Purpose:

Background: The iodine clock reaction is a reaction between potassium iodate (KIO₃) and sodium bisulfite (NaHSO₃). The reaction occurs in a series of steps shown below:

\[
\begin{align*}
NaHSO_3 + H_2SO_4 & \rightarrow H_2SO_3 + NaHSO_4 \\
KIO_3 + 3H_2SO_3 & \rightarrow KI + 3H_2SO_4 \\
KIO_3 + 3H_2SO_4 + 5KI & \rightarrow 3K_2SO_4 + 3H_2O + 3I_2 \\
I_2 + H_2SO_3 + H_2O & \rightarrow H_2SO_4 + 2H^+ + 2I^- \\
I_2 + \text{starch} & \rightarrow \text{starch·I}_2 \text{ (blue-black in color)}
\end{align*}
\]

Steps 1-4 continue until all of the NaHSO₃ has been used up. Then the I₂ is no longer consumed by reaction (4) so the iodine (I₂) reacts with starch to give the blue-black color change. This signals when the reaction between KIO₃ and NaHSO₃ is complete. Step (5) is a very fast step, and does not contribute to the reaction time. Varying the concentration of the KIO₃ solution and changing the temperature at which the reaction takes place can affect the reaction rate of KIO₃ and NaHSO₃.

Materials:
Procedure:
For all parts of procedure:
Solution A = 0.020M KIO$_3$ solution
Solution B = 0.020M NaHSO$_3$ solution

Part A: Effect of Concentration on Reaction Rate

1. Measure 5.0mL of solution A (using pipette) into a small beaker.
2. Measure 5.0mL of solution B into the other small beaker.
3. Pour solution A into the beaker containing solution B. (The stopwatch should be started the moment of mixing.) Immediately pour both back into the beaker originally holding A (this mixes the solutions thoroughly). When the blue-black color appears, stop the stopwatch. This is how long it took the reaction to occur.
4. Complete steps 1-3 again (trial #2). Average your reaction times. Record your data in the data table. Your average reaction time will be used to graph your data in this section. Clean your beakers and shake dry each between reactions.

Now you will complete steps 1-3 again with different concentrations of solution "A". You will always use 5.0mL of solution B.

5. Measure 5.0mL of solution A into a small beaker. Add 1.0mL of distilled water. Complete steps 2-4 above using the diluted solution A.
6. Complete step 5 again using different dilutions (mixtures) of solution A. For your third mixture you will add 2.0mL of water to solution A, the fourth you will add 3.0mL of water to solution A, and for the fifth you will add 4.0mL of water to solution A. Remember for each concentration you will have two trials.

Part B: Effect of Temperature

1. Prepare a water bath within your assigned temperature range.
2. Measure 5.0mL of solution A into a test tube.
3. Measure 5.0mL of solution B into another test tube.
4. Place the test tubes in the water bath.
5. Put the thermometer in the test tube with solution A.
6. When solution A is within the temperature range for at least two minutes, assume that both test tubes are at that temperature. Record that temperature in your data table.
7. Pour the contents of both test tubes into a small beaker. (Mark this time on the stopwatch as the beginning time of the reaction).
8. Stop timing when the color changes, signaling the end of the reaction.
9. Record the time in your data table and perform a second trial. Both of these trials will be used as data points when graphing the data for this section.
10. Obtain data for the four other temperature ranges.
Calculations: You will need to calculate the molarity of each of the diluted solutions of "A" used in Part A of the procedure. Each time you added water you diluted solution A by increasing the total amount of solution. Use $M_1V_1 = M_2V_2$ to calculate the molarity for mixtures 2-5.

Graphs: You need to construct a graph for Part A and Part B on a separate piece of paper (use Graphical Analysis) and attach it.

- **Part A** - Independent Variable (x-axis) ____________________
  - Dependent Variable (y-axis) _________________________

- **Part B** - Independent Variable (x-axis) ____________________
  - Dependent Variable (y-axis) _________________________

Conclusion:
1. In your own words describe the relationship (shown in your graph) between concentration and reaction rate.

2. Select two temperature ranges, and draw pictures of what is happening at the molecular level.