# Experiment 14, Reaction Rates, The Clock Reaction

**Name _____ Per ___**

Purpose: To investigate the effect of changing the concentrations and temperatures on a reaction.

Every reaction is the result of a series of steps involving two particle collisions. The balanced equation is the resultant of the series of steps, it does not show the individual steps. The slowest of these step is called the ***Rate Controlling Step***.

The *Rate Controlling Step* is the "slowest car on Highway 9". It determines the flow of traffic. In our reaction today, the *Rate Controlling Step* is so slow that we can time it. Hence we can time the effects of changing concentrations and temperatures. Here is the reaction:

$$5\ I^-_{(aq)} + 6\ H^+_{(aq)} + IO_3^-{}_{(aq)} \text{----> } 3\ I_{2\ (s)} + 3\ H_2O_{(l)}$$

**The $I_2$ reacts with starch to give a blue solution which we shall use for the timing.**

## Procedure:

### Part I The Effect of Concentration Changes

**Solution A** will be reacted with **Solution B** and timed in seconds.

a. Use a graduated cylinder to measure 10.0 ml of **Solution A** and pour it into a 18 X 150 mm test tube. Rinse the cylinder and in a similar manner place 10 ml of **Solution B** into another test tube.

b. Start timing as you quickly pour the two solutions back and forth into each other to mix them well. Three pours is sufficient. Stop timing when the mixture changes color. Observations:

We shall now use different dilutions of **Solution A** to vary the concentration of the $IO_3^-{}_{(aq)}$ the iodate ion. **Solution B will always be 10.0 ml**. **The dilution of Solution A is as follows:**

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| Student Group | ml Solution A | ml Distilled water |
|---|---|---|
| 3 | 9.0 | 1.0 |
| 1 | 8.0 | 2.0 |
| 2 | 7.0 | 3.0 |
| 3 | 6.0 | 4.0 |
| 2 | 5.0 | 5.0 |
| 1 | 4.0 | 6.0 |
| 3 | 3.0 | 7.0 |
| 2 | 2.0 | 8.0 |
| 1 | 1.0 | 9.0 |

**Notice that the total volume of the diluted Solution A's is 10 ml, so we shall always be mixing 10 ml of diluted A with 10 ml of straight undliluted B.**

## Exchange information with the other groups to complete this Data Table:

| Student Group | ml Solution A | Time in Seconds |
|---|---|---|
| 3 | 9.0 | s |
| 1 | 8.0 | s |
| 2 | 7.0 | s |
| 3 | 6.0 | s |
| 2 | 5.0 | s |
| 1 | 4.0 | s |
| 3 | 3.0 | s |
| 2 | 2.0 | s |
| 1 | 1.0 | s |

## Part II. The Effect of Temperature on Reaction Rate:

We shall vary the temperatures and time the results. Choose a temperature between 25°C and 35°C (DO NOT exceed 35°C) such that yours is different from that of others. Then exchange results for comparison. Your chosen temp:_____°C.

## Procedure:

a. Put 5.0 ml of **Solution A** into a test tube. Add 5.0 ml of **distilled water**. Put 10.0 ml of **Solution B** into another test tube. Place both tubes into a beaker of tap water and heat it to your chosen temperature. Keep it there for 5 minutes.

b. Mix and time the reaction as before. Collect data from four other groups and enter it into this **Data Table:**

| Group | Temp | Time |
|---|---|---|
| Yours | °C | s |
| 1 | °C | s |
| 2 | °C | s |
| 3 | °C | s |
| 4 | °C | s |

c. What conclusion can you draw from the above data?

## Calculations for Part 1. Show your method, Hup, Two, Three, Four.

1. The concentration of $IO_3^-$ in **Solution A** is 0.02 M. Calculate the number of moles of $IO_3^-$ in each milliliter of each test tube in the Data Table from Part 1. Hint: mol = ML, L = ml/1000ml/L. And M = is 0.02 M. **Calculations Table:**

| Test Tube | Number of Moles |
|---|---|
| 9.0 | mol |
| 8.0 | mol |
| 7.0 | mol |
| 6.0 | mol |
| 5.0 | mol |
| 4.0 | mol |
| 3.0 | mol |
| 2.0 | mol |
| 1.0 | mol |

2. Calculate the concentration of $IO_3^-$ in each test tube of **Solution A** in the table above: Hint: M = mol/L, L = ml/1000ml/L. **Calculations Table:**

| Test Tube | Molar Concentration |
|---|---|
| 9.0 | M |
| 8.0 | M |
| 7.0 | M |
| 6.0 | M |
| 5.0 | M |
| 4.0 | M |
| 3.0 | M |
| 2.0 | M |
| 1.0 | M |

3. On the back, plot a graph of the concentration time data with **time** on the **vertical** axis and the **concentration** of the $IO_3^-$ on the **horizontal** axis.

4. What generalization can you make concerning the effect of varying the concentration on the time of the reaction?

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5. How is the time of the reaction related to the rate of the reaction?

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6. How does temperature effect the rate of the reaction?

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Write a Critique for this lab.