Chemistry
Lab – Conservation of Mass, Chemical Reaction

Name _____
Date _____
Block _____

Background:

The law of conservation of mass states that during any physical or chemical change the total mass of matter will remain the same. The matter may change in appearance as in a physical change or it may change in a more fundamental way with new molecules present after the change as in a chemical change. In either case, the mass remains constant. You have already investigated the Law of Conservation of mass in the context of physical changes when you did the sand/salt separation. The mass of the mixture was equal to the sum of the masses of the sand and salt separately – at least that is our expectation. You tested how accurate your results were and how good your technique was by determining the percentage error assuming that the mass at the end would equal the mass at the beginning of the experiment. We would like to test the conservation of mass in the context of a chemical change as well.

The reaction:

Many household substances should be considered from their chemical properties. We will react two household substances in this reaction, baking soda and vinegar. Baking soda is sodium bicarbonate, $NaHCO_3$. Vinegar is composed of 5% acetic acid, $HC_2H_30_2$. The sodium bicarbonate is a solid. The acetic acid is in a solution with water as the solvent. The reaction is:

$$NaHCO_3(s) + HC_2H_3O_2(aq) \longrightarrow NaC_2H_3O_2(aq) + H_2O + CO_2(g)$$

The most obvious evidence that a chemical reaction has occurred in this reaction is the formation of carbon dioxide, a gas. We will use this reaction to show the conservation of mass as well as to indicate that gases are matter – that is, they occupy space and have mass.

PROCEDURE:

1. Add 25.0 mL of acetic acid solution to a screw top bottle. If the outside of the bottle becomes wet, dry it.
2. Measure the mass of the bottle and the acetic acid.
3. Measure the mass of a small test tube.
4. Add sodium bicarbonate to the test tube until it is about 1/2 full.
5. Measure the mass of the test tube and sodium bicarbonate.
6. Place the test tube into the bottle and tighten the cap.
7. Find the mass of the entire bottle and its contents.
8. While the bottle is sealed, tilt the bottle to allow the reactants to mix.
9. Record your observations.
10. When the reaction is completed, reweigh the sealed bottle.
11. Carefully open the bottle to prevent liquid from escaping.
12. Reweigh the entire bottle, capped, with its contents.

MEASUREMENTS: (Quantitative Data)

Include units and the correct number of decimal places in your measurements.

Volume of acetic acid _____
Mass of bottle and acetic acid _____
Mass of small test tube _____
Mass of test tube and sodium bicarbonate _____
Total mass BEFORE mixing _____
Total mass AFTER mixing (Sealed) _____
Total mass AFTER mixing (Opened) _____

OBSERVATIONS: (Qualitative Data) Use short phases to describe the reaction as it occurs.

Analysis of Data:

1. What evidence indicates that the process is a chemical reaction?

2. How does the data give evidence for the Law of Conservation of Mass? Cite specific data in answering this question.

3. Is there any evidence in the data that shows that carbon dioxide has mass? If so, describe the data.

4. Determining the mass of carbon dioxide gas formed during the reaction. Show and label your numbers, including units.

5. Does the sum of the mass (test tube and sodium bicarbonate) and (bottle and acetic acid) equal the total mass before mixing? Why?

6. Which elements are present in the reactants in this reaction?

7. Which elements are present in the products of this reaction?

8. In the written chemical equation, explain the symbols below:
   (s) (aq) (g) (1)