BLOWING UP BALLOONS, chemically

PRE LAB DISCUSSION:

Today we will be using a closed system. A closed system does not permit matter to enter or exit the apparatus. Lavoisier's classic 12-day experiment, which lead to the discovery of oxygen and an understanding of *burning,* was conducted in a closed system.

The system we will be using is closed to matter, but it is not closed to energy. If the system becomes warmer, energy is being released by the reaction. This is called an *exothermic reaction.* If the system becomes cooler, energy is being used by the reaction. This is called an *endothermic reaction.* Most laboratory thermometers will not fit inside a closed flask, but the students can determine temperature changes by just touching the bottom of the flask before and after the reaction.

Sometimes chemists use an experimental apparatus which is designed to be closed to the transmission of energy. This type of apparatus permits the chemist to determine exactly how much energy change there is in a specific chemical reaction.

If time is limited, the class may be divided into two groups, with one group assigned to do the reaction with zinc[1] and hydrochloric acid[2] and the other group with sodium bicarbonate and acetic acid [vinegar].

OBJECTIVES: To determine what observable factors are changed in a chemical reaction and what factors remain constant.

CHEMICALS/EQUIPMENT: 250 ml flask, balloon, balance, acetic acid[3], hydrochloric acid, sodium bicarbonate, zinc

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[1] Zinc can be obtained by melting pennies over a Bunsen burner. The penny has a copper coat over a zinc core. Pennies can be cut into small pieces with shears for this lab. The small amount of copper will make no difference in the final outcome.

[2] Hydrochloric acid is sold as "muriatic acid " by commercial cleaning supply companies. It may be as strong as 12 M. It must be diluted to 3 M for this lab.

PROCEDURE:

PART I

1. Place 50 ml hydrochloric acid in the 250 ml flask and determine the combined mass of the flask and acid.

2. Place 8 grams of Zn in the balloon and determine the combined mass of the balloon and the reagent.

3. Place the balloon on to the mouth of the flask with out dropping the contents of the balloon into the flask. Determine the total mass of the system at this point. BEFORE doing anything else, think about and answer question number 1. You may wish to check the weights again.

4. Hold the balloon up so that the reagents in the balloon fall into the flask. Carefully observe the reaction and carefully and fully record all your observations [temperature, colors, changes in the reagents, volume of the substances, etc.].

5. After the reaction has reached completion, determine the total mass of the system. DO NOT OPEN THE SYSTEM. The balloon and gases produced by the reaction must be weighed.

PART II

1. Place 50 ml of acetic acid in a 250 ml flask and determine the combined mass of the flask and acid.

2. Place 15 grams of sodium bicarbonate in a balloon and determine the combined mass of the balloon and reagent.

3. Place the balloon on to the mouth of the flask with out dropping the contents of the balloon into the flask. Determine the total mass of the system at this point. BEFORE doing anything else, think about and answer question number 1. You may wish to check the weights again.

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[3]Food coloring may be added to the acids. This helps avoid the problem of students using the wrong acid and may result in reactions that have interesting color changes.

4. Hold the balloon up so that the reagents in the balloon fall into the flask. Carefully observe the reaction and carefully and fully record all your observations [temperature, colors, changes in the reagents, volume the substances etc].

5. After the reaction has reached completion, determine the total mass of the system. DO NOT OPEN THE SYSTEM. The balloon and gases produced by the reaction must be weighed.

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DATA

PART I

1. Mass of flask and HCl.....

2. Mass of balloon and zinc.....

3. total.....

4. Mass of flask, acid, balloon & zinc before the reaction.....

5. Mass of apparatus and chemicals after the reaction.....

Changes observed in the system as it reacted

_____
_____
_____
_____
_____

PART II

1. Mass of flask and acid.....

2. Mass of balloon and $NaHCO_3$.....

3. total.....

4. Mass of flask, acid, balloon & chemicals before the reaction.....

5. Mass of apparatus and chemicals after the reaction.....

Changes observed in the system as it reacted

_____
_____
_____
_____
_____

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THINKING SCIENTIFICALLY

1. Is the total mass of the chemical system (3) equal to the ***sum*** of the mass of (1) flask and acid plus (2) the mass of the balloon and reagents?

Why or why not?

2. Is there any significant difference in the mass of the system after the reactants have formed the products?

Why or why not?

3. Did the zinc and hydrochloric acid system take in energy [endothermic] or give off energy [exothermic] to the environment?

How did you determine this?

4. Did the sodium bicarbonate and acetic acid system take in energy [endothermic] or give off energy [exothermic] to the environment?

How did you determine this?

5. In each part, which had a greater volume, the reactants or the products?

How do you know this?

5. Did the color of the liquid change?_____
If so, tell what color it was before, during, and after the reaction.

6. Did the color of the solids change?_____
If so, tell the color before and after the reaction.

7. Did the texture, shape or form of the solids change?_____
If so, describe how they looked before and after the reaction.

8. What is the "law of the conservation of matter"?

9. How does the "law of the conservation of matter" apply in this experiment?