The Reaction of Acetic Acid and Sodium Bicarbonate

Introduction:

The Law of Conservation of Mass states that in a chemical reaction, the mass of the reactants will equal the mass of the products. This is often restated as 'matter cannot be created or destroyed'. This law is supported by hundreds of scientists doing many thousands of experiments that demonstrate its truth. Today we are going to be performing a chemical reaction and taking some careful measurements to test this Law. It is important to take your time and double check your measurements during this lab.

Before we begin, lets take some time to learn about the chemicals we will be using today.

- Vinegar is a mixture of water and Acetic Acid ($HC_2H_3O_2$) which is the part of vinegar that gives it the sour taste and unique smell and it is what causes the vinegar to react.
  - It is the colorless, clear liquid that can be found in the film canister labeled "B"
- Sodium Bicarbonate ($NaHCO_3$) is the official name for "baking soda" and it acts like a base
  - It is the white powder that can be found in the film canister labeled "A"

The chemical equation for this reaction is:

$$HC_2H_3O_{2(l)} + NaHCO_{3(s)} \longrightarrow H_2O_{(l)} + CO_{2\,(g)} + NaC_2H_3O_{2(l)}$$

1) What are the reactants in this equation?

_____

2) What are the products in this equation?

_____

3) What states of matter are present during this reaction?

_____

4) Restate the Law of Conservation of Mass in your own words:

_____

_____

Materials:

• 1 plastic bag

• 22mL of Vinegar (Acetic Acid)

• 6.5g of Baking Soda (Sodium Bicarbonate)

• Goggles

• Aprons

• Triple Beam Balance

Procedure:

1. Put on safety goggles and aprons
2. Carefully remove the canisters from your bag
3. Measure the mass of each canister and record the mass in the data table
4. Make sure the bag is open and squeeze out as much air as possible
5. Seal the bag
6. Measure the mass of the empty bag and record the result
7. Open the bag and blow a small amount of air into the bag to inflate it slightly
8. Seal the bag
9. Measure the mass of the inflated bag and record the result
10. Carefully open the bag and place the film canisters inside, be careful not to spill any of the contents
11. Set the bag with the canisters sitting upright on the balance tray
12. Carefully remove the tops to each canister and place them back in the bag standing upright
13. Carefully place the tops to the canisters in the bag
14. Squeeze out any extra air from the bag, seal it and meaure the mass of your bag with the film canisters inside and record it in the data table
15. Double check the seal on your bag
16. When you are ready, tip over the canisters and allow the chemicals to mix
17. You may need to gently squish the bag to mix the chemicals
18. Record any observations you have about the reaction
19. Once the fizzing stops, measure the mass of the bag and record it in the data table
20. Carefully open the bag, squeeze out any extra air, reseal the bag and measure the mass and record it in the data table

Data:

Item	Mass (g)	Observations:
Canister A		
Canister B		
Empty Bag		
Inflated Bag		
Bag with Canisters (Before)		
Bag with Canisters (After)		
Bag with Canisters (After without extra air)		

Analysis:

The Mass of Gas

1) What was the mass of the Empty Bag: _____

2) What was the mass of the Inflated Bag: _____

3) What was the mass of the gas inside the inflated bag: _____

4) Do gases have mass? What data from your experiment can use use to support your answer?

_____

_____

_____

_____

The Reaction

5) You started the reaction with 22mL of vinegar and 6.5g of baking soda. Why do you think you

needed so much more vinegar than baking soda for the reaction? _____

_____

6) Remember that vinegar is a mixture of water and acetic acid and only the acetic acid will react with the sodium bicarbonate. If the vinegar was 30% acetic acid, how much acetic acid was in the 22ml sample? _____

7) Look back at the first page of the lab. Which of the products do you think is the gas that inflated the bag during the reaction? _____

8) What was the mass of the Bag with Canisters before the reaction: _____

9) What was the mass of the Bag with Canisters after the reaction: _____

10) Does your data support the Law of Conservation of Mass? _____

11) What data can you use to support your answer? _____

_____

12) What are some factors that may have affected the mass of your bag? _____

_____

_____

_____

13) Percent Error refers to the difference between a theoretical answer and the answer you actually got in during an experiment. According to the Law of Conservation of Mass, the before and after mass should be the same. To calculate percent error, divide your After mass by the Before mass and multiply by 100. What was your Percent Error?

$$\frac{After}{Before} \; X \; 100 = \underline{\hspace{3cm}}$$

14) How much gas was produced during the reaction? _____

15) What data can you use to support your answer? _____

_____

_____