**Limiting Reactants and Percent Yield**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Pre-Lab:**

1. Write the balanced chemical equation for the reaction between sodium bicarbonate and acetic acid.
2. Calculate the mass of sodium bicarbonate required to react fully with 2.48 grams of acetic acid. Show work.
3. How many grams of carbon dioxide should be produced when 2.48 grams of acetic acid are combined with the amount of baking soda your group will use (shown below)?

**Materials:**

|  |  |  |
| --- | --- | --- |
| clean, dry 200-mL plastic beaker | **sodium bicarbonate (baking soda)** | |
| 50-mL or 100-mL graduated cylinder | **Group 1:** 2.00 g | **Group 5:** 4.00 g |
| scoopula | **Group 2:** 2.50 g | **Group 6:** 4.50 g |
| acetic acid (5% vinegar) | **Group 3:** 3.00 g |  |
| weigh boat | **Group 4:** 3.50 g |  |

**Group Data Table:** Construct a table to record all necessary data from your group’s experiment.

**Procedure:**

1. Carefully measure out exactly 50.00 mL of vinegar using your graduated cylinder, which is more precise than the beaker. This volume of vinegar contains 2.48 grams of acetic acid, HC2H3O2. Carefully add the acetic acid to your **clean, completely dry** beaker and record the **combined** mass of the vinegar and beaker.
2. Using the weigh boat, measure out the precise amount of baking soda for your group (shown in the Materials above). Be sure to record the actual mass of the sodium bicarbonate measured out.
3. Bend the weigh boat slightly, and carefully pour the sodium bicarbonate into the beaker, taking care not to spill any. Make sure that all of the sodium bicarbonate is placed into the beaker. Record observations. After the initial eruption, gently swirl the flask to allow the reaction to proceed. **Do not spill any of the contents**. Swirl gently for five minutes, until no more bubbles appear on the bottom of the flask.
4. Once the sodium bicarbonate has completely reacted with the acetic acid, record the new, combined mass of the beaker and its contents. Calculate of the mass of CO2 released in your group data table (below).
5. Dispose of the contents of the flask down the drain. Thoroughly rinse with lots of water, then dry the flask.

**Class Data Table:** Construct a table recording the grams of baking soda used and grams of CO2 released for each group.

**Graph of Class Data:** Create a graph of the mass of carbon dioxide released versus the mass of baking soda reacted.

**Calculations:**

1. Identify the limiting reactant, if any, in your group’s reaction. Use calculations and observations to support your answer. Also identify the excess reactant.
2. Interpret your graph. Why does the mass of carbon dioxide released versus the mass of baking soda reacted show a **linear** relationship in the first part of the graph, yet plateau or taper off in the second part?
3. On your graph, identify the two different regions above. Label the limiting reactant and excess reactant for each.
4. On your graph, draw a straight line indicating the **stoichiometric ratio** of baking soda consumed to CO2 produced for this experiment. This is the amount of baking soda needed to fully react with 50.00 mL of vinegar. (Hint: Refer to #2 in your pre-lab.) Is this line consistent with your findings in #2 and #3 above?
5. Calculate the mass of carbon dioxide actually released in your experiment. Show work.
6. Calculate your percent yield of carbon dioxide gas generated. (Refer to Pre-Lab Question 3.)
7. Using complete sentences provide **three** plausible reasons why your percent yield was not exactly 100%.