UNIT 8 - CHEMICAL EQUATIONS

Types of Chemical Reactions Lab

DISCUSSION & OBJECTIVE:

Chemical reactions are sometimes classified into several broad categories. This classification is by no means intended to include every individual reaction. The benefit of studying reactions in classes is to assist you in learning what to predict about the outcome of a reaction.

In this lab, you will examine several types of reactions including single replacement, double replacement, and decomposition reactions. **Please keep accurate records of the reactions and their products.**

MATERIALS (EQUIPMENT):

- test tubes (6)
- test tube rack
- stirring rod
- wood splints (4)
- matches
- funnel
- filter paper (2)
- ring stand
- iron ring
- wire gauze
- 250 mL beaker (2)
- lab burner
- beaker tongs

MATERIALS (CHEMICALS):

SOLIDS: - zinc - iron - copper - MnO_2

AQUEOUS SOLUTIONS:

- $CuSO_4$ - NaOH* - H_2SO_4* - $FeSO_4$ - H_2O_2*

* dropper pipets included

PROCEDURES:

A. Double Replacement

1. Label test tubes 1, 2, 3, 4, 5, and 6.
2. Place about 5 mL of $CuSO_4$ solution in test tube 1. (The $CuSO_4$ should be added until it is about the height of your thumb nail.) Then, add 4 drops of NaOH solution.
3. Let the test tube stand until the solid has stopped forming. At this point, you will need to ask your instructor to put your test tube in the centrifuge. (The purpose of putting your test tube in the centrifuge is to collect all of the solid that has formed at the bottom of the test tube.)
   The solid formed is called a precipitate. Decant the solution remaining in the test tube. This simply means to carefully pour the liquid on top of the precipitate into test tube 2. The centrifuge should help the precipitate remain at the bottom of the test tube. The liquid poured off is called the supernatant.
4. Add 3 or 4 drops of NaOH to the supernatant liquid from above. Observe.

B. Single Replacement (replacement of hydrogen)

1. Place a small piece of zinc in test tube 3. Add enough H_2SO_4.to cover the piece of zinc. **CAUTION! H_2SO_4 is sulfuric acid. It can cause severe burns. Use caution when handling any equipment that contains H_2SO_4.**
2. Hold your thumb over the open end of the test tube for about 1 to 2 minutes. (You may have to hold your thumb over the end of the test tube for less than 1 minute or more than 2 minutes. You will feel pressure begin to push on your thumb. When that pressure builds up, then you should go on to step 3.)
3. Place a burning wood splint into the open end of the test tube. (Make sure that you keep your thumb over the end of the test tube until you are ready to put the wood splint near the end of the tube.) Observe.
4. Let the test tube stand until there is no more Zn or until the reaction has stopped as evidenced by no further bubbling. Filter the solution into a 250 mL beaker to prevent any unreacted Zn from getting into the beaker. Once the liquid has finished draining through the filter paper, throw the filter paper and its contents in the trash. (Please note that trash does not belong in the sink!)
5. Place the 250 mL beaker with the solution on the ring stand (with the wire gauze on it) and heat it **gently!** (You will not get accurate results if you heat the solution too quickly. Use a SMALL flame.)
   When most of the solution has evaporated, and the crystal is nearly dry, remove from the heat. Observe.
6. Obviously, the crystal formed was dissolved in water to begin with. To test for solubility after the evaporation, allow the beaker to cool (go on to Part C), and later add water and stir to determine if the solid is still soluble.

C. Single Replacement

1. Place about 5 mL of $CuSO_4$ solution (thumb nail height) in test tube 4 and add 7 drops of H_2SO_4. Carefully add about 5 small scoops of iron (as much iron as you can collect on the end of an unused wood splint) into test tube 4. The acid (H_2SO_4) is a catalyst. **Use caution when handling acids.**
2. Let the setup stand for 5 minutes or so and then pour through a new piece of filter paper. Once all of the liquid has drained through, open the filter paper and observe the solid. You can pour the supernatant solution down the sink.

D. Single Replacement

1. Place about 5 mL of $FeSO_4$ solution (thumb nail height) in test tube 5 and add 7 drops of H_2SO_4. Carefully add about 5 small scoops of copper (as much copper as you can collect on the end of a different unused wood splint) into test tube 5.
2. Let the setup stand for 5 minutes or so and then pour through a new piece of filter paper. Once all of the liquid has drained through, open the filter paper and observe the solid. You can pour the supernatant solution down the sink.

E. Decomposition

1. Place 5 mL of H_2O_2 (hydrogen peroxide) in test tube 6 and observe.
2. Carefully add a small amount of MnO_2 to the H_2O_2. You only need about as much as the end of a wood splint will hold.
3. Note the changes that occur after adding the MnO_2. (Please note that MnO_2 is NOT chemically changed as a result of the reaction. It is a catalyst. It simply speeds up the rate of the reaction.)

Types of Chemical Reactions - DATA CHART & QUESTIONS

OBSERVATIONS:

	Before Rxn.	During rxn.	After rxn.	Special Notes
Part A				
Part B				
Part C				
Part D				
Part E				

UNIT 8 - CHEMICAL EQUATIONS

REACTIONS:

In this section, you will be writing the equations that you performed in Parts A, B, C, D, & E. You will write out the equation in words (including states of matter - aq, s, l. g), then you will write it out using formulas. (When using formulas, do not forget to balance the equations. Also remember that some elements by themselves occur as diatomic molecules.)

Part A

1. Aqueous copper (II) sulfate solution is reacted with an aqueous solution of sodium hydroxide to produce _____ and _____
2. Write the reaction using symbols and formulas. (Do not forget to include the state of matter for each substance. (aq) means aqueous or dissolved in water, (s) means solid, (l) means liquid, and (g) means gas)

   _____ ( ) + _____ ( ) --> _____ ( ) + _____ ( )

Part B

1. solid zinc metal and an aqueous solution of sulfuric acid produces _____ and _____
2. Zn(s) + _____ ( ) --> _____ ( ) + _____ ( )

Part C

1. solid iron plus copper (II) sulfate aqueous solution yields _____ and _____
2. Rewrite the equation using symbols.

   _____ ( ) + _____ ( ) --> _____ ( ) + _____ ( )

Part D

1. solid copper plus iron (II) sulfate aqueous solution yields _____ and _____
2. Rewrite the equation using symbols.

   _____ ( ) + _____ ( ) --> _____ ( ) + _____ ( )

Part E

1. _____ solid is added to hydrogen peroxide as a catalyst to produce

   _____ and _____
2. Rewrite using symbols. Catalysts are usually placed on the arrow.

   _____ ( ) ----------> _____ ( ) + _____ ( )

QUESTIONS:

Part A

1. Why is this called a double replacement reaction?
2. Using the solubility rules (p. 6 of Reference Tables), which of the products is the precipitate (ppt) in this reaction?

Part B

1. What evidence did you observe that indicated that a reaction was taking place?

2. Why is this called a single replacement reaction?
3. List two (2) other metals that could have worked in this procedure. (Hint: You will need to use the Activity Series for this question.)
4. Name two (2) zinc compounds (other than zinc sulfate) that are also soluble in water. (EXTRA CREDIT: Write the formulas for these compounds.)

Part C

1. What is the purpose of using H_2SO_4 (sulfuric acid)?
2. What formed on the iron? Why? (Hint: Activity Series)
3. List two (2) other metals that would produce the same results as the iron.

Part D

1. What formed on the copper? Why?
2. List two (2) other metals that would produce the same results as the copper.

Part E

1. Describe the physical appearance of hydrogen peroxide.
2. What gas was produced?
3. Describe the role MnO_2 played in the reaction.
4. What is the correct name for the compound MnO_2?
5. What is one (1) everyday use of hydrogen peroxide? (If your answer is correct and different from all other answers in your class, you get 5 bonus points on your lab!)

* BONUS *

A bewildered but determined chemistry student is given 4 test tubes of colorless, odorless solutions. None of the tubes are labeled, but he is told they contain individually one of the following: $AgNO_3$, $Ca(NO_3)_2$, $Ba(NO_3)_2$, and $NaNO_3$. Based on solubility, what kind of salt (compound) solution could he add to pick out the test tube that contained the silver?