TYPES OF CHEMICAL REACTIONS

Pre-Lab Discussion: There are many kinds of chemical reactions and several ways to classify them. One useful method classifies reactions into five major types. These are (1) combination; (2) decomposition; (3) single replacement; (4) double replacement; (5) combustion. Not all reactions can be put into one of these categories. Many, however, can. In this investigation you will observe examples of the first four types of reactions. You will be expected to balance the equations representing the observed reactions.

PROBLEM/PURPOSE: Observe some chemical reactions and identify reactants and products of those reactions. Classify the reactions and write balance equations.

EQUIPMENT:
- burner
- sandpaper, fine
- test tubes, (7)
- crucible tongs
- microspatula
- evaporating dish
- safety goggles
- test tube holder

MATERIAL:
- zinc, mossy (Zn)
- copper wire, 10 cm (Cu)
- Sodium Carbonate
- 6M hydrochloric acid
- 0.1 M Zinc Acetate
- 0.1 M sodium phosphate Na₃PO₄
- 1M sodium bicarbonate NaHCO₃
- Magnesium ribbon, 5 cm Mg
- copper (II) sulfate CuSO₄

SAFETY: In this investigation you will be working with open flame, heating chemicals, handling acids, working with poisonous chemicals, and producing gaseous products. Remember your safety rules, when in doubt ask the teacher.

PROCEDURE:
PART A: COMBINATION;
1. Use a fine sandpaper to clean a piece of copper wire until the wire is shiny. Note the appearance of the wire.
2. Using crucible tongs, hold the wire in the hottest part of a burner flame for 1-2 minutes. Examine the wire and note any change in its appearance caused by heating.
3. Place an evaporating dish near the base of the burner. Examine a piece of magnesium ribbon. Using crucible tongs, hold the sample in the burner flame until the magnesium starts to burn. DO NOT LOOK DIRECTLY AT THE FLAME. HOLD THE BURNING MAGNESIUM AWAY FROM YOU AND DIRECTLY OVER THE EVAPORATING DISH. When the ribbon stops burning, put the remains in the evaporating dish. Examine this product carefully.

PART B: DECOMPOSITION;
4. Place 1 small scoop of Sodium carbonate (Na₂CO₃) in a clean, dry test tube. Note the appearance of the sample. Please do not spill.
5. Using a test tube holder, heat the Na₂CO₃ strongly for about 2 minutes. Then insert a burning wood splint into the test tube. If carbon dioxide gas (CO₂) is present, it will put the flame out. Note any change in the appearance of the residue in the test tube.

PART C: SINGLE REPLACEMENT;
6. In a clean dry test tube add about 5mL of 6 M hydrochloric acid (HCl). CAUTION, Handle acids with care. They can cause painful burns. Do not inhale any HCl fumes. Now carefully drop a couple small piece of zinc metal (Zn) into the acid in the test tube. Observe and record what happens.
7. Invert a second test tube over the mouth of the test tube in which the reaction is taking place, using a test tube holder. Remove the inverted tube after about 30 seconds and quickly insert a burning wood splint into the
mouth of the tube. (A “pop” indicates the presence of hydrogen gas.) Note the appearance of the substance in the reaction test tube.

8. Add about 2ml of copper (II) sulfate solution to a clean, dry test tube. Place a small amount of magnesium metal in the solution. Note the appearance of the solution and the magnesium before and after the reaction.

PART D: DOUBLE REPLACEMENT;

9. Add about 2 mL of 0.1 M zinc acetate [Zn(C₂H₃O₂)₂] solution to a clean test tube (rinsed with distilled water). Next, add about 2 ml of .1M sodium phosphate (Na₃PO₄) solution to another clean test tube. Pour the Zinc Acetate into the Sodium Phosphate and observe what happens and note any changes in the mixture.

10. Add about 2 ml of 1M Sodium bicarbonate (NaHCO₃) solution to a clean, dry test tube. Next, add about 2 ml of 1M hydrochloric acid (HCl) solution to another clean test tube. Pour the sodium bicarbonate into the Hydrochloric acid and observe what happens and note any changes in the mixture. Notice the bubbles that form, do not smell the gas.

<table>
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<th>OBSERVATIONS AND DATA</th>
<th>Before Reaction</th>
<th>During and after the Reaction</th>
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<td>1. Copper + Oxygen</td>
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<td>2. Magnesium + Oxygen</td>
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<td>B. Decomposition</td>
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<td>3. Sodium Carbonate</td>
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<td>C. Single Replacement</td>
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<td>4. Zinc + Hydrochloric Acid</td>
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<td>6. Zinc Acetate + Sodium Phosphate</td>
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<td>7. Sodium Bicarbonate + Hydrochloric Acid</td>
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Include careful observation above, I expect detailed complete observations.
**CALCULATIONS:** BALANCE the equations from the reactions used above. All seven equations should start out with the appropriate word equation, be translated into the a skeletal equation, and balanced. Please include the (s), (g), (l), and (aq)’s in all 7 equations and indicate if any of the reactions are exothermic by including heat as a product.

**EXAMPLE:**

Copper metal + aqueous silver nitrate $\rightarrow$ aqueous copper (II) nitrate + silver metal  
$\text{Cu(s)} + 2\text{AgNO}_3(\text{aq}) \rightarrow \text{Cu(NO}_3\text{)}_2(\text{aq}) + 2\text{Ag(s)}$

**QUESTIONS:**

1. Describe the test was used to identify hydrogen gas from the Zinc and Hydrochloric Acid reaction? Write a balanced equation describing the combustion of hydrogen gas.

2. Describe the test was used to identify carbon dioxide gas from the decomposition of sodium carbonate above?

3. Research and explain the simple flame test is used to identify Oxygen gas.

4. Balance the equations below and identify the type of reaction represented by each equation.
   
   a. Aqueous silver Nitrate + copper metal $\rightarrow$ aqueous copper(II)nitrate + silver metal
   
   b. Aqueous barium chloride + aqueous sodium sulfate $\rightarrow$ aqueous sodium chloride + aqueous barium sulfate
   
   c. Chlorine gas + aqueous sodium bromide $\rightarrow$ aqueous sodium chloride + bromine (l)
   
   d. Solid potassium chlorate $\rightarrow$ solid potassium chloride + oxygen gas
   
   e. Hexane ($\text{C}_6\text{H}_{14}$) (l) + oxygen gas $\rightarrow$ carbon dioxide + water vapor