Period: ***Name:***

Pre-Lab Discussion

Read through the entire lab investigation and the relevant pages of your textbook. Then answer the questions that follow.

1. What constitutes a positive test for each of the following gases?
   a. oxygen _____
   b. hydrogen _____
   _____
   c. carbon dioxide _____
   _____
   d. water vapor _____
   e. ammonia _____
2. What is the proper way to smell a substance in the lab? Why should care be taken when smelling a gas such as ammonia? _____
   _____
   _____
3. What is the role of a catalyst in a reaction?
   _____
   _____
   _____
   _____
4. Limestone ($CaCO_3$) is identified by dropping a small amount of hydrochloric acid (HCl) on it. Fizzing is a positive test (carbon dioxide production). **Write out in words** the information represented by the following balanced chemical equation, providing the molar ratio and physical states of the compounds.

$$CaCO_{3(s)} + 2\,HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$$

   _____
   _____
   _____
   _____
5. Identify four ways chemical equations are used to describe what occurs in chemical reactions.
   1. _____
   2. _____
   3. _____
   4. _____

Period: ***Name:***

Introduction

If you examine a car that has been in a junkyard for a while, you will notice that it has rusted. Rusting is a slow chemical reaction of the iron in the car with oxygen gas. If sodium is put into water, a much more rapid chemical reaction occurs. Sodium reacts with water to produce sodium hydroxide and hydrogen gas. During this reaction, enough heat is liberated to ignite the hydrogen gas, causing it to explode.

Chemists observe what is happening in a chemical reaction and try to describe it in language that is simple and clear. A chemical equation used formulas and symbols to describe the substances involved in a reaction, the physical state of the substance, the use of a catalyst (a substance that speeds up a reaction but is not used up in the process), and relative proportions. The general form of an equation is:

Reactants ⟶ Products

In this investigation you will perform a series of reactions and make careful observations of the changes that occur. Using simple tests and your knowledge of chemistry, you will determine the identity of the products. With this information, you will write chemical equations to describe the reactions.

Materials

_____ chemical splash goggles
_____ tongs
_____ lab burner
_____ matches
_____ watch glass
_____ 6 test tubes
_____ graduated cylinder
_____ test-tube rack & holder
_____ 3 wooden splints
_____ 1 well plate
_____ file
_____ spatula
_____ ammonium carbonate, $(NH_4)_2CO_3$
_____ cobalt chloride paper
_____ 3% hydrogen peroxide solution, H_2O_2
_____ manganese (IV) oxide, MnO_2
_____ 3.0 *M* hydrochloric acid, HCl
_____ 2 pieces of magnesium ribbon
_____ copper wire
_____ lead (II) nitrate, $Pb(NO_3)_2$
_____ potassium iodide, KI

Safety

- Wear your goggles at all times during the investigation.
- Avoid looking at the burning magnesium. The bright light could seriously damage your eyes.
- Tie back loose hair and clothing when working with a flame.
- Hydrochloric acid is corrosive. Avoid any direct contact with it.
- Clean up all spills immediately.
- Ammonia is a skin and respiratory irritant, so avoid inhaling it deeply.
- Lead compounds are poisonous, so be sure to avoid contact with skin. If contact occurs with any of these chemicals, immediately wash the affected area with plenty of water and inform your teacher.
- Lead and copper compounds should be collected in designated waste containers.
- Glass tubing breaks easily. Exercise caution when working with it.

Period: ***Name:***

Procedure

1. Put on your goggles. For each of the reactions, record in the Data Table observations such as the appearance of the reactants; evidence that a chemical reaction has taken place; the results of tests performed on any gasses produced; the appearance of the products; and any other relevant data. Each reaction must have at **LEAST** 3 observations. Do **NOT** include conclusions, i.e. writing the name of the gas that is present.

2. Place a test tube in the test-tube rack. Have a second test tube ready in a test-tube holder. Using a graduated cylinder, add 3-5 mL of 3.0 *M* HCl to the first test tube. Drop a 2-cm piece of magnesium ribbon into the acid and **IMMEDIATELY** invert the second test tube over the mouth of the first test tube as shown in Figure 25-1. CAUTION: *Hydrochloric acid is corrosive. Avoid spills and splashes. If you do spill acid, immediately rinse the area with plenty of cold water and report the spill to your teacher.*

3. When the reaction appears to have ended, light a match (or wooden splint) and **IMMEDIATELY** test the collected gas for flammability by holding the burning match/wood splint near the mouth of the inverted test tube. CAUTION: *The gas in the test tube will make a popping sound. Do not be startled.* Rinse the excess hydrochloric acid down the drain with plenty of water.

4. Light the lab burner. Grasp a small piece of copper wire with your tongs and heat it in the burner flame until it is red hot. Remove it from the flame and allow it to cool. Using a spatula, scratch the surface of the metal.

5. Carefully place about one spatula of ammonium carbonate, $(NH_4)_2CO_3$, into a test tube. Holding the test tube with a test-tube holder, heat the solid gently by holding the test tube in the flame for a few seconds, then removing it for a few seconds. Continue heating in this manner for 1 minute. As you heat the solid, carefully waft the air toward your nose to detect any odor.

Observations:

CAUTION: *When heating the test tube, point the open end away from yourself and anyone nearby. The gas coming from the tube is a skin and respiratory irritant, so avoid inhaling it deeply.* Continuing to heat the solid, place a burning splint at the mouth of the test tube. Finally, as heating continues, place a piece of clue cobalt paper just inside the mouth of the test tube. Put the test tube in the rack to cool. Turn off the burner.

6. Place approximately 10-15 mL of hydrogen peroxide, H_2O_2, into a test tube. Have a wooden splint and matches ready. Add a very small amount (about the tip of a spatula) of manganese (IV) oxide, MnO_2, to the hydrogen peroxide. As the reaction occurs, light the splint and allow it to burn freely for 5 seconds. Blow the flame out and place the glowing splint halfway into the test tube. ****The splint will brightly glow or even relight!*** Turn off the burner.

7. Using the well plate, place one drop of $Pb(NO_3)_2$ and one drop of KI into a well depression. Record your observations and then wipe out the chemicals from the well plate using a paper towel.

8. Clean your work area by washing down the lab station with a wet paper towel, clean all lab equipment (used or unused) with water and soap, return all materials to their proper containers, push in all chairs, wash your hands and then wait to checked off by your teacher.

- **Used copper wire, used magnesium strips** are to be placed in the appropriate waste container at the center lab station.

- **Used wooden splints and cobalt paper** are to be placed in the appropriate waste container.

Observations:

Period: ***Name:***

Data Table

Complete the table below in pen!

Reaction	**Observations** ***Describe reactants, products and reaction. You must have at least 4 observations!***	
Mg and HCl	▪ ▪ ▪	▪ ▪ ▪
Heating Cu	▪ ▪ ▪	▪ ▪ ▪
Heating $(NH_4)_2CO_3$	▪ ▪ ▪	▪ ▪ ▪
H_2O_2 and MnO_2	▪ ▪ ▪	▪ ▪ ▪
KI and $Pb(NO_3)_2$	▪ ▪ ▪	▪ ▪ ▪

Period: ***Name:***

Analysis

Do your work for the equations on a separate piece of paper, then write in the correct answer. No cross outs! Balance, state catalysts and physical states!

Reaction	**Balanced Equation** ***(with physical states)***	**Type of Reaction**
Mg and HCl		
Heating Cu		
Heating $(NH_4)_2CO_3$		
H_2O_2 and MnO_2		
KI and $Pb(NO_3)_2$		

Period: ***Name:***

Conclusion Questions

1. A positive test for hydrogen is the "pop" test. What reaction causes the "pop"? Write a balanced chemical equation for this reaction test. Include the catalyst and the reactant/product physical states.

2. Express the "pop" test chemical equation in words.

Critical Thinking Application Questions

Include the question in your answer and number the section in your lab write-up. Remember to write the balanced chemical equation including catalysts and physical states.

1. For each of the following situations, determine the identity of the gas produced from the information given and write a balanced chemical equation with catalysts and physical states that represents the reaction.

   a. When potassium bromate ($KBrO_3$) is heated, it decomposes into potassium bromide and a gas that supports the combustion of a glowing splint.

   b. Sodium metal reacts violently with water to produce sodium hydroxide and a gas that "pop" in the presence of a burning splint.

   c. The recipe for the volcanic eruption used in many science projects is the reaction of baking soda ($NaHCO_3$) and vinegar (CH_3COOH). When these compounds are mixed together, the salt sodium acetate ($NaCH_3COO$) is formed as well as a gas that extinguishes a burning flame and a substance that turns blue cobalt chloride paper pink.