Name_____

Dancing Spaghetti: Chemical Reactions & Equations

Goggles must be worn during this activity!!

Background information: In chemistry, the term *change* can refer to both ***physical*** and ***chemical changes.*** In the simplest sense, a ***physical change*** is a change in the *form* of the original substance. A ***chemical change*** is a change in the *composition* of the original substance. A chemical change is also called a ***chemical reaction***. Chemists have developed a list of common signs that may indicate the occurrence of a chemical change. These include:

1. Bubbles of gas appear
2. A precipitate forms
3. An unexpected color change occurs
4. Gain or release of energy (heat or light)
5. A change in volume occurs
6. A change in electrical conductivity occurs
7. A change in melting point or boiling point occurs
8. A change in odor or taste occurs
9. A change in a distinctive chemical or physical property occurs; not easily reversed

During a chemical change, the form or the composition of the matter changes. The atoms within the matter rearrange to form new substances, but they are not destroyed and new atoms are not created. The number and type of atoms remains the same. ***As a result, the total mass of the matter is the same before and after a physical or chemical change***. This is known as the Law of Conservation of Mass

Chemists use a kind of shorthand to represent chemical changes. One type of shorthand notation is called *word equations*, for example:

Hydrogen + Oxygen → Water

Any chemical reaction has one or more substances to the left of the arrow, representing the ***reactants*** before the reaction, and one or more substances to the right of the arrow, representing the ***products*** of the chemical change. The arrow represents the point at which the reaction takes place, and is sometimes called the "yield" arrow. The above reaction would be read, "Hydrogen reacts with oxygen to yield (or to produce) water."

Word equations are not used very often. It is usually more useful to write full chemical equations, in which chemical symbols and formulas replace the names of the elements and compounds. For example:

We have the word equation:

Reactants Products

Oxygen + Hydrogen ------> Water

Replace the names of the words with the symbols of the elements and formulas of the compounds:

$$H + O \text{ ---> } H_2O$$

Hydrogen and oxygen actually exist as molecules (2 atoms bonded), so we must change the equation like this,

$$H_2 + O_2 \text{ ---> } H_2O$$

The law of conservation of mass tells us that matter is not created or destroyed in a chemical reaction, but the above equation makes it look like that four atoms react to form three atoms! Oxygen is not really being destroyed in the reaction; we must ***balance*** the equation:

Reactants Products

$$2H_2 + O_2 \text{ ---> } 2H_2O$$

Now the equation is balanced. There are 4 atoms of hydrogen and 2 atoms of oxygen on either side of the yield arrow. The 2 before the H is called a coefficient. Now the equation reads, "Two molecules of hydrogen react with one molecule of oxygen to form two molecules of water."

Spaghetti is denser than water and, therefore, sinks when placed in water. When spaghetti is placed in a solution of $NaHCO_3$ (sodium hydrogen carbonate or baking soda) and $HC_2H_3O_2$ (acetic acid or vinegar) the spaghetti will rise to the surface due to the CO2 (carbon dioxide) gas that adheres to it. When the spaghetti reaches the surface of the water, the gas bubbles pop and the spaghetti sinks again.
The equation for this reaction is

$$NaHCO_3 + HC_2H_3O_2 \text{ ------> } CO_2 + H_2O + NaC_2H_3O_2$$

Materials:

Large beaker	20 g of $NaHCO_3$	25 mL of $HC_2H_3O_2$
10 2-cm pieces of thin spaghetti	Triple beam balance	Wax paper
Graduated cylinder	Funnel	Water
Spoon		

Procedure:

1. Fill a beaker with 100 mL water.
2. Use the triple beam balance to measure out 20 g of $NaHCO_3$ - sodium hydrogen carbonate (baking soda). Use a square of wax paper to protect balance from the chemical.
3. Add the $NaHCO_3$ to the water and stir to dissolve.
4. Use the graduated cylinder to measure out 25 ml of $HC_2H_3O_2$ - acetic acid (vinegar).
5. Add the $HC_2H_3O_2$ to the solution of water and $NaHCO_3$.
6. Quickly add the spaghetti pieces and watch as they begin to dance.
7. As the reactants are used up, the reaction will slow or stop and the spaghetti will stop “dancing”. At this point, you can add a small amount of baking soda and vinegar to refresh the reaction.
8. Record your observations of the reaction.

Data:

Questions:

1. What evidence of a chemical reaction did you observe?

   _____

   _____

2. What are the reactants in this investigation?

   _____

3. What are the products in this investigation?

   _____

4. What is sodium hydrogen carbonate? _____
   Write the formula for sodium hydrogen carbonate. _____

5. How many sodium atoms are there in the sodium carbonate? _____
   hydrogen? _____ carbon? _____ oxygen? _____

6. What is acetic acid? _____
   Write the formula for acetic acid. _____

7. How many hydrogen atoms are there in acetic acid? _____
   carbon? _____ oxygen? _____

8. What in the product do you see that might explain the bubbles adhering to the surface of the spaghetti, causing it to rise?

   _____

9. What variables can be changed to cause the spaghetti to rise at a different rate?