

GCSE Chemistry required practical activity: Temperature changes

Student sheet

Investigation of the temperature changes which take place when an acid is neutralised by an alkali

You will monitor the temperature rise as small volumes of sodium hydroxide solution are added to dilute hydrochloric acid. The acid will be contained in an insulated cup.

Plot a graph of your results. Determine how much sodium hydroxide was needed to fully react with the acid.

Risk assessment

- Safety goggles should be worn throughout.

Method

You are provided with the following:

- 2 M dilute hydrochloric acid
- 2 M sodium hydroxide solution
- expanded polystyrene cup and lid
- 250 cm³ beaker
- 10 cm³ measuring cylinder
- 50 cm³ measuring cylinder
- thermometer.

Read these instructions carefully before you start work.

1. Use the 50 cm³ measuring cylinder to put 30 cm³ dilute hydrochloric acid into the polystyrene cup.
2. Stand the cup inside the beaker. This will make it more stable.
3. Use the thermometer to measure the temperature of the acid. Record it in the first blank column of the table such as the one below.
4. Put 5 cm³ sodium hydroxide solution into the 10 cm³ measuring cylinder.
5. Pour the sodium hydroxide into the cup. Fit the lid and gently stir the solution with the thermometer through the hole.

When the reading on the thermometer **stops changing**, write the temperature in the next space in the table.

6. Repeat steps 4 and 5 to add further 5 cm³ amounts of sodium hydroxide to the cup. A total of 40 cm³ needs to be added.

The last few additions should produce a temperature fall rather than a rise.

7. Repeat steps 1–6 and record the results in the second blank column of the table.

8. Calculate the **mean** maximum temperature reached for each of the sodium hydroxide volumes. Record these means in the third blank column.

Total volume of sodium hydroxide added in cm ³	Maximum temperature in °C		
	First trial	Second trial	Mean
0	23.0	25.0	
5	25.0	27.0	
10	27.0	29.0	
15	29.0	31.0	
20	31.0	33.0	
25	33.0	35.0	
30	34.0	36.0	
35	32.0	34.0	
40	30.0	32.0	

9. Plot a graph with:

- 'Mean maximum temperature in °C' on the y-axis
- 'Total volume of sodium hydroxide added in cm³' on the x-axis.

Draw two straight lines of best fit:

- one through the points which are increasing
- one through the points which are decreasing.

Ensure the two lines are extended so they cross each other.

10. Use the graph to estimate how much sodium hydroxide solution was needed to neutralise 25 cm³ dilute hydrochloric acid.