

Practical 4 – Chapter 6

Investigating the effect of temperature on reaction rate

In this experiment you will study how changing temperature affects the rate of a reaction.

The reaction you will study is that between sodium thiosulfate solution and hydrochloric acid:



The reaction produces a precipitate of sulfur. You will time how long it takes to obscure a cross drawn on a piece of paper placed under the reaction flask. In other words, you will measure the time it takes to produce a fixed amount of sulfur.

Safety

- 2 mol dm⁻³ HCl is an irritant.
- The reaction produces SO₂, which is toxic and is an irritant to the eyes and respiratory system.
- Wear eye protection.

What to do

- Use the cross supplied.
- Place the conical flask on the cross.
- Put 50 cm³ of 0.15 mol dm⁻³ sodium thiosulfate into the flask.
- Measure the temperature of the sodium thiosulfate solution.
- Measure out 5 cm³ of 2.0 mol dm⁻³ hydrochloric acid using a measuring cylinder (**Care!**).
- Add the hydrochloric acid to the conical flask, start the stopwatch and swirl to mix the chemicals.
- Time how long it takes for the sulfur produced to obscure the cross.
- Measure the final temperature of the mixture.
- Wash the contents of the flask down the sink with lots of water.
- Repeat the experiment for four other temperatures, using a water bath to heat the individual solutions to the required temperature.
- You must be careful to use the same boiling tubes for the hydrochloric acid and sodium thiosulfate each time. Also make sure you do not mix up the thermometers.

Data collection

Record your results in a neat table.

Each measured quantity must have units and an uncertainty.

Processing the results

Because the procedure involves timing how long it takes to produce a fixed amount of product, the rate of reaction is inversely proportional to the reaction time:

$$\text{rate} \propto \frac{1}{\text{time}}$$

Work out the average temperature for each run.

Plot a graph of rate of reaction (on the y -axis) against temperature (on the x -axis).

Draw a line of best fit, as either a straight line or a curve. Do NOT just join the points.

Explain, as far as you can, what your results indicate about the relationship between reaction rate and temperature. In particular, concentrate on how increasing the temperature by 10 °C affects the rate of the reaction. You should look at different areas of the graph to try and explain this as far as possible.

Explain your conclusion in term of collision theory.

Answer the following questions

- 1 Identify any results which you believe to be anomalous.
- 2 Suggest as many ways as you can in which the experiment could be improved to give more accurate results.