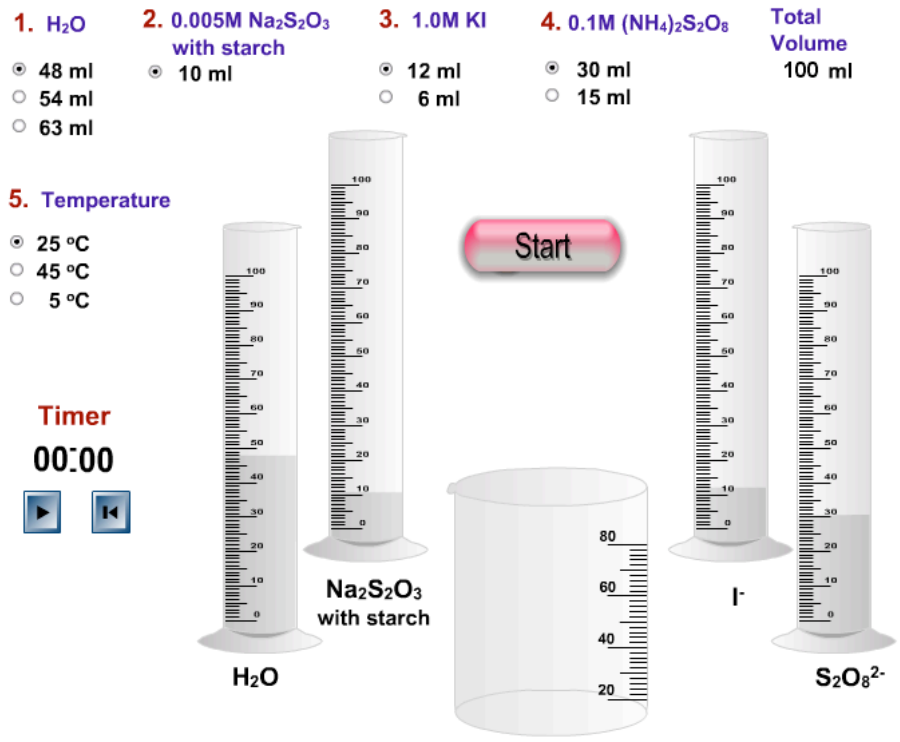
Iodine Clock

Name_____ Lab Section_____

Problem Statement: How do concentration and temperature influence the rate of a chemical reaction?

I. Data Collection:

A. Go to http://cheminfo.chem.ou.edu/~mra/home.html and open the Iodine Clock Simulation. Your screen should look like the figure.



The reaction to be investigated occurs in the beaker when four colorless solutions from four graduated cylinders are mixed. Different amounts of the solutions can be added together at a specified temperature. Radio buttons control these amounts and the temperature. A timer can be used to monitor how long it takes for a chemical reaction to use up one of the reactants.

The series of chemical interactions that take place follows:

$$3\ I^-\ (aq) + S_2O_8^{2-}\ (aq) \rightarrow 2\ SO_4^{2-}\ (aq) + I_3^-\ (aq) \qquad (1)$$

$$I_3^-\ (aq) + S_2O_3^{2-}\ (aq) \rightarrow 3\ I^-\ (aq) + S_4O_6^{2-}\ (aq) \qquad (2)$$

$$2\ I_3^-\ (aq) + \text{Starch} \rightarrow \text{Blue/Black Complex} + I^-\ (aq) \qquad (3)$$

The first reaction produces I_3^-. When I_3^- comes in contact with starch (in reaction three) it produces a characteristic blue/black color. However, before that can happen $S_2O_3^{2-}$ reacts with it to produce colorless products (in reaction two). Because reaction two is much faster than reaction three, the third reaction won't take place until all of the $S_2O_3^{2-}$ is used up. Once that occurs, the colorless solution changes color.

B. If necessary, use the buttons to adjust the volume of KI (aq) to 12 mL and $(NH_4)_2S_2O_8$ (aq) to 30 mL. Then adjust the volume of water so that the sum of all the solutions when combined equals 100 mL. Make sure the temperature is set at 25 ºC. Click on the start button. When the last solution is added, Click to start the timer. Pause the timer when the reaction solution changes color. Record your data in the following table.

Trial	1.0 M KI (aq)	0.1 M $(NH_4)_2S_2O_8$(aq)	Time @ 25 ºC	Time @ 45 ºC	Time @ 5 ºC
1	12 mL	30 mL			
2	6 mL	30 mL			
3	12 mL	15 mL			

C. Adjust the amounts and temperatures of the reactants specified in the preceding table and repeat the general procedure of the preceding section. Record your data in the table.

II. Data Analysis and Interpretation

A. From the data you collected in the table from section I. B. calculate the molar concentration of I^-, $[I^-]$, and $S_2O_8^{2-}$, $[S_2O_8^{2-}]$ for each trial and record your results in the following table.

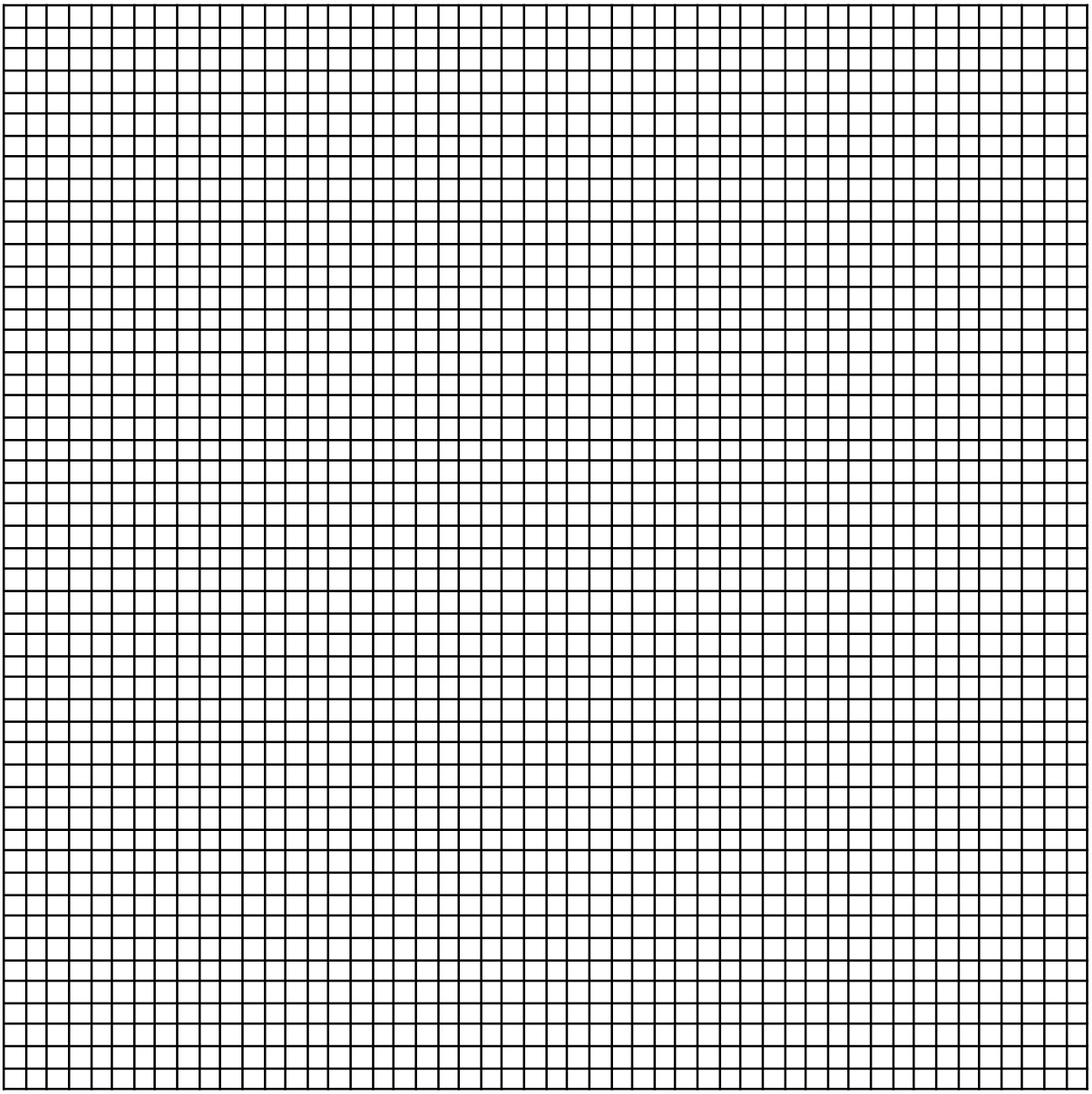
Trial	$[I^-]$	$[S_2O_8^{2-}]$	Ave Rate @ 25 ºC	Ave Rate @ 45 ºC	Ave Rate @ 5 ºC
1					
2					
3					

B. The rate of a chemical reaction is inversely proportional to the amount of time it takes for the reaction to happen. (If it takes half the amount of time its rate is twice as big.) Calculate the average rate of each trial ($time^{-1}$) and record your results in the preceding table.

C. Relate the change in $[I^-]$ to the change in average rate. How are they related? Are the changes directly proportional? What trials did you use to come to your conclusions?

D. Relate the change in $[S_2O_8^{2-}]$ to the change in average rate. How are they related? Are the changes directly proportional? What trials did you use to come to your conclusions?

E. On the following graph, or using a graphing program, plot the relationship between the temperature of the reactants and the rate of the reaction in trial 1. What happens to the rate of a chemical reaction as the temperature changes? What is the nature of this relationship? Are the changes directly proportional? (Optional. How are they related mathematically? Using a graphing program plot the amount of rate vs. the temperature. Then use the curve fitting function of your graphing program to draw the best line through all of the points. Try each of the available functions and see which gives you the best fit. Record the equation of your best-fit line.)



III. Conclusions

A. Make a generalization of how concentration changes affect the rate of a chemical reaction.

B. Make a generalization of how temperature changes affect the rate of a chemical reaction.