GCSE Chemistry required practical activity: Rates of reaction

Student sheet

Investigation into how the concentration of a solution affects the rate of a chemical reaction

There are two parts to this practical which investigate how the rate of reaction can be measured.

Activity 1: Observing colour change

You will react sodium thiosulfate with hydrochloric acid. You will then find out how the rate of reaction changes as the thiosulfate solution becomes more dilute.

Activity 2: Measuring the volume of gas produced

You will react magnesium ribbon and hydrochloric acid. You will then find out how the rate of reaction is affected by the concentration of the acid.

Risk assessment

- Safety goggles should be worn throughout.

Method

Activity 1: Observing colour change

You are provided with the following:

- 40 g/dm^3 sodium thiosulfate solution
- 2.0 M dilute hydrochloric acid
- 10 cm^3 measuring cylinder
- 100 cm^3 measuring cylinder
- 100 cm^3 conical flask
- printed black paper cross
- stopclock.

Read these instructions carefully before you start work.

1. Use a measuring cylinder to put 10 cm^3 sodium thiosulfate solution into the conical flask.

   Use the measuring cylinder to then add 40 cm^3 water. This dilutes the sodium thiosulfate solution to a concentration of 8 g/dm^3.

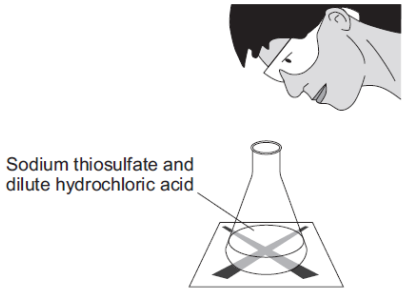
   Put the conical flask on the black cross.

2. Put 10 cm^3 of dilute hydrochloric acid into the 10 cm^3 measuring cylinder.

3. Put this acid into the flask. At the same time swirl the flask gently and start the stopclock.

4. Look down through the top of the flask. Stop the clock when you can no longer see the cross.

   Take care to avoid breathing in any sulfur dioxide fumes.



5. Write the time it takes for the cross to disappear in the first blank column of the table such as the one below. Record the time **in seconds**.

   You will need to multiply any minutes by 60 and then add the extra seconds.

Concentration of sodium thiosulfate in g/dm^3	**Time taken for cross to disappear in seconds**			
	First trial	**Second trial**	**Third trial**	**Mean**
8	197	200	205	
16	108	100	98	
24	50	46	51	
32	19	21	20	
40	9	8	11	

6. Repeat steps **1–5** four times, **but in step 1 use:**
   - 20 cm^3 sodium thiosulfate + 30 cm^3 water (concentration 16 g/dm^3)
   - 30 cm^3 sodium thiosulfate + 20 cm^3 water (concentration 24 g/dm^3)
   - 40 cm^3 sodium thiosulfate + 10 cm^3 water (concentration 32 g/dm^3)
   - 50 cm^3 sodium thiosulfate + no water (concentration 40 g/dm^3)

7. Then repeat the **whole investigation** (steps **1–5**) twice more.

   Record the results in the second and third blank columns of the table.

8. Calculate the **mean** time for each of the sodium thiosulfate concentrations. Leave out anomalous values from your calculations.

   Record the means in the fourth blank column.

9. Plot a graph with:
   - 'mean time taken for cross to disappear in seconds' on the y-axis
   - 'Sodium thiosulfate concentration in g/dm^3' on the x-axis

   Draw a smooth curved line of best fit.

   What can you say about the effect of the independent variable (concentration) on the dependent variable (time taken for the cross to disappear)? What were your control variables?

Activity 2: Measuring the volume of gas produced

You are provided with the following:

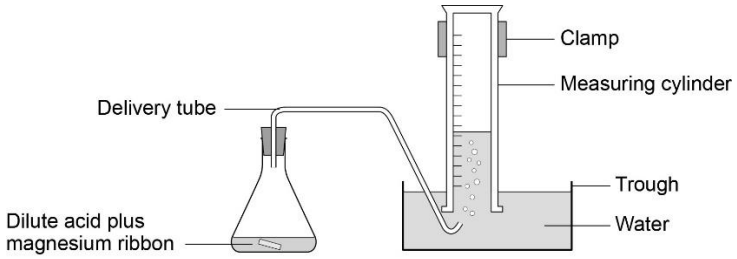
- safety goggles
- conical flask (100 cm^3)
- single-holed rubber bung and delivery tube to fit conical flask
- trough or plastic washing-up bowl
- two measuring cylinders (100 cm^3)
- clamp stand, boss and clamp
- stop clock
- graph paper
- magnesium ribbon cut into 3 cm lengths
- dilute hydrochloric acid, (2.0 M, and 1.0 M).

Read these instructions carefully before you start work.

1. Measure 50 cm^3 of 2.0 M hydrochloric acid using one of the measuring cylinders. Pour the acid into the 100 cm^3 conical flask.

2. Set up the apparatus as shown in the diagram.

   Half fill the trough or bowl with water.



3. Fill the other measuring cylinder with water. Make sure it stays filled with water when you turn it upside down.
4. When you are ready, add a 3 cm strip of magnesium ribbon to the flask, put the bung back into the flask as quickly as you can, and start the stopclock.
5. Record the volume of hydrogen gas given off at suitable intervals (eg 10 seconds) in a table such as the one below.

   Continue timing until no more gas appears to be given off.

Time in seconds	**Volume of gas produced for 2.0 M hydrochloric acid in cm^3**
10	30.0
20	40.0
30	50.0
40	55.0

50	57.0
60	58.0
70	58.0
80	58.0
90	58.0
100	58.0

6. Repeat steps **1-5** using 1.0 M hydrochloric acid.
7. Plot a graph with:
   - 'Volume of gas produced in cm^3 (for 2.0 M hydrochloric acid)' on the y-axis
   - 'Time in seconds' on the x-axis

   Draw a smooth curved line of best fit
8. Plot a curve for 1.0 M hydrochloric acid on the same graph.
9. Use this graph to compare the rates of reaction of 1.0 M and 2.0 M hydrochloric acid with magnesium
10. Compare your results with the data collected in **Activity 1.**
11. Use kinetic theory to explain your findings.