

Clock Reaction: Chemistry 30
A Study of the Rates of a Reaction

Name _____ Partner _____ Date _____

Purpose:

- To study the role of concentration on the rate of a reaction.
- To study the role of temperature on the rate of a reaction

Materials:

- Solution A – dilute solution of $\text{KIO}_3(\text{aq})$ (0.020 mol/L)
- Solution B – contains starch and $\text{HSO}_3^-(\text{aq})$
- Clean test tubes (use the same sizes. They must hold at least 20 mL of fluid)
- Graduated cylinder
- Stop watch

Prelab: Use oxidation numbers to balance each reaction below. Clearly identify the OA and the RA for each reaction. (6 marks)

- Reaction 1 $\text{IO}_3^-(\text{aq}) + \text{HSO}_3^-(\text{aq}) \leftrightarrow \text{I}^-(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$
- o Oxidation $\frac{1}{2}$ _____
- o Reduction $\frac{1}{2}$ _____

Redox reaction _____

- Reaction 2 $\text{I}^-(\text{aq}) + \text{IO}_3^-(\text{aq}) \rightarrow \text{I}_2(\text{s})$
- o Oxidation $\frac{1}{2}$ _____
- o Reduction $\frac{1}{2}$ _____

Redox reaction _____

Identify control variable(s) that will be used in this experiment. (1 mark)

Background:

When the hydrogen sulfite ions are used up in reaction 1, the iodide ions react with the remaining iodate ions to produce iodine. The molecular iodine forms a blue substance with the starch present in solution 2 to give a visible blue indication that the reaction has proceeded to reaction 2.

In order to make this happen, which reagent is the excess reagent and the limiting reagent in Reaction 1? (1 mark)

Procedure:

PART A

1. Use a clean graduated cylinder to measure 10 mL of solution A and pour it into a clean test tube.
2. In a similar manner, measure 10 mL of solution B and pour into a second clean test tube
3. Get the stopwatch ready. Then pour the solution of A into the solution of B and pour back and forth between the two test tubes to ensure good mixing
4. Record the time when the visible colour change occurs.
5. Repeat the experiment at least three times to ensure a constant measure of time

PART B

1. Continue to use 10 mL of solution B
2. But for solution A, prepare the following dilutions.

a. 9.0 mL solution A	1.0 mL distilled water
b. 7.0 mL solution A	3.0 mL distilled water
c. 5.0 mL solution A	5.0 mL distilled water
d. 3.0 mL solution A	7.0 mL distilled water
3. Repeat the process of mixing these solutions and wait for the colour change.
4. Record the times. Repeat the dilution steps at least twice. Average your times for each dilution step.

PART C

1. Prepare 10 mL samples of UNDILUTED solution A at one or two different temperatures. Use a water bath of either hot or cold water to attain these temperatures. See the table under Analysis and note that 12 different temperatures are required.
2. Record your temperatures on the board so that other students will choose different temperatures from you. As a class you want a wide spectrum of temperatures. Try for nice round values like 15°C, 20°C, 25°C, etc.
3. Do NOTHING to change the temperature of solution B.
4. Then repeat the mixing of these samples of solution A with 10 mL samples of solution B.
5. Record the time that it takes to reach the colour change.
6. If time permits, repeat the experiment again at each temperature. Hopefully the values will be similar!
7. Obtain results from other students who have done the experiment at different temperatures.

Observation Tables:**Part A:**

Trial	Volume of A (mL)	Volume of B (mL)	Time to colour change
1	10	10	
2	10	10	
3	10	10	

Part B:

Trial	Volume of A (mL)	Volume of B (mL)	Time to colour change
1	9.0	10.0	
2	9.0	10.0	
1	7.0	10.0	
2	7.0	10.0	
1	5.0	10.0	
2	5.0	10.0	
1	3.0	10.0	
2	3.0	10.0	

Part C:

	Volume of A (mL)	Temperature of solution A	Volume of B (mL) at room temperature	Time to colour change
	10		10	
	10		10	
	10		10	
	10		10	

Analysis:

1. If the concentration of potassium iodate in solution A is 0.020 mol/L, find the diluted concentration(s) of solution A that you prepared in PART B.
(2 marks)

Volume of solution A (mL)	Volume of water added (m)	Concentration of Solution A mol/L
9.0	1.0	
7.0	3.0	
5.0	5.0	
3.0	7.0	

2. Make a summary of all the observations made by your classmates for Part C. Look for a pattern. If there are 'exceptions' to the pattern, be prepared to discuss why this has happened.

Lab Group who gathered information	Temperature of solution A (°C)	Time for reaction to take place (s)
	5	
	10	
	15	
	20	
Lab Group who gathered information	Temperature of solution A (°C)	Time for reaction to take place (s)
	25	
	30	
	40	
	45	
	50	
	55	
	60	
	65	

Lab Group who gathered information	Temperature of solution A (°C)	Time for reaction to take place (s)
	5	

3. Then plot concentration/time graph for PART B and a temperature/time graph for PART C. Remember to put the **manipulated variable** on the x axis and the **responding variable** on the y axis. (3 marks for each graph)

Conclusions:

Give generalization(s) based on your observations for PART B. and Part C. Be sure to support these generalizations with accepted scientific theory. (2 marks)

Part B

Part C
