

Name:

Partners' name:

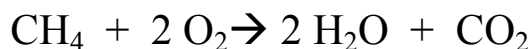
Laboratory 9: Types of Chemical Reactions

1. Lab Quiz 12
2. What are the different types of reactions?
3. What influences the rate of reactions?
4. Do reactions always go one way?
5. **Demo:** Yellow and blue switcheroo
6. **Demo:** The chemical kidney
7. Conservation of mass: What happens to atoms and molecules in a reaction?
8. **Demo:** Dancing pennies

Purpose: To perform the copper cycle to demonstrate the law of conservation of mass. To describe the different types of chemical reactions.

Lecture Notes

There are six types of chemical reactions. Scientists classify things according to similar properties or characteristics in order to get a better understanding of what they are studying. Like a biologist classifies organisms, a chemist classifies chemical reactions. This helps the chemist predict what will happen in a chemical reaction. A chemical equation is a shorthand notation of the materials that react and the materials that are produced. Here is an equation for a typical chemical reaction:



Reactants

Products

In the above equation, CH_4 , O_2 , H_2O , CO_2 are the chemical formulas of the materials in the equation. According to the Law of Conservation of Matter, the number of atoms of each element that results from a reaction (products) must equal the number of atoms of each element that went in (reactants). Notice in the above equation that the 1 carbon, 4 hydrogen and 4 oxygen atoms that went into the reaction (reactants) are matched by an equal number of each atom that came out (products). If the number of atoms of each element is the same on both sides of the equation, the equation is considered "balanced."

When writing balanced equations, fractions of molecules are not permitted. Thus, it would be improper to write the above equation as: $\frac{1}{2} \text{CH}_4 + \text{O}_2 \rightarrow \text{H}_2\text{O} + \frac{1}{2} \text{CO}_2$.

In addition, balanced equations require coefficients to be the lowest common denominator. Thus, it would be improper to write the above equation as: $2 \text{CH}_4 + 4 \text{O}_2 \rightarrow 4 \text{H}_2\text{O} + 2 \text{CO}_2$

To count the number of atoms in an equation, there are two factors to consider. A subscript indicates the number of atoms of that element in a substance. A coefficient indicates the number of molecules of that substance needed in the equation. For example, $2 \text{H}_2\text{O}$ indicates:

2 times 2 = 4 hydrogen atoms

2 times 1 = 2 oxygen atoms

A. Types of Chemical reactions

The six types of chemical reactions are:

1. Composition (combination)
2. Decomposition
3. Single replacement
4. Double replacement
5. Combustion
6. Oxidation/reduction

1. Composition

2. Decomposition

3. Single Replacement

4. Double Replacement

5. Combustion

6. Oxidation/Reduction

B. Formula mass and percent composition

Formula mass:

Find the formula mass of water

Percent composition:

Find the percent composition of water:

Notes:

Procedure and Observations and Data: (To be done in groups of two)

Reaction 1

1. Obtain a piece of copper wire from your instructor. Weigh an empty evaporating dish and record the mass. _____
2. Weigh the evaporating dish with the copper wire in it and record the mass. _____
3. Put the copper into a 250 ml beaker and put the beaker and copper in the fume hood.
4. Your instructor will pour 4.0 ml of concentrated nitric acid into your beaker.

Record at least three observations:

Write the balanced equation:

What type of chemical reaction was this?

5. After the copper has dissolved, slowly add about 100 ml of deionized water to the beaker.

Reaction 2

6. Do this step slowly since you are adding a base to an acid that gives off heat. Stir the solution with a glass rod and slowly add 15 ml of dilute NaOH. This forms a solid $\text{Cu}(\text{OH})_2$.
7. Test the solution with red litmus paper to see that it is basic (red litmus should turn blue). If the solution is not basic add 5 ml of NaOH.

Record two observations:

Write the balanced equation:

What type of chemical reaction was this ?

Reaction 3

8. Heat the beaker and mixture to the point where it just boils. Stir continuously. As you stir, the precipitate will clump together and sink to the bottom.
9. After the reaction is complete take away the heat and continue stirring for another minute.

Record two observations:

Write the balanced equation:

What type of chemical reaction was this ?

10. Decant the liquid layer (this is called a supernatant) without letting our any of the solid spill.
11. Heat up 100 ml of de-ionized water and add it to the precipitate. This is to wash the compound. Let the solid settle to the bottom and repeat the cleaning step with another 100 ml of hot de-ionized water.

Reaction 4

12. Slowly add 15 ml of dilute H_2SO_4 while stirring. Make sure the entire black solid dissolves.

Record two observations:

Write the balanced equation:

What type of chemical reaction was this?

3. What is the percent yield of copper? $(\text{Original mass Cu}/\text{final mass}) \times 100$
4. Make a table below. Do not forget to show the mass of the dish and copper that you weighed at the beginning and end of the lab.

Table 1

Demonstration Observations:

Questions and Answers:

1. You started and ended with copper. Are these the exact same atoms of copper you started with? What did this teach you about the nature of atoms and elements?

2. Explain why the mass of copper you started with was different from what you ended up with.

3. What is the percent of copper in $\text{Cu}(\text{OH})_2$, CuSO_4 , and CuO ?

4. How did this lab influence your understanding of chemistry?

5. Did this experiment help you to write balanced equations?

6. Did having a variety of reactions help you to identify and understand the reaction types?

7. Would you have preferred doing many repetitions of each reaction type? Why or why not?

8. How would you define Conservation of Mass?
