

## Your teacher may watch to see if you can...

- carefully control variables during investigations
- measure change accurately.

**Aim**

To investigate the effect on the **rate** of reaction of changing the surface area of solids and the concentration of solutions, by measuring the production of a gas.

**Method****Apparatus**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>eye protection</li> <li>balance</li> <li>water trough</li> <li>100 cm<sup>3</sup> measuring cylinder</li> <li>stop clock</li> <li>conical flask</li> </ul> | <ul style="list-style-type: none"> <li>delivery tube and bung</li> <li>stand and clamp</li> <li>five dilute hydrochloric acid solutions (1.0, 0.8, 0.6, 0.4 and 0.2 mol dm<sup>-3</sup>)</li> <li>marble chips (small)</li> <li>marble chips (large)</li> </ul> |
|---|---|

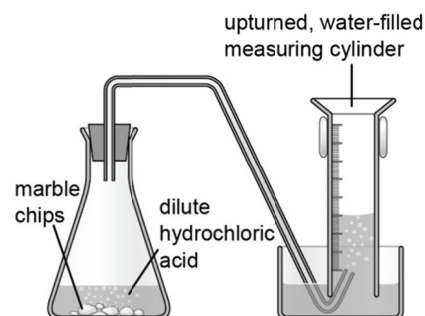
**! Safety**

Wear eye protection at all times.

Care is needed with acid solutions. Wash off splashes immediately.

**Task 1**

- Set up the apparatus as shown in the diagram.
- Measure 40 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> hydrochloric acid into a conical flask.
- Add 5 g of small marble chips to the flask.
- Immediately stopper the flask and start the stop clock.
- Note the total volume of gas produced after every 30 seconds for five minutes or until the reaction has finished.
- Repeat steps **A–E** using 5 g of larger marble chips.

**Task 2**

- Follow steps **A–D** above.
- Note the amount of carbon dioxide produced in one minute.
- Repeat steps **G** and **H** using 0.8, 0.6, 0.4 and 0.2 mol dm<sup>-3</sup> acid.

**Recording your results**

- Record your results for each task separately, in tables with suitable headings.

**Considering your results/conclusions**

- Use your results to draw a scatter diagram, including lines of best fit, to look for correlations between the **variables** under investigation.
- Use your results and graphs to write a conclusion for each of the tasks.

**Evaluation**

- Suggest possible sources of error in these investigations and possible changes to the method that could improve the reliability of the results.

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_ **Task 1****Recording your results**

1 Record your results in the table below.

Time (min)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Small chips – volume of gas (cm <sup>3</sup> )											
Large chips – volume of gas (cm <sup>3</sup> )											

**Considering your results/conclusions**

- Use your results to draw a graph of volume of gas against time for small chips and the same graph for large chips on the same axes. Put time on the horizontal axis and volume of gas on the vertical axis. Draw a line of best fit for each graph, using different coloured lines and labels.
- Explain how you can tell from the graphs when the reactions were finished.
- Describe how the size of the marble chips is related to the surface area for a fixed mass of chips.
- Describe how increasing the surface area affects the rate of reaction.
- Explain how your results and graph fit with your conclusion in question 5.

**Evaluation**

- Suggest possible sources of error in this investigation.
- Suggest possible changes to the method that could improve the reliability of the results.

**Task 2****Recording your results**

9 Record your results in the table below.

Concentration of acid (mol dm <sup>-3</sup> )	0.2	0.4	0.6	0.8	1.0
Volume of gas produced in one minute (cm <sup>3</sup> )					

**Considering your results/conclusions**

- Use your results to draw a scatter graph of concentration of acid against volume of gas produced in one minute. Put volume of gas on the horizontal axis and concentration on the vertical axis.
- Describe how the rate of the reaction is related to the concentration of the acid.
- Explain how your results and graph fit with your conclusion in question 11.

**Evaluation**

- Suggest possible sources of error in this investigation.
- Suggest possible changes to the method that could improve the reliability of the results.