NAME _____ PREF _____ SECTION SC_____ DATE _____

EXPERIMENT 20: DETERMINATION OF COMBINING RATIO OF REACTANTS

Equipment: 100mL graduated cylinder, litmus paper, balance, thermometer, styrofoam cup.
Materials: zinc (metal), 1.0M $CuSO_4$, H_2O

In this experiment you will study the reaction between zinc metal and copper sulfate solution in order to determine the number of moles of zinc atoms that react with a mole of copper sulfate in solution.

Since the reaction is exothermic, the heat released can be detected by a release in temperature of the solution in which the reaction takes place. The amount of temperature rise will enable you to determine the molar combining ratios of zinc and copper sulfate. Each team of students will be assigned a different weight of zinc and a volume of copper sulfate solution for the experiment (see table below).

A. Place the assigned volume of copper sulfate solution in a 100 mL. graduated cylinder. Add enough water to bring the total volume to 100 mL. Use water that has been kept at room temperature. Pour the solution from the graduated cylinder into a calorimeter cup. Measure the temperature to the nearest 0.2°C. Record this as the initial temperature in the appropriate column of the table below.

Assign ment #	mL of $CuSO_4$	Grams of Zn	Initial Temp.	Final Temp.	Δt	Moles Zn	Moles $CuSO_4$
1	90	0.65					
2	80	1.29					
3	70	1.93					
4	60	2.58					
5	50	3.22					
6	40	3.87					
7	30	4.51					
8	20	5.15					
9	10	5.80					

B. Weigh the assigned amount of zinc to the nearest 0.01 gram on a circle of filter paper. (Don't forget the weight of the filter paper!) Add zinc to the calorimeter. Stir the mixture slowly and continuously; read the temperature every 30 seconds until it no longer rises. Record the highest temperature in the final temperature column of the paper. Record the difference between the final and the initial temperatures as Δt in the table. Observe any changes in the appearance of the mixture.

C. Obtain the values of t found by the other teams of students from the instructor and record these in your table. Complete the table by calculating the number of moles of zinc from the weights used; calculate the number of moles $CuSO_4$ used in each assignment from the fact that there is 0.1 mole of $CuSO_4$ in each 100 mL of the original solution.

D. Plot a graph using data from the table. Plot the t values on the vertical axis, and the number of moles of zinc on the horizontal axis. Underneath each value for moles of zinc, write the number of moles of $CuSO_4$ used with it. Draw the best SMOOTH curve indicated by the point plotted.

SUMMARY QUESTIONS

1. After the reaction was completed, what changes in the appearance of the mixture did you observe ? What product can you recognize?

2. From the graph , determine which combination of zinc and copper sulfate gives the greatest temperature rise. What does this tell you about the number of moles of zinc and copper sulfate that reacted?

3. Write the balanced equation for the reaction . Compare the molar ratios shown in the balanced equation to those on the graph used to answer question 2.

4. If 0.01 moles of Zn are added to 0.07 moles of $CuSO_4$, how many moles of Cu metal will be formed? How much of the $CuSO_4$ will react? How much will remain used?

5. What is the purpose of adding water to make the total volume of solution in the calorimeter 100mL ?

6. In what way can this experiment be improved to make the measurements more exact?