Chemical Kinetics   
**Task 13** Name:

Due: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Chemical kinetics and rates of reactions are integral to our understanding of a variety of processes. From synthetic chemistry to environmental and industrial processes, the chemical reactions that underpin these situations will occur at different rates.

Today, we will be looking at a ‘clock’ reaction between sodium thiosulfate and hydrochloric acid. A ‘clock’ reaction is any chemical reaction with an observable change, in which the timing of that change can be predicted. The reaction in question can be represented by the equation:

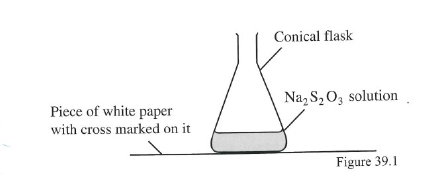
S2O32-(aq) + 2H+(aq) 🡪 S (s) + SO2 (aq) + H2O (l)

We will be varying the amount of thiosulfate we add according to the table below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Vol. of 0.25 mol L-1 Na2S2O3 (mL) | Vol. of H2O added (mL) | Total volume after adding & mixing 5 mL HCl | Concentration of Na2S2O3 on mixing (mol L-1) | Time for cross to disappear (s) | 1 / time (s-1) |
| 45 | 0 | 50 | 0.225 |  |  |
| 35 | 10 | 50 |  |  |  |
| 25 | 20 | 50 |  |  |  |
| 15 | 30 | 50 |  |  |  |
| 5 | 40 | 50 |  |  |  |

**Method:**

1. Place 45 mL of 0.25 mol L-1 Na2S2O3 in a 100 mL conical flask. Put the flask over a cross marked on a piece of white paper as shown in the figure below.



1. Add 5 mL of 2 mol L-1 HCl and briefly agitate to ensure mixing of the reactants. Start a stopwatch at the moment of addition.
2. Note and record the time taken for the cross to ‘disappear’ when it is viewed through the solution from directly overhead. The formation of solid sulfur causes the cross to be obscured.
3. Repeat the experiment using various sodium thiosulfate concentrations, made up as indicated in the table on page 91.

**Processing of results and discussion questions**

1. Calculate 1/time for each experiment and enter the results into the table.
2. Plot a graph of 1/time (a measure of the reaction rate) against sodium thiosulfate concentration.
3. Why do we plot the graph of 1/time as opposed to time?
4. What effect does the concentration of sodium thiosulfate have on the reaction rate? Explain why.
5. Why did we add water at each step? Why not just change the amount of thiosulfate?
6. If the concentration of sodium thiosulfate is doubled, what happens to the rate of reaction? Use data from your graph to explain why.
7. Why did we draw a cross on a piece of paper for this experiment? What is another method we could have used to achieve a similar goal? (hint: SO2 is normally a gas, but just dissolved in solution momentarily)
8. Identify two random errors in this experiment. How could these errors be minimised?