Chemical Reactions Lab

Objectives:

* Identify the different types of chemical reactions
* Name chemical compounds
* Write chemical formulas
* Write and balance chemical reactions

Background:

A chemical reaction is defined as the process by which one or more substances convert into one or more new substances. The new substances formed will exhibit different physical and chemical properties from the original substances used. The substances used initially are referred to as the reactants of the chemical reaction. The new substances formed are referred to as the products of the chemical reaction.

Reactants 🡪 Products

There are five types of chemical reactions that are outlined below.

* **Synthesis:** a reaction that occurs between two or more substances to form a compound

C(s) + O2(g) 🡪 CO2(g)

* **Combustion:** the reaction of a carbon-based compound, usually a hydrocarbon, with oxygen.

C3H8(g) + 5O2(g) 🡪 3CO2(g) + 4H2O(g)

* **Single-displacement:** in this type of reaction a single element reacts with a compound and displaces another element from the compound

Fe(s) + CuSO4(aq) 🡪 Cu(s) + FeSO4(aq)

* **Double-displacement:** in this type of reaction two compounds in solution exchange ions and form two new compounds. The rule to follow for these types of reactions is the metal replaces the metal and the nonmetal replaces the nonmetal.

2KI(aq) + Pb(NO3)2(aq) 🡪 PbI2(s) + 2KNO3(aq)

* **Decomposition:** these reactions are the opposite of synthesis reactions. During this type of reaction one compound breaks down into two or more simpler compounds. These reactions usually take place with the input of energy, such as heat or electricity.

2H2O(l) + electricity 🡪 2H2(g) + O2(g)

Pre-lab:

1. Write the chemical formulas for the compounds listed below.
   1. Zinc Zn
   2. Hydrochloric acid HCl
   3. Methane CH4
   4. Oxygen O2
   5. Magnesium Mg
   6. Calcium carbonate CaCO3
   7. Sodium carbonate Na2CO3
   8. Cobalt (II) chloride CoCl2
2. Write and balance the chemical equation for the reaction occurring between the two substances listed below.
   1. Zinc reacting with hydrochloric acid

Zn(s) + 2HCl(aq) 🡪 ZnCl2(aq) + H2(g)

* 1. Methane reacting with oxygen

CH4(g) + 2O2(g) 🡪 CO2(g) + 2H2O(g)

* 1. Magnesium reacting with oxygen

2Mg(s) + O2(g) 🡪 2MgO(s)

* 1. Calcium carbonate and heat

CaCO3(s) + heat 🡪 CaO(s) + CO2(g)

* 1. Sodium carbonate reacting with cobalt (II) chloride

Na2CO3(aq) + CoCl2(aq) 🡪 CoCO3(s) + 2NaCl(aq)

1. Classify the type of reaction that occurs in the question above.
   1. Single-replacement reaction
   2. Combustion reaction
   3. Synthesis reaction
   4. Decomposition reaction
   5. Double-replacement reaction

1. Write the name of all of the products produced by the reactions in question two.
   1. Zinc chloride and hydrogen gas
   2. Carbon dioxide and water
   3. Magnesium oxide
   4. Calcium oxide and carbon dioxide
   5. Cobalt (II) carbonate and sodium chloride

Safety:

* Safety glasses must be worn at ALL TIMES!
* Hair must be pulled back! Long, loose-fitting clothing, scarves, and sweatshirt strings must be tied back or contained in some way.
* Hydrochloric acid is corrosive! Be careful, avoid spills, and avoid contact with skin. If you get it on your skin notify your teacher.
* Magnesium ribbon burns brightly and emits UV light. Avoid looking directly into the flame. Be sure to use the cobalt blue watch glass to observe the reaction.
* Methane is extremely flammable! Make sure the valve for the gas is closed when not being used.
* Do not leave Bunsen burners unattended when in use.

Procedure:

Determine which station you and your partner will be starting at. Follow the directions outlined below for each station.

**Station 1 – Single-Displacement Reaction**

Zn(s) + 2HCl(aq) 🡪 ZnCl2(aq) + H2(g)

1. Clamp a large test tube to a ring stand.
2. Place a small amount of zinc into a large test tube.
3. Add approximately 10 mL of 6 M HCl to the test tube, stopper the test tube using a stopper with a hole in the top and observe the reaction that occurs. Record your observations in the observation section below.
4. Hold another large test tube over the hole in the stopper on the test tube where the reaction is taking place. Be sure to not tip the test tube when collecting the hydrogen gas so it does not escape. Place the test tube on the bench top to trap the hydrogen gas.
5. Light a Bunsen burner and light a wooden splint. Take the test tube containing the hydrogen gas you collected during the reaction and place the wooden splint at the bottom of the test tube. You should hear a loud pop. This is called the pop test and confirms the presence of hydrogen in the test tube.
6. Let the reaction in the test tube complete and empty the test tube into the waste beaker provided.

**Station 2 – Double-Displacement Reaction**

Na2CO3(aq) + CoCl2(aq) 🡪 CoCO3(s) + 2NaCl(aq)

1. Add approximately ten drops of 1 M Na2CO3 to a test tube and make note of the color of the solution.
2. Add approximately ten drops of 1 M CoCl2 to the Na2CO3 in the test tube. Record any changes you observe in the observation section below.
3. Discard the contents of the test tube into the waste beaker provided.

**Station 3 – Synthesis Reaction**

2Mg(s) + O2(g) 🡪 2MgO(s)

1. Obtain a piece of Mg ribbon from your teacher.
2. Light a Bunsen burner.
3. While holding the Mg ribbon with tongs, place the ribbon into the flame of the Bunsen burner. \*\*Caution: DO NOT look directly at the reaction. Observe the reaction through a cobalt blue watch glass.\*\* Record your observations in the observation section provided.
4. Dispose of the MgO ash in the beaker provided.
5. Make sure the Bunsen burner is turned off.

**Station 4 – Decomposition Reaction**

CaCO3(s) + heat 🡪 CaO(s) + CO2(g)

1. Weigh out about 2 grams of solid CaCO3 and place it in a clean, dry, large test tube. Make sure the CaCO3 is not packed tightly in the bottom of the test tube.
2. Shake the test tube so that the CaCO3 is on the side and not packed in the bottom of the test tube. Clamp the test tube at a 45o angle on a ring stand or hold the test tube with a test tube holder.
3. Light a Bunsen burner and heat the test tube containing the CaCO3 until the sample completely changes color.
4. Once the sample has completely changed color, insert a burning wooden splint into the test tube and record what you observe in the observation section.
5. Empty the contents of the test tube into the waste beaker provided for this station and make sure the Bunsen burner is off.

**Station 5 – Combustion Reaction**

CH4(g) + 2O2(g) 🡪 CO2(g) + 2H2O(g)

1. Place a tube connected to the gas line in a beaker of soapy water.
2. Turn the gas on while holding the tube into the soapy water. Bubbles will begin to form. \*\*Only leave the gas on for about 5 seconds!\*\* Make sure to turn off the gas once you form bubbles.
3. Using a burning splint, ignite the bubbles. \*\*DO NOT stand close to the bubbles!\*\* Record your observations in the section below.
4. Make sure the burning splint is put out and the gas is turned off.

Observations:

|  |  |  |
| --- | --- | --- |
| Station | Reaction Observations | Product Observations |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |

Discussion Questions:

1. Based off of what you observed at station 1, why are party balloons filled with helium instead of hydrogen?

Hydrogen is an explosive gas and it wouldn’t be safe.

1. At station 4, the burning splint should have gone out when placed in the test tube. Is this what you observed? Why would this occur?

CO2 was a product from the reaction. The lack of oxygen in the test tube would cause the burning splint to go out.