Name: _____ Date: _____

Basic research is when I'm doing what I don't know what I'm doing.
--Werner von Braun

Title: Factors Affecting Reaction Rates

Introduction: In this lab you will investigate factors that may effect the rate of a reaction. As you go through this lab activity, you might find it useful to keep in mind the two main concepts of **collision theory**:

1. collisions must occur if a reaction is to take place,
2. not all collisions result in reactions.

For example, when you are exploring the role of concentration on reaction rate, ask yourself: "how would changing the concentration have an effect on the number of collisions that lead to a successful chemical reaction"? Try to interpret your results always in terms of effect on successful collisions.

Materials:

You will be provided with the following materials:

1. acidified 0.4 M $Na_2C_2O_4$ (sodium oxalate)
2. acidified 0.1 M $FeSO_4$
3. 0.02 M $KMnO_4$
4. 0.01 M $MnCl_2$
5. set of 6 small test tubes
6. distilled water
7. stopwatch
8. heat source

Note: "acidified means that the solution contains also 1 M H_2SO_4 (aq). The reaction won't occur unless there are some H^+ ions around.

Day 1

1. Compare the rates of reaction for $FeSO_4$ with $KMnO_4$.
   - Set up three test tubes with 10 drops of the iron(II) solution (this should be enough to make a small pool of reagents at the bottom of your test tubes).
   - Add a drop of $KMnO_4$. and time the reaction. You will know it is over when the purple color is gone. Take an average of your results. (Hint: the disappearance in color is probably most easily seen if compared to a white background!!) Record your data.
2. Repeat the process with $Na_2C_2O_4$ with $KMnO_4$
3. These tests represent your **control** rates.
4. With your group, design an experiment to test one variable that you think may affect the reaction rates of both reactions. Use the scoring guide to help design the experiment.
5. What is the question or problem you will address?

6. What is the variable you will test?

7. Describe the steps you will take.
   a.

   b.

   c.

   d.

   e.

   f.

Hypothesis:

Data:

Trial

Trial	1	2	3	Average
Control:				
$FeSO_4$ with $KMnO_4$.				
$Na_2C_2O_4$ with $KMnO_4$				
Experiment:				
$FeSO_4$ with $KMnO_4$.				
$Na_2C_2O_4$ with $KMnO_4$				

Analysis

1. What did your experiment show about reaction rates?

2. How does collision theory explain your results?

3. Explain the difference between the undiluted and diluted solutions in relation to collision theory.

4. Explain the difference between the room temperature and heated reactions in relation to collision theory.

5. What were sources of error in the experiments?

6. What would you do differently next time?

7. Substances which increase the rate of a reaction without being consumed are known as catalysts. In the oxalate/permanganate system, Mn^{2+} acts as an auto catalyst (i.e., it is a product which catalyzes its own reaction). What experimental evidence is there that Mn^{2+} is a catalyst for this reaction system?

8. The "nature of the reactants" is often given as one factor that affects the rate of a chemical process. In both of these reactions, MnO_4^- is converted to Mn^{2+}. But the oxidations are very different. In one case Fe^{2+} is converted to Fe^{3+}. In the other case $C_2O_4^{2-}$ is converted to CO_2 gas. In light of collision theory suggest a reason for the difference in the observed rates of these two processes.

Conclusion: