

# Module 5; Classifying Chemical Reactions

## Introduction

You will be studying five kinds of reactions:

1. Decomposition:  $AB \rightarrow A + B$
2. Synthesis:  $A + B \rightarrow AB$
3. Single Replacement:  $AB + C \rightarrow AC + B$
4. Double Replacement:  $AB + CD \rightarrow AD + CB$
5. Combustion: Compound with carbon +  $O_2 \rightarrow CO_2 + H_2O$

In your unit on COMPOUNDS, you did a lab called “Making Ionic Compounds from Elements” in which you reacted iron and copper with S,  $Cl_2$  and  $O_2$ . You observed the ionic compounds and named them and wrote their formula. In this experiment, you will be asked to analyze those reactions – to classify them and to write out balanced chemical equations. In addition, you will observe other reactions and classify them.

## Data and Data Analysis

### PART A: Reaction of Magnesium and Oxygen

Watch the following video and answer the following questions: <https://www.youtube.com/watch?v=w2ydd9rJHws>

- 1) Write out the balanced equation for the reaction of magnesium with oxygen gas:
- 2) Describe what the magnesium looks like in this experiment:
- 3) Describe what happens when magnesium is heated up in the presence of  $O_2$  (in the air):
- 4) Describe the product of this reaction. In particular, what TWO ways is the product different than magnesium:
- 5) Was this change physical or chemical?
- 6) At the end of the video a practice slide is shown with four reactions (call them 1, 2, 3 and 4). Classify these four reactions. (synthesis, decomposition, single replacement, double replacement or combustion).

## Part B: Reactions of metals with nonmetals (review)

<p>Rewatch the video showing the reaction of copper with chlorine: <a href="https://www.youtube.com/watch?v=edLpxdERQZc">https://www.youtube.com/watch?v=edLpxdERQZc</a></p> <p>Recall that a colored Copper product has a Copper with a <math>2^+</math> charge.</p> <p>Write the name of the product:</p> <p>Write the formula of the product:</p> <p>Write the balanced equation for this reaction;</p> $\text{___ Cu} + \text{___ Cl}_2 \rightarrow \text{___}$ <p>Classify this reaction.</p>	<p>Rewatch the video showing the reaction of copper with sulfur. Remember to focus on the copper wire. <a href="https://www.youtube.com/watch?v=Jhu-0ACrMsQ">https://www.youtube.com/watch?v=Jhu-0ACrMsQ</a></p> <p>Recall that a colored Copper product has a Copper with a <math>2^+</math> charge.</p> <p>Write the name of the product:</p> <p>Write the formula of the product:</p> <p>Write the balanced equation for this reaction;</p> $\text{___ Cu} + \text{___ S} \rightarrow \text{___}$ <p>Classify this reaction.</p>
<p>Rewatch the video showing the reaction of Iron (the steel wool) with Oxygen to make Iron (III) oxide. <a href="https://www.youtube.com/watch?v=TkE1uVjrY0w">https://www.youtube.com/watch?v=TkE1uVjrY0w</a></p> <p>Write the formula of the product:</p> <p>Write the balanced equation for this reaction;</p> $\text{___ Fe} + \text{___ O}_2 \rightarrow \text{___}$ <p>Classify this reaction.</p>	<p>Rewatch the video showing the reaction of Copper with Oxygen: <a href="https://www.youtube.com/watch?v=1qZxJG8xMmQ">https://www.youtube.com/watch?v=1qZxJG8xMmQ</a></p> <p>Recall that a colored copper product has a copper with a <math>2^+</math> charge. But red copper-oxygen products have a <math>1^+</math> charge.</p> <p>Write the name of the “inside” product:</p> <p>Write the formula of the product:</p> <p>Write the balanced equation for this reaction;</p> <p>Write the name of the “outside” product:</p> <p>Write the formula of the product:</p> <p>Write the balanced equation for this reaction;</p> <p>Classify these reactions.</p>

## Part C: Classifying Reactions

Watch the video showing six different reactions and answer the questions below.

<https://www.youtube.com/watch?v=nsEkKliOz7Q>

### Reaction #1: DECOMPOSITION reaction.

In this reaction, hydrogen peroxide decomposes. It is the only reactant. Soap captures the gas produced in bubbles and food coloring colors the bubbles. So, these just make the reaction fun. Potassium Iodide is a catalyst: it is needed to make the reaction go, but it is not changed during the reaction, so it will not show up in the reaction equation. The reaction is given in words in the video. Write the reaction equation using standard symbols. Balance it. Hint: Hydrogen peroxide is  $\text{H}_2\text{O}_2$  and don't forget that oxygen gas is diatomic ( $\text{O}_2$ ).

Reaction Equation:

In your own words, why is this considered a decomposition reaction?

### Reaction #2: DOUBLE REPLACEMENT reaction

In this reaction, potassium chromate ( $\text{K}_2\text{CrO}_4$ ) and silver nitrate ( $\text{AgNO}_3$ ) react to form silver chromate ( $\text{Ag}_2\text{CrO}_4$ ) and potassium nitrate ( $\text{KNO}_3$ ). Write the reaction equation and balance it.

Reaction Equation:

What color is the reactant, potassium chromate?

What color is the reactant, silver nitrate?

What color is the product, silver chromate?

In your own words, why is this considered a double replacement reaction?

### Reaction #3: COMBUSTION reaction

In this reaction, ethanol ( $\text{C}_2\text{H}_6\text{O}$ ) reacts with oxygen gas from the air in the bottle when heat is applied. The reaction produces carbon dioxide and water. Write and balance the reaction equation.

Reaction Equation:

Two products were made in this reaction. Describe the product you saw.

Combustion reactions ALWAYS have  $\text{O}_2$  and ALWAYS make  $\text{CO}_2$  and  $\text{H}_2\text{O}$ . So, the above reaction was the combustion of ethanol. Write the reaction equation (and balance it) for the combustion of methanol ( $\text{CH}_3\text{O}$ ).

#### Reaction #4: SINGLE REPLACEMENT reaction

In this reaction, hydrochloric acid (HCl) reacts with zinc (Zn) to make Zinc chloride (you can figure out its formula with the help of your periodic table) and hydrogen gas (H<sub>2</sub>). Write and balance the reaction equation.

Reaction Equation:

Why did the balloons fill up? (Look at the products in the reaction equation you just wrote).

Both Erlenmeyer flasks had the same chemicals in them. Why do you think the pink balloon got twice as big?

In your own words, why is this considered a single replacement reaction?

#### Reaction #5: SYNTHESIS reaction

In this reaction, iron and sulfur react to make Iron (II) sulfide (Presenter has updated it under the video description).

What is the formula for Iron (II) sulfide?

Write and balance the reaction equation.

What color is the iron? The sulfur? The iron/sulfur mix?

When the iron and sulfur are mixed, is this a physical or chemical change?

What color is the Iron (II) sulfide at the end of the reaction?

Why do you think the experiment required the heated glass rod?

In your own words, why is this considered a synthesis reaction?