

Chemical Reactions Lab

Introduction:

There are millions of chemical reactions occurring around us during every second of every day. Chemical reactions are involved in the making of food, paper, plastics, pharmaceuticals, fuel, soaps, and numerous other products that we enjoy using. They also enable us to breathe, grow, see, and digest and metabolize food for energy. In this laboratory activity, you will perform five reactions, look for evidence of a chemical reaction, write the chemical equations, and classify the reactions according to reaction types.

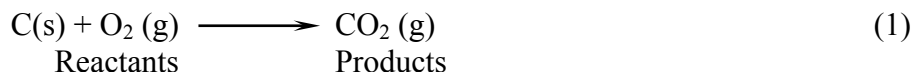
Background:

Evidence of a Chemical Reaction

For many chemical reactions, clues to indicate that a reaction did indeed occur can be observed. Such clues include production or absorption of heat, absorption or emission of light, production of a sound, a change of color, formation of a precipitate or a new product, or release of a gas. Some chemical reactions may exhibit only one of these clues, while other chemical reactions may reveal several clues. By looking for these clues, you can determine whether a chemical reaction has occurred and what kind of reaction has occurred.

Writing Chemical Equations

Any chemical change involves the reorganization of the atoms in one or more substances. For example, when carbon (C) combines with oxygen gas (O₂) in the air and burns, carbon dioxide gas (CO₂) is formed. This process is represented by a *chemical equation*, a symbolic expression used in chemistry to represent a chemical reaction. The *reactants* (carbon and oxygen) are written on the left side of the equation and the *products* (carbon dioxide) are written on the right side of the equation. A plus sign is used between two substances to indicate reactants combined or products formed. An arrow represents the direction of the reaction and is read as "yields" or "produces":



The chemical equation for a reaction provides two important types of information: the nature of the reactants and products (indicated by the correct chemical formula) and the relative numbers of each. The equation often gives the physical states of the reactants and the products using state symbols, which are written after the chemical formulas in parentheses. Solids are represented with (s), liquids with (ℓ), gases with (g), and aqueous solutions with (aq) to indicate that the substance is dissolved in water.

Types of Chemical Reactions

Despite the fact that there are so many different chemical reactions that can occur, most can be classified into five basic types of chemical reactions—synthesis reactions, combustion reactions, decomposition reactions, single replacement reactions, and double replacement reactions. Refer to the *Types of Chemical Reactions* handout for more information.

Chemical Concepts:

- Writing chemical equations
- Evidence of a chemical reaction
- Types of chemical reactions

Materials:

Chemicals:

0.5 M Calcium chloride solution, CaCl_2 , 3 mL	Copper wire, Cu, 4 in
Ethyl alcohol, $\text{CH}_3\text{CH}_2\text{OH}$, 1 mL	Magnesium metal ribbon, Mg, 2 in
0.5 M Silver nitrate solution, AgNO_3 , 5 mL	Copper(II) carbonate, CuCO_3 , 1 g
0.5 M Sodium carbonate solution, Na_2CO_3 , 3 mL	

Equipment:

Bunsen burner	Butane safety lighter
Test tube clamp	Scoop or spatula
3 Test tubes, borosilicate glass, 13×100 mm	Test tube rack
Watch glass, Pyrex [®]	Tongs or forceps
4 Beral-type pipets	Wooden splint

Safety Precautions:

Avoid contact between silver nitrate and skin or clothing, as it will readily stain skin and clothing brown. Ethyl alcohol is a flammable liquid and a dangerous fire risk. Addition of denaturant makes the alcohol poisonous—it cannot be made nonpoisonous. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron.

Procedure: Read through the instructions for each reaction BEFORE beginning the reaction. Make sure all of your equipment and materials are available and ready to go. Record careful observations in the Data Table for each reaction as it is performed. Specify all evidence that a chemical reaction has occurred. Write the *balanced* chemical reaction (hint: start with the reactants and determine the products), then identify the type of reaction that it represents. Complete the data tables and questions on the next pages. Tear off these instructions and hand in ONLY the completed data tables and questions.

Reaction #1:

Caution: Perform this reaction away from the ethyl alcohol, which is flammable.

1. Place about 1 g of copper(II) carbonate (about the size of a large pea) in a test tube. Record your observations of the solid before heating.
2. Light the laboratory burner.
3. Holding the test tube with a test tube clamp, heat the solid in the test tube **gently** in the burner flame for about one minute. Record your observations as the solid is heated.
4. While the solid is heating, light a wooden splint. While continuing to heat the solid, place the burning wooden splint in the mouth of the test tube (do NOT drop the splint into the test tube). What gas is responsible for what you see? **Record your observations.**

Reaction #2:

Caution: Perform this reaction away from the ethyl alcohol, which is flammable.

- Obtain a strip of magnesium metal ribbon about two inches in length. **Record your observations** of the magnesium before burning it.
- Light the laboratory burner.
- Hold the piece of magnesium metal ribbon with a pair of metal tongs. Place the ribbon in the burner flame and allow it to burn. **DO NOT LOOK DIRECTLY AT THE BURNING MAGNESIUM!** The bright light emitted by the burning magnesium ribbon is UV light, which can damage your eyes. Observe by looking slightly to one side and using peripheral vision.
- When the magnesium metal ribbon is finished burning, place the remains in a watch glass. Turn off the burner.
- Record your observations** of the burned metal ribbon.

Reaction #3:

Caution: Perform this reaction away from any open flame.

- Using a pipet, place about 1 mL of ethyl alcohol (about 1 squeeze of the pipette) in a Pyrex watch glass.
- Light a butane safety lighter. Bring the flame close to the ethyl alcohol in the watch glass so that the alcohol begins to burn. Allow the ethyl alcohol to burn until it is completely consumed. Do not touch the hot watch glass. **Record your observations.**

Reaction #4:

- Place a medium-sized test tube in a test tube rack. Add one pipet-full of a 0.5 M calcium chloride solution to the test tube.
- Add one pipet-full of a 0.5 M sodium carbonate solution to the test tube. **Record your observations.**

Reaction #5:

Caution: **Silver nitrate can stain skin and clothing.**

- Rinse a medium-sized test tube three times with *distilled* water.
- Place the clean test tube in a test tube rack. Fill the test tube with about 3-5 mL (3-5 pipettes) of a 0.5 M silver nitrate solution.
- Obtain a piece of copper wire about four inches in length. Wrap the wire around a pencil so that it forms a loose coil. **Record your observations** of the reactants **before** mixing.
- Submerge the coiled copper wire into the silver nitrate solution. Observe for several minutes as the wire reacts with the solution. Gently swirl the test tube to speed up the reaction. **Record your observations during** the reaction **and after** the reaction is complete.
- After the reaction has concluded, empty the contents of the test tube into the waste beaker at the front of the room before cleaning test tube.

Lab [25 pts]
Chemical Reactions Lab

NAME _____
Lab Partner(s) _____
Period _____ Date _____

Data Tables

Record all of your observations and answer the questions about each reaction in the tables below. (20 pts)

Reaction #1	
Observations	
Evidence that a Chemical Reaction Occurred	
Balanced Chemical Equation	
Type of Reaction	

Reaction #2	
Observations	
Evidence that a Chemical Reaction Occurred	
Balanced Chemical Equation	
Type of Reaction	

Reaction #3

Observations	
Evidence that a Chemical Reaction Occurred	
Balanced Chemical Equation	
Type of Reaction	

Reaction #4

Observations	
Evidence that a Chemical Reaction Occurred	
Balanced Chemical Equation	
Type of Reaction	

Reaction #5	
Observations	
Evidence that a Chemical Reaction Occurred	
Balanced Chemical Equation	
Type of Reaction	

Questions (5 points)

- One of the reactions performed in this laboratory activity falls into more than one category of reaction type. Which one is it, and what two types can it be classified as? *Explain why it is each type.* [1 pt]

- For each of the following word equations, write a balanced chemical equation and identify each reaction type. [4 pts]

	<u>Type of Reaction</u>
a) Solid manganese (II) sulfate is heated and forms solid manganese (II) oxide and sulfur trioxide gas.	_____
b) A solution of nickel (II) sulfate is mixed with a solution of lithium phosphate and forms solid nickel (II) phosphate and lithium sulfate solution.	_____
c) Chlorine gas reacts with aqueous potassium iodide to form potassium chloride solution and solid iodine.	_____
d) Nickel powder (solid) reacts with oxygen gas to form solid nickel(III) oxide.	_____