Lab #7

The Clock Reaction
Factors Affecting Reaction Rates

SAFETY FIRST!
1. Wear safety glasses at all times.
2. Always treat all chemicals as dangerous. Avoid any unnecessary contact with all of the solutions.

PROCEDURE
1. Obtain one well tray for your group. All reactions, except for Part B, will be done in this well tray. Also, obtain one stopwatch and a toothpick.
2. To begin, we will run our standard reaction for this lab. In one well, add 2 drops of 0.010 M KI solution, 4 drops of water, 2 drops of 0.1 M HCl solution, 1 drop of 2% starch solution, and 1 drop of 0.0010 M Na$_2$S$_2$O$_3$ solution. MAKE SURE YOUR NUMBER OF DROPS IS EXACT!! IF NOT, START OVER IN ANOTHER WELL!
3. Prepare your stopwatch. Add 2 drops of KBrO$_3$ solution to the same well and immediately start the stopwatch. Use the toothpick to stir the liquid in the well.
4. Record the time on the stopwatch at the moment the liquid turns blue.
5. Repeat steps 2 and 3 in other wells and stop when you get two similar times in two different reactions. MAKE SURE TO RINSE AND DRY YOUR TOOTHPICK AFTER EVERY TRIAL!
   a) Average the times of your repeated trials.
   b) This average time will be the standard reaction time which you will make comparisons to for the remainder of this experiment.

PART A – Changes in Concentration

6. For this part of the experiment you will be changing the concentration of two of the reactants in the reaction and recording the new reaction times. The total number of drops cannot change, so when you add more of something, you should add less water.
7. Follow steps 2 and 3 above, using the amounts of each chemical below to run four more reactions. **MAKE SURE TO ADD THE KBrO\textsubscript{3} LAST AND START RECORDING THE TIME AS SOON AS ITS ADDED!!**

<table>
<thead>
<tr>
<th></th>
<th>KI</th>
<th>H\textsubscript{2}O</th>
<th>HCl</th>
<th>Starch</th>
<th>Na\textsubscript{2}S\textsubscript{2}O\textsubscript{3}</th>
<th>KBrO\textsubscript{3}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in [KI]</td>
<td>4 drops</td>
<td>2 drops</td>
<td>2 drops</td>
<td>1 drop</td>
<td>1 drop</td>
<td>2 drops</td>
</tr>
<tr>
<td>Change in [HCl]</td>
<td>6 drops</td>
<td>0 drops</td>
<td>2 drops</td>
<td>1 drop</td>
<td>1 drop</td>
<td>2 drops</td>
</tr>
<tr>
<td></td>
<td>2 drops</td>
<td>2 drops</td>
<td>4 drops</td>
<td>1 drop</td>
<td>1 drop</td>
<td>2 drops</td>
</tr>
<tr>
<td></td>
<td>2 drops</td>
<td>0 drops</td>
<td>6 drops</td>
<td>1 drop</td>
<td>1 drop</td>
<td>2 drops</td>
</tr>
</tbody>
</table>

8. Repeat each experiment twice and average your results.

**PART B – Changes in Temperature**

9. For this part of the experiment, you will change the temperature of the reaction and record the new reaction time. Around the classroom, you will find two hot water baths, one at 35°C and one at 45°C.

10. Repeat step 2 exactly, only this time use a small test tube. After adding all of the chemicals in step 2, place your test tube in the hot water bath. Let the test tube sit in the water for 5-10 minutes to allow the liquid in the test tube to reach the correct temperature.

11. Follow step 3, using the KBrO\textsubscript{3} solution that is in the same hot water bath, starting the timer as soon as it is added. Again, make sure to stir the reaction, this time with a glass rod.

12. Repeat the reaction twice at each temperature, and average your results for each.

**PART C – Effect of a Catalyst**

13. For this part of the experiment you will be testing several chemicals as possible catalysts for this experiment, 0.10 M Cu(NO\textsubscript{3})\textsubscript{2} solution, 0.10 M CuCl\textsubscript{2} solution, and 0.10 M NaCl solution.

14. Repeat step 2, this time only using 3 drops of water and adding 1 drop of catalyst.

15. Repeat step 3 exactly.

16. Repeat steps 14 and 15 for each of the three catalysts, doing each one two times and average you results for each catalyst.
Lab Report #7 Instructions

Your lab report must include the following:

Cover Sheet
Use the cover sheet paper that you were given and fill in all of the appropriate information. This includes the title of the lab, the date of the lab, when the lab report is due, your name and the name of your lab partner, and your reflection on the lab. Talk about what you have learned in the lab, any mistakes you may have made, how you felt about the lab, how you could have done things differently, etc...

Introduction
Write an introduction to the lab that includes all of the following information:

- What are reaction rates?
- What are some things that affect reaction rates?
- What is a clock reaction? Why is it useful for observing the rate of a reaction?
- What is a catalyst? How does a catalyst affect the rate of a reaction?
- What is the purpose of this experiment?

Procedure
Write a detailed list of everything you did in this experiment, in the order in which it was done. This should be written so that anyone could repeat the exact same procedure you used. It should be written using the passive voice; for example, “Water was slowly added to the density tower using a pipet.” or “A bolt was dropped into the density tower.”

Data and Analysis

1. Create three data tables, one for each part of the experiment. Include the original data for the standard reaction in all three data tables for comparison. Make sure to include all of the recorded times from every trial you did, as well as the calculated average for each type of experiment.
Discussion and Conclusion

1. Based on your data in Part A, how do you think the concentration of reactants affects the rate of a reaction? Why?

2. Based on your data in Part B, how do you think the temperature of the reaction affects the rate of a reaction? Why?

3. Based on your data in Part C, which of the three solutions were effective catalysts? Why? Based on this answer, what ion do you think is responsible for the catalytic activity?