Writing and Balancing Equations

Chemical reactions are written as chemical equations. A chemical equation summarizes what happens in a chemical reaction. It tells you the substances you start with and the substances you get at the end. The substances you have at the beginning are called the reactants. When the reaction is complete you have different substances with different properties. These new substances are called the products of the reaction.

You have learned there are four clues that provide evidence that a chemical reaction has taken place. These clues are a temperature change, formation of a gas, the formation of a solid called a precipitate and a color change. A color change typically happens when a solution changes from an acid to a base or from a base to an acid. We can observe this by using an indicator solution. The grape juice we used in the last experiment was an indicator solution. Today we will use bromthymol blue as the indicator solution. It is blue in a basic solution and yellow in an acid solution.

Materials: Test tube, straw, bromthymol blue, paper towel

What To Do:

1. Your teacher will give you a test tube that contains water and a few drops of bromthymol blue.
2. Place the straw in the test tube and place a paper towel over the top of the test tube.
3. GENTLY blow into the straw to create bubbles.
4. Keep blowing until the blue changes color.

What chemical reaction happened? The carbon dioxide in your breath combined with the water in the test tube to create carbonic acid. The water is a basic solution so the bromthymol blue is blue. When the carbonic acid was created the bromthymol blue turned yellow. Evidence of a chemical reaction!

Chemical equations have a definite structure. The reactants are written on the left with + signs in between each reactant. An arrow follows the reactants. You read the arrow as "yield." The products are written on the right. Look at the example below.

Reactant + Reactant $\longrightarrow$ Product + Product

We have observed some chemical reactions in our experiments. Let's write them out in words.

1. Water and carbon dioxide make carbonic acid.

_____ + _____ yield _____

2. Baking Soda and vinegar make sodium acetate and carbon dioxide.

_____ + _____yield _____ + _____

3. Calcium Chloride and water make calcium hydroxide and hydrochloric acid.

_____ + _____ yield _____ + _____

Turning Word Reactions into Chemical Equations

Now that we have written the word reactions, let's change the words into the chemical formulas and write the chemical equations.

1. Water and carbon dioxide yield carbonic acid.

_____ $\longrightarrow$ H_2CO_3

2. Baking Soda and vinegar yield sodium acetate and carbon dioxide.

_____ $\longrightarrow$ $C_2H_3NaO_2$ + _____

3. Calcium chloride and water yield calcium hydroxide and hydrochloric acid.

_____ $\longrightarrow$ $Ca(OH)_2$ + _____

Count the number of atoms of each element in the chemical reactions above.

Reactants	# of atoms
Hydrogen	
Oxygen	
Carbon	

Products	# of atoms
Hydrogen	
Oxygen	
Carbon	

Reactants	# of atoms
Sodium	
Hydrogen	
Oxygen	
Carbon	

Products	# of atoms
Sodium	
Hydrogen	
Oxygen	
Carbon	

Reactants	# of atoms
Calcium	
Oxygen	
Hydrogen	
Chlorine	

Products	# of atoms
Calcium	
Oxygen	
Hydrogen	
Chlorine	

Counting the number of atoms in a chemical reaction is very important. There is a law in science called the Law of Conservation of Mass. It states that mass is neither created nor destroyed in an ordinary chemical reaction. So, the mass of the products produced by a chemical reaction is always equal to the mass of the reactants. When written in chemical equations this means the number of atoms of each element must be the same before and after the chemical reaction. This is called a balanced equation.

Look at the data tables you created for each reaction. Do the number of atoms of each element in the reactants match the number of atoms of each element in the products?

1. It is (balanced/unbalanced). Circle the correct answer.

2. It is (balanced/unbalanced).

3. It is (balanced/unbalanced).

We will come back to balance the unbalanced equations after the next part of the lesson.

Balancing Equations

As we learned in the Law of Conservation of Mass when we write a chemical equation the number of atoms on the reactant side must equal the number of atoms on the product side. If the initial reaction is not balanced we must then add a coefficient to create a balanced equation. Let's look at what happens when steel rusts.

$Fe_3C + O_2 \longrightarrow Fe_3O_2 + CO_2$

Questions:

1. Which element is not balanced? _____
2. Which side has more of that element? _____
3. What coefficient could you add to the reactant side to make it have the same number of oxygen atoms? _____
4. Write the balanced equation below.

Balance the following equations by count in the number of atoms on each side and writing the correct coefficient where indicated.

1.

$$\_\_\_C + \_\_\_H_2O \rightarrow C_6H_{12}O_6$$

atoms of C _____ atoms of C _____
atoms of H _____ atoms of H _____
atoms of O _____ atoms of O _____

2.

$$C + O_2 \rightarrow \_\_\_CO_2$$

atoms of C _____ atoms of C _____
atoms of O _____ atoms of O _____

3.

$$2Na + Cl_2 \rightarrow \_\_\_NaCl$$

atoms of Na _____ atoms of Na _____
atoms of Cl _____ atoms of Cl _____

4.

$$CH_4 + \_\_\_O_2 \rightarrow CO_2 + \_\_\_H_2O$$

atoms of C _____ atoms of C _____
atoms of H _____ atoms of H _____
atoms of O _____ atoms of O _____

5.

$$\_\_\_HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + \_\_\_H_2O$$

atoms of H_____ atoms of H _____
atoms of Cl _____ atoms of Cl _____
atoms of Ca _____ atoms of Ca _____
atoms of C _____ atoms of C _____
atoms of O _____ atoms of O _____

6.

$$\_\_\_CO_2 + H_2O \rightarrow H_2CO_3$$

atoms of C _____ atoms of C _____
atoms of H _____ atoms of H _____
atoms of O _____ atoms of O _____

Name _____ period _____

EXIT TICKET

Balancing Equations

$$6C + \_\_\_H_2O \rightarrow C_6H_{12}O_6$$

1. Which coefficient will make the equation above balanced?

A. 2
B. 4
C. 6
D. 8

2. How many atoms of Hydrogen are on the reactant side of the balanced equation above?

A. 2
B. 12
C. 22
D. 32

$$\_\_\_HCl + CaCO_3 \rightarrow CaCl_2 + \_\_\_CO_2 + H_2O$$

3. What coefficients will make the equation above balanced?

A. 2, 1
B. 2, 2
C. 2, 3
D. 2, 4

Name _____ period _____

EXIT TICKET

Balancing Equations

$$\_\_\_HCl + CaCO_3 \rightarrow CaCl_2 + \_\_\_CO_2 + H_2O$$

1. What coefficient will make the equation above balanced?

A. 2, 1
B. 2, 2
C. 2, 3
D. 2, 4

2. How many atoms of Hydrogen are on the reactant side of the balanced equation above?

A. 1
B. 2
C. 3
D. 4

$$6C + \_\_\_H_2O \rightarrow C_6H_{12}O_6$$

3. Which coefficient will make the equation above balanced?

A. 2
B. 4
C. 6
D. 8