Chemistry 534 **Name:_____**

Effect of Temperature and of Surface Area on Rates

Purpose: To examine the effect of temperature and surface area on the following reaction:

$2\ KMnO_{4(aq)} + 5\ Fe_{(s)} + 8\ H_2SO_{4(aq)} \rightarrow 2\ MnSO_{4(aq)} + 5\ FeSO_{4(aq)} + K_2SO_{(aq)\ 4} + 8\ H_2O_{(l)}$

purple ←*almost colourless*→

Apparatus and Materials: $KMnO_4$ (0.00160 moles/L acidified with an equal volume of 0.01M H_2SO_4); two iron nails (2 inch finishing nails); equal mass of iron filings; three 4 inch test tubes; test tube rack ; 10 ml graduated cylinder; hot plate; small plastic beaker; 100 ml beaker; 250 ml beaker; tap water; stopwatch; thermometer; rubber stoppers

Procedure:

Part 1: Effect of Surface Area

1. From the little plastic beaker, transfer acidified $KMnO_4$ solution into a 10 mL graduated cylinder. Then transfer 10.0 mL into a dry clean test tube.
2. Weigh 1.7 g of iron filings. This should equal to the mass of the iron nail that you will be using later. Check and adjust the mass of filings accordingly, if necessary.
3. Add the iron filings to the test tube containing the purple $KMnO_4$ solution. Start the stopwatch.
4. Stopper the test tube, and mix it constantly.
5. Using the data table on the next page, record the time it takes for the test tube's purple colour to disappear. **It should turn light mud-brown in colour.**

Part 2: Effect of Temperature

1. You'll find some hot water in a 400 ml beaker on a hot plate. Wait for the water to boil. Make sure that at least 400 ml of water is present.
2. While the water is heating up, use a 10 mL graduated cylinder to transfer 10.0 mL of acidified $KMnO_4$ solution into each of two dry clean test tubes.
3. Place one tube into the beaker of boiling water, and leave the other one in a test tube rack. Record the air temperature.
4. *After 2.5 minutes*, record the initial temperature of the hot water.
5. While starting the stopwatch, quickly and simultaneously drop an iron nail into each of the two test tubes.
6. Record the time it takes for the hot tube's purple colour to disappear and for the first brown colour to appear.

7. Record the final temperature of the hot tube.
8. At this point note the colour of the solution in the test tube at room temperature.

Data:

Reaction time for test tube 1 (with filings)	
Initial temperature of hot water	
Final temperature of hot water	
Average temperature of hot water	
Air temperature	
Reaction time for test tube 2 in hot water	
Colour of solution in test tube 3 at room temp at completion of reaction for other tube(2)	

Analysis:

1. a. Which reaction occurred faster: the one in Part 1(test tube 1)? Or test tube 3?

   b. Why?

2. Often each temperature-increase of 10^{o} C doubles the rate of reaction. Assume that this rule applies to our reaction and predict how long it would take for the reaction in test tube 3 to go to completion.

3. Now use your estimate for the reaction in test tube 3, and predict how much more surface area the iron powder in tube 1 had compared to the iron nail in tube 3.

Conclusion: