Practical 6 – Chapter 6

Effect of concentration on reaction rate

Hydrogen peroxide will react with potassium iodide to produce iodine:

$$H_2O_2 + 2KI + H_2SO_4 \rightarrow 2H_2O + I_2 + K_2SO_4$$

The rate of this reaction can be followed by looking at how quickly the iodine is produced.

Safety

- 1 mol dm^{-3} H_2SO_4 is an irritant.
- Wear eye protection.

What to do

Carry out the following experiment, observing how the appearance of the mixture changes with time.

1 Measure out the following volumes of solutions into a 100 cm^3 beaker:
- 10 cm^3 of 1 mol dm^{-3} H_2SO_4 (**Care!**)
- 15 cm^3 of 0.1 mol dm^{-3} KI
- 10 cm^3 of distilled water

2 Now add 5 cm^3 of 0.1 mol dm^{-3} hydrogen peroxide solution, start the stopwatch, swirl the mixture and observe the colour every 30 s for 2 minutes.

Although we can see that iodine is being produced, it is very difficult to be quantitative about the rate at which this is occurring. This could be done by carrying out the reaction in a colorimeter, as this allows us to measure the darkness of the colour of the iodine solution. However, it is done more conveniently by using the **iodine clock** technique.

For an iodine clock reaction we add a fixed amount of sodium thiosulfate ($Na_2S_2O_3$) solution to the reaction mixture and then add a small amount of starch solution. The sodium thiosulfate reacts with the iodine as soon as it is formed but when all the sodium thiosulfate is used up the iodine reacts with the starch to give the characteristic blue-black colour.

Now carry out the same reaction as above except that, this time, you will also add 10 cm^3 of 0.005 mol dm^{-3} sodium thiosulfate solution and 1 cm^3 of starch solution to the reaction mixture before adding the hydrogen peroxide. Now time how long it takes for the mixture to go blue-black.

You are going to carry out a series of experiments to investigate how changing the concentration of the potassium iodide changes the rate of the reaction.

Make up the following mixtures:

Expt No.	**Volume H_2SO_4 / cm^3**	**Volume KI / cm^3**	**Volume H_2O / cm^3**	**Volume $Na_2S_2O_3$ / cm^3**
1	10	25	0	10
2	10	20	5	10
3	10	15	10	10
4	10	10	15	10
5	10	5	20	10

To each mixture add 1 cm^3 of starch solution.

Add 5 cm^3 of hydrogen peroxide solution, start the stopwatch and swirl the mixture to ensure complete mixing.

Stop the stopwatch when the mixture becomes blue-black.

You must use a different measuring cylinder for each solution – label the measuring cylinders so that you don't get them mixed up.

The rate at which the reaction occurs is inversely proportional to the time of the reaction. We can work out reaction rate as:

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

Plot a graph of rate against volume of potassium iodide (proportional to concentration of potassium iodide) and explain what you can about how changing the concentration of the potassium iodide affects the rate.