2 A student investigates the temperature change when a 5 cm length of coiled magnesium ribbon reacts with excess dilute sulfuric acid.

The student does five experiments.

Experiment 1

- Rinse a burette with distilled water and then with dilute sulfuric acid.
- Fill the burette with dilute sulfuric acid. Run some of the dilute sulfuric acid out of the burette so that the level of the dilute sulfuric acid is on the 0.0 cm^3 mark.
- Use the burette to add 30.0 cm^3 of dilute sulfuric acid to a boiling tube.
- Use a thermometer to measure the initial temperature of the acid.
- Record the initial temperature.
- Add a coil of magnesium ribbon to the boiling tube. At the same time start a stop-watch.
- Continually stir the contents of the boiling tube using the thermometer.
- After 1 minute, measure the temperature of the mixture in the boiling tube.
- Record this temperature.

Experiment 2

- Refill the burette with dilute sulfuric acid. Run some of the dilute sulfuric acid out of the burette so that the level of the dilute sulfuric acid is on the 0.0 cm^3 mark.
- Use the burette to add 25.0 cm^3 of dilute sulfuric acid to a new boiling tube.
- Use the thermometer to measure the initial temperature of the acid.
- Record the initial temperature.
- Add a coil of magnesium ribbon to the boiling tube. At the same time start the stop-watch.
- Continually stir the contents of the boiling tube using the thermometer.
- After 1 minute, measure the temperature of the mixture in the boiling tube.
- Record this temperature.

Experiment 3

- Repeat Experiment 2, using 20.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

Experiment 4

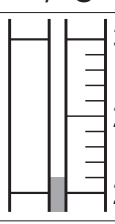
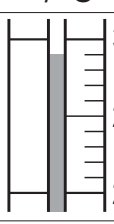
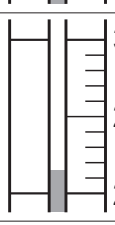
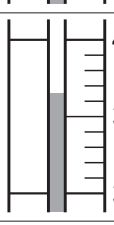
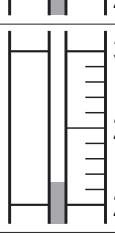
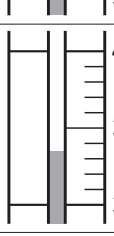
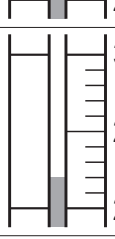
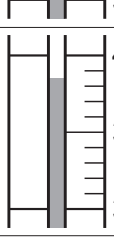
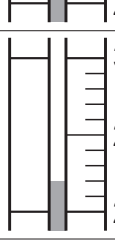
- Repeat Experiment 2, using 15.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

Experiment 5

- Repeat Experiment 2, using 10.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

(a) Use the thermometer diagrams to complete Table 2.1.

Table 2.1

experiment	volume of dilute sulfuric acid / cm^3	thermometer diagram for initial temperature / °C	initial temperature / °C	thermometer diagram for temperature after 1 minute / °C	temperature after 1 minute / °C	temperature increase / °C
1	30.0					
2	25.0					
3	20.0					
4	15.0					
5	10.0					

[4]

(b) On Fig. 2.1, complete a suitable scale on the *y*-axis and plot the results from Experiments 1 to 5. Draw a line of best fit.

Fig. 2.1

[4]

(c) Explain why the temperature increase changes as the volume of dilute sulfuric acid changes.

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..... [2]

(d) Extrapolate the line of best fit on your graph in Fig. 2.1 to deduce the temperature increase if 33.0 cm^3 of dilute sulfuric acid is used.

Show clearly **on Fig. 2.1** how you worked out your answer.

temperature increase = ... [3]

(e) The investigation is repeated using 2.5 cm lengths of coiled magnesium ribbon instead of 5 cm lengths.

On Fig. 2.1, sketch a line to show the results you would expect. Label this line **E**. [1]

(f) **(i)** Give **one** reason why a burette, rather than a measuring cylinder, is used to measure the volume of the dilute sulfuric acid.

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..... [1]

(ii) Explain why the contents of the boiling tube are stirred during each experiment.

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..... [1]

(g) Describe **one** change to the apparatus that will give more accurate results.

Explain your answer.

change to apparatus .....

.....

explanation .....

..... [2]

[Total: 18]