**PRACTICAL 14 - DETERMINING A RATE EQUATION**

**(CORE PRACTICAL 7a)**

Sodium thiosulphate reacts with hydrochloric acid as follows:

Na2S2O3(aq) + 2HCl(aq) 🡪 S(s) + SO2(g) + H2O(l)

The sulphur produced in this reaction forms a precipitate which turns the mixture opaque. The rate of this reaction can be monitored by measuring the time taken for a cross under the reaction mixture to cease to be visible.

The aim of this experiment is to find the order of reaction with respect to Na2S2O3 and HCl.

1. Take a piece of filter paper and use a thick pen to draw an X on it.
2. Take a 250 ml conical flask and place it on top of the X on the filter paper.
3. Take a 50 cm3 measuring cylinder and label it “HCl”. Take another 50 cm3 measuring cylinder and measure it “Na2S2O3”.
4. Measure 50 cm3 of Na2S2O3 into the labelled measuring cylinder and then pour it into the conical flask.
5. Measure out 50 cm3 of HCl into the other labelled measuring cylinder. Pour it into the conical flask and start the stopclock immediately.
6. Record the time taken for the cross to disappear. This is experiment 1.
7. Rinse out the conical flask and repeat the experiment using different concentrations of Na2S2O3 and HCl as follows:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | “HCl cylinder” | | | “Na2S2O3 cylinder” | | |
| Experiment Number | Volume of HCl/cm3 | Volume of water/cm3 | [HCl]/  moldm-3 | Volume of Na2S2O3/cm3 | Volume of water/cm3 | [Na2S2O3] /moldm-3 |
| 1 | 50 | 0 | 2.0 | 50 | 0 | 0.25 |
| 2 | 50 | 0 |  | 40 | 10 |  |
| 3 | 50 | 0 |  | 30 | 20 |  |
| 4 | 50 | 0 |  | 20 | 30 |  |
| 5 | 50 | 0 |  | 10 | 40 |  |
| 6 | 40 | 10 |  | 50 | 0 |  |
| 7 | 30 | 20 |  | 50 | 0 |  |
| 8 | 20 | 30 |  | 50 | 0 |  |
| 9 | 10 | 40 |  | 50 | 0 |  |

1. Use the results of your experiments to calculate 1/time taken for each experiment and put your results in a table as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Experiment | [Na2S2O3] /moldm-3 | [HCl]/moldm-3 | Time taken/s | 1/time taken (s-1) |
| 5 |  |  |  |  |
| 4 |  |  |  |  |
| 3 |  |  |  |  |
| 2 |  |  |  |  |
| 1 |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Experiment | [Na2S2O3] /moldm-3 | [HCl]/moldm-3 | Time taken/s | 1/time taken (s-1) |
| 9 |  |  |  |  |
| 8 |  |  |  |  |
| 7 |  |  |  |  |
| 6 |  |  |  |  |
| 1 |  |  |  |  |

1. Plot a graph of rate of reaction against [Na2S2O3] using experiments 1 – 5
2. Plot a graph of rate of reaction against [HCl] using experiments 1 and 6 – 9
3. Use your graphs to deduce the orders of reaction with respect to HCl and Na2S2O3, write a rate equation for the reaction and calculate the rate constant.