NAME_____ **SECTION**_____

PARTNER(S)_____ **DATE**_____

AN INVESTIGATION OF CHEMICAL REACTIONS I

This laboratory activity will give you some experience with different chemical reactions. You will use your observational skills to describe physical properties of the reactants (starting materials) and products (substances formed as a result of a chemical change). You will practice writing formulas, naming elements and compounds, and balancing equations. As you become familiar with the types of reactions, it will be easier for you to make reasonable predictions about what will happen when unfamiliar substances chemically change

PRE-LAB QUERIES

1. You are about to perform a number of chemical reactions. How will you know that a reaction is taking place? List and explain some of the things you expect to observe as chemical changes occur.

2. Let's suppose that you mixed two colorless, clear solutions and there was no visible change. Could a chemical reaction have occurred? Explain how you might know.

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BACKGROUND

Here are some important things to remember or refer to as you do this activity:

- Chemical changes are rearrangements of atoms. New substances with different properties are formed.
- Chemical equations *represent* chemical changes. All formulas for reactants and products must be accurate.
- Matter is neither created nor destroyed during chemical or physical changes. All atoms must be accounted for. **Balancing** an equation means making the number of atoms of a particular element equal on both sides of the equation. You can **never change a subscript** to balance the equation. You add or change numbers in front of substances to achieve the equality. These added values are called **coefficients**.
- The diatomic elements (hydrogen, oxygen, nitrogen, fluorine, chlorine, bromine, iodine) must be written with a subscript of 2 when they are not combined with another element.
- If one metal is more reactive than another metal (hydrogen included) it will replace the less active metal in a compound.
- Many reactions take place in solution, that is, the reactants are dissolved in water. In some cases, one of the products is a gas or solid that does not dissolve in water. When this occurs it is easy to tell that a reaction has taken place because you can see bubbles or a solid (cloudiness) appear suddenly. The formation of a solid through a chemical reaction is called **precipitation**. In certain reactions, however, the product(s) dissolve instantly so that it is not obvious that a reaction has occurred. There are chemicals called **indicators** that let us know that new substances have been formed because they change color in the presence of the new products or when reactants have been consumed.

PROCEDURE

Identifying Gases

Before you begin the investigation you need some simple procedures for detecting gases that are products in a reaction since they may have no odor or color. We employ a **wooden splint** which can be ignited. For this reason, these tests are called **splint tests**. You ignite the splint with a Bunsen burner. To determine which splint test is appropriate you should look at the reactants and predict what gas is likely to be formed.

Hydrogen Place a burning wooden splint in or near the mouth of the reaction container (usually a test tube). If there is a "pop", like a mini-explosion, the gas produced is probably hydrogen. Hydrogen is the least dense gas and escapes quickly when it is generated. It may be helpful to put your finger over the end of the tube for 10-20 seconds as the reaction is occurring to trap some gas for the test.

Oxygen Place a glowing splint (lit and blown out) into the mouth of a test tube. If the splint relights, the gas is probably oxygen.

Carbon Dioxide Place a burning splint into the mouth of the test tube. If the splint is extinguished, the gas is probably carbon dioxide.

Investigating Reactions

General Procedures

- Follow the specific instructions for each of the following nine activities.
- Do not use more chemicals than called for and dispose of all end products in the properly labeled waste containers.
- For each activity, observe and record the following information on the data sheet:

  Reactants: list names and formulas of **all** starting materials (even invisible ones)

  Description of Reactants: describe the physical properties of the reactants (color, state, luster, mass (if asked for), density...)

  Observations During Reaction: describe what you see as the reaction takes place (color changes, gas formed, solid produced, heat evolved...)

  Description of Products: describe the physical properties of the **all** materials produced in the reaction (even the invisible ones)
- Write the balanced chemical equation, word equation (compound or element names rather than formulas), and the type of reaction for each chemical change you observe on the data sheet. Below is an example.

Reactants	***Description of Reactants***	***Observations During Reaction***	***Description of Products***
mercury (II) oxide or HgO	red solid	solid changed to form silver, shiny liquid; during splint test glowing splint relit	silver, metallic liquid colorless gas

Chemical Equation: $2\ HgO\ (s) \rightarrow 2\ Hg\ (l) + O_2\ (g)$

Word Equation: solid mercury (II) oxide when heated forms liquid mercury and oxygen gas

Reaction Type: decomposition or analysis

- Complete any questions assigned by the instructor.

Specific Procedures

NOTE: Some of the procedures below specify that you use a **pyrex** test tube. Pyrex is a specially tempered glass that withstands rapid changes in temperature without shattering. Look for the word **pyrex** (not kimax) on the test tube.

1. Place a 25 x 250 mm test tube in a test tube rack. Add about 5 mL of dilute hydrochloric acid, HCl, to the tube. Clean a 1 cm piece of magnesium ribbon with steel wool until shiny. This removes any oxide coating that may interfere. Add the magnesium to the HCl. Use a splint test to identify one of the products.

2. Place a small amount (to <u>just cover</u> the curved bottom of a test tube) of copper (II) carbonate, $CuCO_3$, in a **pyrex** test tube. Clamp the test tube to a ring stand at a slight angle, pointed away from any student. Strongly heat the contents of the tube with a Bunsen burner flame. Use a splint test to help identify one of the products. Allow the tube to cool before disposing of the product.

3. Using crucible tongs, place a 2 cm piece of magnesium ribbon in the hottest part of a Bunsen burner flame. **Do not look directly at this reaction as it happens** since the bright light may affect your eyes.

4. Place a **small** amount (to <u>just cover</u> the curved bottom of a test tube) of solid sodium bicarbonate, $NaHCO_3$, in a test tube. Add about 5 mL of dilute hydrochloric acid, HCl. Immediately do a splint test to identify one of the products.

5. Fill a well of a spot plate with $CuSO_4$, copper (II) sulfate. Add a small wad of steel wool (composed mainly of iron metal) to the solution allowing a small part to remain out of the solution. Wait about two minutes. Using a tweezers or tongs, carefully remove the steel wool and place it on a paper towel. Examine the wool and any material left in the spot plate well.

6. Place about 5 drops of $CoCl_2$ (aq), cobalt (II) chloride solution, in a well of a spot plate. Add 5 drops of Na_3PO_4 (aq), sodium phosphate solution. Water does not take part in the reaction.

7. Place a small amount (to cover the curved bottom of the test tube) of potassium chlorate, $KClO_3$, into a **pyrex** test tube. Heat the bottom of the tube in the hottest part of the Bunsen burner flame. While heating, use a glowing splint test to help identify one of the products. Heat until you no longer have a positive splint test. DO NOT DROP THE SPLINT INTO THE TEST TUBE.

8. Mass a small wad of steel wool on a **pyrex** watch glass. Record the mass on your data sheet. Holding a Bunsen burner at the base, carefully direct a flame at the top of the steel wool until it glows brightly for five minutes. **Do not heat the watch glass from the bottom.** Be careful not to lose any of the material from the watch glass. Allow the materials to cool and re-mass the watch glass and product.

9. Place exactly 5.0 drops of dilute hydrochloric acid, HCl (aq), in a well on a spot plate. Place an additional drop of this solution on a piece of blue litmus paper. Add exactly 5.0 drops of dilute sodium hydroxide solution, NaOH (aq), to the HCl solution. Mix them thoroughly but gently with a glass stirring rod. With the glass rod, place a drop of the mixture on a piece of blue litmus paper. If you get the same result as before add NaOH dropwise until something different happens. Blue litmus paper turns pink in the presence of acid and remains blue in the presence of an alkaline solution.

DATA AND RESULTS TABLE

NAME_____ **SECTION** _____

	Reactants	Description of Reactants	Observations During Reaction	Description of Products
1				
	Chemical Equation			
	Word Equation			
	Reaction Type			
2				
	Chemical Equation			
	Word Equation			
	Reaction Type			
3				
	Chemical Equation			
	Word Equation			
	Reaction Type			

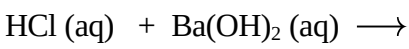
	Reactants	Description of Reactants	Observations During Reaction	Description of Products
4				
	Chemical Equation			
	Word Equation			
	Reaction Type			
5				
	Chemical Equation			
	Word Equation			
	Reaction Type			
6				
	Chemical Equation			
	Word Equation			
	Reaction Type			

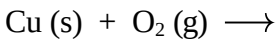
	Reactants	Description of Reactants	Observations During Reaction	Description of Products
7				
	Chemical Equation			
	Word Equation			
	Reaction Type			
8				
	Chemical Equation			
	Word Equation			
	Reaction Type			
9				
	Chemical Equation			
	Word Equation			
	Reaction Type			

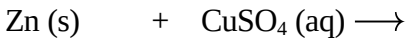
POST-LAB QUESTIONS

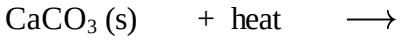
1. List and explain four types of evidence (visual or auditory) that indicate a reaction occurred based on observations in this activity.

2. Complete and balance the following equations and indicate what type they are:









3. If you had not used litmus paper before and after the reaction in #9, what could you have concluded after mixing the chemicals together? Why?