 that is blue in the presence of a base (like NaHCO3) and yellow in the presence of an acid (like HCl).

5. Obtain a small amount of 3 M HCl in a large barrel pipet. **This is very concentrated acid**, SO DO NOT

 TAKE YOUR SAFETY GOGGLES OFF UNDER ANY CIRCUMSTANCES.

6. Cover the beaker with the watch glass. The concave side of the watch glass should be facing up.

 Add HCl through the spout of the beaker. Add only a few drops of HCl at a time.

7. After every few drops of HCl, CAREFULLY swirl the beaker from side to side. You want all

 the sodium bicarbonate to come in contact with hydrochloric acid. Do not remove the watch glass.

 Continue adding HCl until the mixture stops bubbling and the solution has a **slight** yellow

 appearance. You want to be certain that all the sodium carbonate has reacted and there is a **slight**

 excess of HCl.

8. Use the wash bottle to rinse the bottom of the watch glass. Make sure to hold the watch glass over

 the beaker. Also rinse the sides of the beaker. This is to ensure that any sodium carbonate that may

 have spattered goes into the solution and is reacted with HCl.

9. Place the beaker on the hot plate. **Gently heat** the contents of the beaker. You do not want the

 contents to spatter! Continue to heat until contents are dry. How can you be certain that all the

 water is gone?

10. Use the glove to remove the beaker from the hot plate. Sit the beaker on the wire gauze and allow

 to cool to room temperature.

11. Measure the mass of the beaker and solid product.

12. If time allows, repeat steps 9-11 until constant mass is obtained.

12. Wash the beaker and watch glass with water and dry. All contents may go in the sink.

**Data Table:**

|  |  |
| --- | --- |
| Mass of empty beaker  | **90.25 g** |
| Mass of NaHCO3  | **3.67 g** |
| Mass of beaker and contents after 1st heating | **92.71 g** |
| Mass of beaker and contents after 2nd heating | **92.68 g** |
| Mass of beaker and contents after 3rd heating | **92.68 g** |
| Mass of solid product (You can calculate this yourself!) |  |

**Post-Lab Questions:**

**Answer the following questions on notebook paper. For questions 1-4, answer in complete sentences. For questions 5-7, write the question and then show all math needed to answer the question. Use good sig figs and don’t forget units.**

1. Using the chemical names, write a sentence or two describing the chemical reactions – look at the balanced, formula equations from the prelab.
2. What is the chemical name and formula for the solid product from this reaction? What is the chemical name and formula for the gas that produced the bubbles from this reaction?
3. What is the mole ratio between sodium bicarbonate and sodium chloride?
4. What is the limiting reactant in this reaction? What is the excess reactant? Explain your choice.
5. Calculate the theoretical yield of sodium chloride.
6. Calculate the actual yield of sodium chloride.
7. Calculate the percent yield of sodium chloride.
8. What is the only way to be certain all the water has been removed from the evaporating dish?
9. Give one source of error which you think may have influenced the accuracy of your experimental results. Indicate whether this error made your **percent yield calculation** too high or too low. Explain.
10. Practice Problem: An excess of chlorine gas reacts with 16.5 grams of solid aluminum.
11. Write the balanced, formula equation for the reaction.
12. How many grams of chlorine will react completely with 16.5 grams of aluminum?
13. What is the theoretical yield of the reaction?
14. If this reaction has a 91.3% yield, how many grams of solid product are actually

 produced?