

- 2 You are going to investigate the temperature change when citric acid reacts with sodium carbonate.

Read all of the instructions carefully before starting the experiments.

Instructions

You are going to do five experiments.

Experiment 1

- Use the 10 cm³ measuring cylinder to pour 1.0 cm³ of distilled water into a boiling tube.
- Use the thermometer to measure the initial temperature of the distilled water.
- Record this temperature, to the nearest 0.5 °C, in Table 1.1.
- Add 4g of solid citric acid and 4 g of solid sodium carbonate to the boiling tube. You may need to gently tap the tube to help the sodium carbonate come out of the tube.
- Stir the contents of the boiling tube with the thermometer and measure the lowest temperature reached by the mixture.
- Record this temperature, to the nearest 0.5 °C, in Table 1.1.
- Rinse out the boiling tube with distilled water.

Experiment 2

- Repeat Experiment 1 using 2.0 cm³ of distilled water instead of 1.0 cm³.

Experiment 3

- Repeat Experiment 1 using 6.0 cm³ of distilled water instead of 1.0 cm³.

Experiment 4

- Repeat Experiment 1 using 6.0 cm³ of distilled water instead of 1.0 cm³.

Experiment 5

- Repeat Experiment 1 using 8.0 cm³ of distilled water instead of 1.0 cm³.

(a) Complete Table 1.1.

Calculate the temperature decrease using the equation shown:

$$\text{temperature decrease} = \text{initial temperature} - \text{lowest temperature}$$

Table 1.1

experiment	volume of distilled water / cm ³	initial temperature / °C	lowest temperature / °C	temperature decrease / °C
1	1.0			
2				
3				
4				
5				

[5]

(b) Write a suitable scale on the y-axis and plot your results from Experiments 1 to 5 on Figure 1.1.
Draw a line of best fit.

temperature decrease / °C

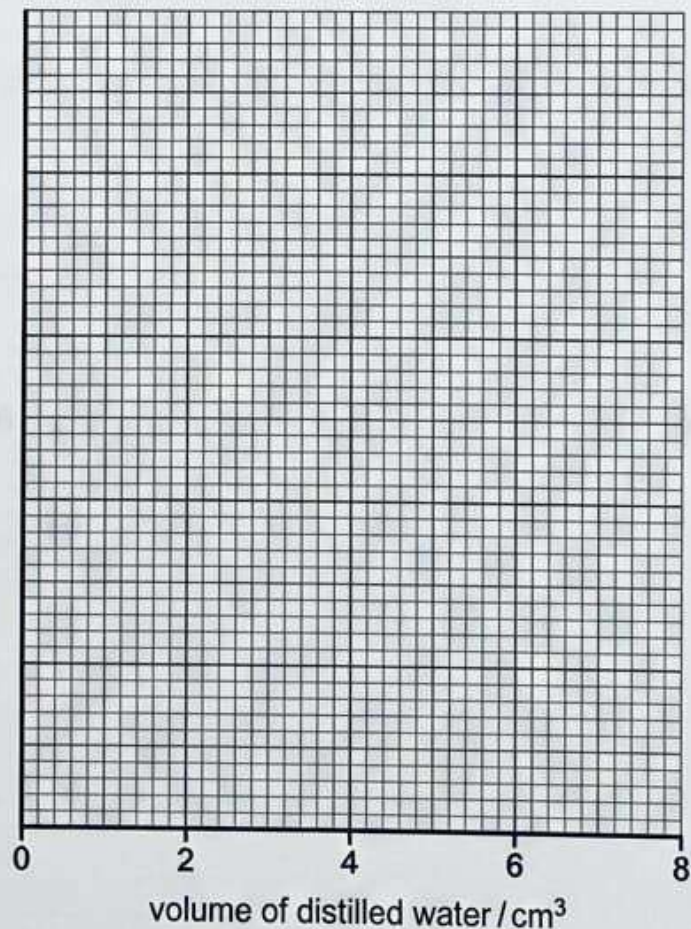


Figure 1.1

[4]

- (c) State if the energy change in the reaction is exothermic or endothermic.

Explain your answer using the results in Table 1.1.

energy change

explanation

..... [1]

- (d) Use your graph in Figure 1.1 to predict the temperature decrease if the experiment is repeated using 5.5cm^3 of distilled water.

Show your working on Figure 1.1.

temperature decrease = °C [2]

- (e) Describe the relationship between the volume of distilled water and the temperature decrease.

..... [1]

- (f) (i) Explain why wrapping the boiling tube in cotton wool would improve the accuracy of the results.

..... [2]

- (ii) Explain why placing the boiling tube in a water-bath at room temperature would **not** improve the accuracy of the results.

..... [1]

- 3 You are provided with two substances: solid **A** and solution **B**.

Do the following tests on solid **A** and solution **B**. Record all of your observations at each stage.

Tests on solid A

Add about a 5 cm depth of water to the boiling tube containing solid **A**. Replace the stopper in the boiling tube. Shake the boiling tube to dissolve solid **A** and form solution **A**. Divide solution **A** into two approximately equal portions in one boiling tube and one test-tube.

- (a) (i) To the first portion of solution **A** in a boiling tube, add aqueous sodium hydroxide dropwise until it is in excess.

Keep the solution formed for use in 3(a)(ii).

Record your observations.

.....
.....
..... [2]

- (ii) To the product from 3(a)(i), add about a 4 cm depth of aqueous hydrogen peroxide. Test any gas given off.

Record your observations.

.....
.....
.....
..... [3]

- (b) To the second portion of solution **A** in a test-tube, add about a 1 cm depth of nitric acid followed by a few drops of aqueous barium nitrate.

Record your observations.

.....
..... [1]

- (c) Identify solid **A**.

.....
.....

Tests on solution B

Divide solution **B** into two approximately equal portions in two boiling tubes.

- (d) To the first portion of solution **B**, add aqueous ammonia dropwise until it is in excess.

Record your observations.

.....
..... [2]

- (e) (i) To the second portion of solution **B**, add aqueous sodium hydroxide dropwise until it is in excess.

Keep the solution formed for use in 2(e)(ii).

Record your observations.

.....
..... [2]

- (ii) To the product from **2(e)(i)**, add a piece of aluminium foil. Warm the mixture gently. Test any gas produced.

Record your observations.

.....
..... [2]

- (f) Identify the **two** ions in solution **B**.

.....
..... [2]

[Total: 16]

